# PROJECT MANUAL

# FOR

# VETERANS AFFAIRS NORTH TEXAS

# REPLACE GARLAND ELEVATORS

# VA PROJECT NO.: 549-24-425

# EA PROJECT NO.: 07.001

**ARCHITECTURAL, MECHANICAL, ELECTRICAL, PLUMBING, COMMUNICATIONS, ELECTRONIC SAFETY & SECURITY, FIRE ALARM, FIRE PROTECTION, IT**

## ISSUED FOR CONSTRUCTION

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**NORTH TEXAS VA HOSPITAL**
**REPLACE GARLAND ELEVATORS**
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**ISSUED FOR CONSTRUCTION**


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# SECTION 01 00 00
# GENERAL REQUIREMENTS

## 1.1 GENERAL INTENTION

A. Contractor shall completely prepare site for building operations, including demolition and removal of existing structures, and furnish labor and materials and perform work for new construction for the **Veterans Affairs Garland Elevator project** as required by drawings and specifications.

B. Not used.

C. Offices of **Enapay, LLC, as Architect-Engineers**, will render certain technical services during construction. Such services shall be considered as advisory to the Government and shall not be construed as expressing or implying a contractual act of the Government without affirmations by Contracting Officer or his duly authorized representative.

D. Before placement and installation of work subject to tests by testing laboratory retained by the **General Contractor**, the Contractor shall notify the Contracting Officer's Representative (COR) in sufficient time to enable testing laboratory personnel to be present at the site in time for proper taking and testing of specimens and field inspection. Such prior notice shall be not less than **three (3)** work days unless otherwise designated by the Contracting Officer's Representative (COR).

E. 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.

F. 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.

G. Training:

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.

2. The **general contractor shall submit** training records of all such employees for approval before the start of work.

**1.2 STATEMENT OF BID ITEM(S)**

A. ITEM I, GENERAL CONSTRUCTION: **The project is located at the VA Hospital in Garland Texas. The project will modernize / replace ten (10) electric elevators and four (4) hydraulic elevators and correct functional deficiencies to bring them up to current elevator codes and VA design guidelines. Areas that will be addressed are: elevator pits, machine rooms, control systems, hoist ways, machine drives, landing doors, phones, safety systems, car operation panels, door operators, signaling devices, upgrade elevator cab interiors, and provide the VA with EMS Panorama to meet existing elevator monitoring system. The GC shall provide a one (1) year repair clause to match a one (1) year maintenance and a one (1) year warranty.**

**Mechanical penthouses: Decommission elevator equipment that will not be used and remove.**

**The VA will be using Siemens Desigo BMS for all elevator control and monitoring. It is expected that the Siemens system would integrate with the elevator manufacturer's system - like the BMS link. The Siemens system installation will be outside the elevator scope, but the BMS link from the elevator controller company should be included in the elevator company's scope of work.**

B. **Not Used.**

C. AFTER AWARD OF CONTRACT, **1 disk containing PDF documents of drawings and specifications Issued for Construction will be provided to the General Contractor.**

D. Additional sets of drawings may be made by the Contractor, at Contractor's expense.

**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.
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.

C. Guards: Not required for this project.

D. Key Control:

1. The General Contractor shall provide duplicate keys and lock combinations to the Contracting Officer's Representative (COR) for the purpose of security inspections of every area of project including tool boxes and parked machines and take any emergency action.
2. The General Contractor shall turn over all permanent lock cylinders to the VA locksmith for permanent installation. See Section 08 71 00, DOOR HARDWARE and coordinate.

E. 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.
4. 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.

5. These security documents shall not be removed or transmitted from the project site without the written approval of Contracting Officer.
6. All paper waste or electronic media such as CD's and diskettes shall be shredded and destroyed in a manner acceptable to the VA.
7. Notify Contracting Officer and Site Security Officer immediately when there is a loss or compromise of "sensitive information".
8. 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. Separate permits shall be issued for General Contractor and its employees for parking in designated areas only.

**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):
   E84-2008.....Surface Burning Characteristics of Building Materials
2. National Fire Protection Association (NFPA):
   10-2006.....Standard for Portable Fire Extinguishers
   30-2007.....Flammable and Combustible Liquids Code
   51B-2003.....Standard for Fire Prevention During Welding, Cutting and Other Hot Work

70-2007.....National Electrical Code

241-2004.....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. Fire Safety Plan: Establish and maintain a fire protection program in accordance with 29 CFR 1926. Prior to start of work, prepare a plan detailing project-specific fire safety measures, including periodic status reports, and submit to Contracting Officer's Representative (COR) and Facility Safety Manager for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES Prior to any worker for the contractor or subcontractors beginning work, they shall undergo a safety briefing provided by the general contractor's competent person per OSHA requirements. This briefing shall include information on the construction limits, VAMC safety guidelines, means of egress, break areas, work hours, locations of restrooms, use of VAMC equipment, etc. Documentation shall be provided to the Contracting Officer's Representative (COR) that individuals have undergone contractor's safety briefing.

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 one-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 Contracting Officer’s Representative (COR) and facility Safety Manager.

H. Egress Routes for Construction Workers: Maintain free and unobstructed egress. Inspect daily. Report findings and corrective actions weekly to Contracting Officer’s Representative (COR) and facility Safety Manager.

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. Sprinklers: Install, test and activate new automatic sprinklers prior to removing existing sprinklers.

M. Existing Fire Protection: Do not impair automatic sprinklers, smoke and heat detection, and fire alarm systems, except for portions immediately under construction, and temporarily for connections. Provide fire watch for impairments more than 4 hours in a 24-hour period. Request interruptions in accordance with Article, OPERATIONS AND STORAGE AREAS, and coordinate with Contracting Officer’s Representative (COR) and facility Safety Manager. All existing or temporary fire protection systems (fire alarms, sprinklers) located in construction areas shall be tested as coordinated with the medical center. Parameters for the testing and results of any tests performed shall be recorded by the

medical center and copies provided to the Contracting Officer’s Representative (COR).

N. Smoke Detectors: Prevent accidental operation. Remove temporary covers at end of work operations each day. Coordinate with Contracting Officer’s Representative (COR) and facility Safety Manager.

O. Hot Work: Perform and safeguard hot work operations in accordance with NFPA 241 and NFPA 51B. Coordinate with Contracting Officer’s Representative (COR). Obtain permits from facility Safety Manager at least 24 hours in advance. Designate contractor's responsible project-site fire prevention program manager to permit hot work.

P. Fire Hazard Prevention and Safety Inspections: Inspect entire construction areas weekly. Coordinate with, and report findings and corrective actions weekly to Contracting Officer’s Representative (COR) and facility Safety Manager.

Q. 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.

R. Dispose of waste and debris in accordance with NFPA 241. Remove from buildings daily.

S. Perform other construction, alteration and demolition operations in accordance with 29 CFR 1926.

T. If required, submit documentation to the Contracting Officer’s Representative (COR) 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 Contracting Officer. The Contractor shall hold and save the Government, its officers and agents, free and harmless from liability of any nature occasioned by the Contractor's performance.

B. Temporary buildings (e.g., storage sheds, shops, offices) and utilities may be erected by the Contractor only with the approval of the Contracting Officer and shall be built with labor and materials furnished by the Contractor without expense to the Government. 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 Contracting Officer, the buildings and utilities may be abandoned and need not be removed.

C. The Contractor shall, under regulations prescribed by the Contracting Officer, use only established roadways, or use temporary roadways constructed by the Contractor when and as authorized by the Contracting Officer. When materials are transported in prosecuting the work, vehicles shall not be loaded beyond the loading capacity recommended by the manufacturer of the vehicle or prescribed by any Federal, State, or local law or regulation. When it is necessary to cross curbs or sidewalks, the Contractor shall protect them from damage. The Contractor shall repair or pay for the repair of any damaged curbs, sidewalks, or roads.

D. Working space and space available for storing materials shall be as shown on the drawings, or as determined by the Contracting Officer’s Representative (COR).

E. Workmen are subject to rules of Medical Center applicable to their conduct.

F. Execute work so as to interfere as little as possible with normal functioning of Medical Center as a whole, including operations of utility services, fire protection systems and any existing equipment, and with work being done by others. Use of equipment and tools that transmit vibrations and noises through the building structure, are not permitted in buildings that are occupied, during construction, jointly by patients or medical personnel, and Contractor's personnel, except as permitted by Contracting Officer’s Representative (COR) where required by limited working space.

   1. Do not store materials and equipment in other than assigned areas.
   2. Schedule delivery of materials and equipment to immediate construction working areas within buildings in use by Department of Veterans Affairs in quantities sufficient for not more than two work days. Provide unobstructed access to Medical Center areas required to remain in operation.
   3. Where access by Medical Center personnel to vacated portions of buildings is not required, storage of Contractor's materials and equipment will be permitted subject to fire and safety requirements.

G. Phasing: To insure such executions, Contractor shall furnish the Contracting Officer's Representative (COR) 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 Contracting Officer's Representative (COR) two 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 Medical Center Director, Contracting Officer's Representative (COR) and Contractor, as follows:

H. Adjacent **Nursing building** will be occupied during performance of work.

1. Contractor shall take all measures and provide all material necessary for protecting existing equipment and property in affected areas of construction against dust and debris, so that equipment and affected areas to be used in the Medical Centers operations will not be hindered. Contractor shall permit access to Department of Veterans Affairs personnel and patients through other construction areas which serve as routes of access to such affected areas and equipment. Coordinate alteration work in areas occupied by Department of Veterans Affairs so that Medical Center operations will continue during the construction period.
2. Immediate areas of alterations not mentioned in preceding Subparagraph 1 will be temporarily vacated while alterations are performed.

I. Construction Fence: Before construction operations begin, Contractor shall provide a chain link construction fence, 2.1m (seven feet) minimum height, around the construction area indicated on the drawings. Provide gates as required for access with necessary hardware, including hasps and padlocks. Fasten fence fabric to terminal posts with tension bands and to line posts and top and bottom rails with tie wires spaced at maximum 375mm (15 inches). Bottom of fences shall extend to 25mm (one inch) above grade. Remove the fence when directed by Contracting Officer's Representative (COR).

J. When a building is turned over to Contractor, Contractor shall accept entire responsibility therefore.

1. Contractor shall maintain a minimum temperature of 4 degrees C (40 degrees F) at all times, except as otherwise specified.

2. Contractor shall maintain in operating condition existing fire protection and alarm equipment. In connection with fire alarm equipment, Contractor shall make arrangements for pre-inspection of site with Fire Department or Company (Department of Veterans Affairs or municipal) whichever will be required to respond to an alarm from Contractor's employee or watchman.

K. Utilities Services: Maintain existing utility services for Medical Center at all times. Provide temporary facilities, labor, materials, equipment, connections, and utilities to assure uninterrupted services. Where necessary to cut existing water, steam, gases, sewer or air pipes, or conduits, wires, cables, etc. of utility services or of fire protection systems and communications systems (including telephone), they shall be cut and capped at suitable places where shown; or, in absence of such indication, where directed by Contracting Officer’s Representative (COR).

1. No utility service such as water, gas, steam, sewers or electricity, or fire protection systems and communications systems may be interrupted without prior approval of Contracting Officer’s Representative (COR). Electrical work shall be accomplished with all affected circuits or equipment de-energized. When an electrical outage cannot be accomplished, work on any energized circuits or equipment shall not commence without the Medical Center Director’s prior knowledge and written approval. Refer to specification Sections 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS for additional requirements.
2. Contractor shall submit a request to interrupt any such services to Contracting Officer’s Representative (COR), in writing, 48 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 Medical Center. Interruption time approved by Medical Center may occur at other than Contractor's normal working hours.
4. Major interruptions of any system must be requested, in writing, at least 15 calendar days prior to the desired time and shall be

performed as directed by the Contracting Officer's Representative (COR).

5. In case of a contract construction emergency, service will be interrupted on approval of Contracting Officer's Representative (COR). 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.

L. Abandoned Lines: All service lines such as wires, cables, conduits, ducts, pipes and the like, and their hangers or supports, which are to be abandoned but are not required to be entirely removed, shall be sealed, capped or plugged. The lines shall not be capped in finished areas, but shall be removed and sealed, capped or plugged in ceilings, within furred spaces, in unfinished areas, or within walls or partitions; so that they are completely behind the finished surfaces.

M. To minimize interference of construction activities with flow of Medical Center traffic, comply with the following:

1. Keep roads, walks and entrances to grounds, to parking and to occupied areas of buildings clear of construction materials, debris and standing construction equipment and vehicles. Wherever excavation for new utility lines cross existing roads, at least one lane must be open to traffic at all times.
2. Method and scheduling of required cutting, altering and removal of existing roads, walks and entrances must be approved by the Contracting Officer's Representative (COR).

N. Coordinate the work for this contract with other construction operations as directed by Contracting Officer's Representative (COR). 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 Contracting Officer's Representative (COR) and a representative of VA Supply Service, of areas of buildings in which alterations occur and areas which are anticipated routes of access, and

furnish a report, signed by all three, to the Contracting Officer. This report shall list by rooms and spaces:

1. Existing condition and types of resilient flooring, doors, windows, walls and other surfaces not required to be altered throughout affected areas of building.
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 Contracting Officer’s Representative (COR).

B. Any items required by drawings to be either reused or relocated or both, found during this survey to be nonexistent, or in opinion of Contracting Officer’s Representative (COR) and/or Supply Representative, to be in such condition that their use is impossible or impractical, shall be furnished and/or replaced by Contractor with new items in accordance with specifications which will be furnished by Government. Provided the contract work is changed by reason of this subparagraph B, the contract will be modified accordingly, under provisions of clause entitled "DIFFERING SITE CONDITIONS" (FAR 52.236-2) and "CHANGES" (FAR 52.243-4 and VAAR 852.236-88).

C. Re-Survey: Thirty days before expected partial or final inspection date, the Contractor and Contracting Officer’s Representative (COR) together shall make a thorough re-survey of the areas of buildings involved. They shall furnish a report on conditions then existing, of resilient flooring, doors, windows, walls and other surfaces as compared with conditions of same as noted in first condition survey report:

1. Re-survey report shall also list any damage caused by Contractor to such flooring and other surfaces, despite protection measures; and, will form basis for determining extent of repair work required of Contractor to restore damage caused by Contractor's workmen in executing work of this contract.

D. Protection: Provide the following protective measures:
   1. Wherever existing roof surfaces are disturbed they shall be protected against water infiltration. In case of leaks, they shall be repaired immediately upon discovery.
   2. Temporary protection against damage for portions of existing structures and grounds where work is to be done, materials handled and equipment moved and/or relocated.
   3. Protection of interior of existing structures at all times, from damage, dust and weather inclemency. Wherever work is performed, floor surfaces that are to remain in place shall be adequately protected prior to starting work, and this protection shall be maintained intact until all work in the area is completed.

**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. Prior to start of work, prepare a plan detailing project-specific dust protection measures, including periodic status reports, and submit to Contracting Officer's Representative (COR) 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.

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 Contracting Officer's Representative (COR). 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 Contracting Officer's Representative (COR). 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 Contracting Officer's Representative (COR) 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 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 Contracting Officer’s Representative (COR) 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.

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 or in specifications as items to be stored. Items that remain property of the Government shall be removed or dislodged from present locations in such a manner as to prevent damage which would be detrimental to re-installation and reuse. Store such items where directed by Contracting Officer’s Representative (COR).
2. Items not reserved shall become property of the Contractor and be removed by Contractor from Medical Center.
3. Items of portable equipment and furnishings located in rooms and spaces in which work is to be done under this contract shall remain the property of the Government. When rooms and spaces are vacated by the Department of Veterans Affairs during the alteration period, such items which are NOT required by drawings and specifications to be either relocated or reused will be removed by the Government in advance of work to avoid interfering with Contractor's operation.
4. PCB Transformers and Capacitors: The Contractor shall be responsible for disposal of the Polychlorinated Biphenyl (PCB) transformers and capacitors. The transformers and capacitors shall be taken out of service and handled in accordance with the procedures of the Environmental Protection Agency (EPA) and the Department of Transportation (DOT) as outlined in Code of Federal Regulation (CFR), Titled 40 and 49 respectively. The EPA's Toxic Substance Control Act (TSCA) Compliance Program Policy Nos. 6-PCB-6 and 6-PCB-7 also apply. Upon removal of PCB transformers and capacitors for disposal, the "originator" copy of the Uniform Hazardous Waste

Manifest (EPA Form 8700-22), along with the Uniform Hazardous Waste Manifest Continuation Sheet (EPA Form 8700-22A) shall be returned to the Contracting Officer who will annotate the contract file and transmit the Manifest to the Medical Center's Chief.

a. Copies of the following listed CFR titles may be obtained from the Government Printing Office:

40 CFR 261.....Identification and Listing of Hazardous Waste

40 CFR 262.....Standards Applicable to Generators of Hazardous Waste

40 CFR 263.....Standards Applicable to Transporters of Hazardous Waste

40 CFR 761.....PCB Manufacturing, Processing, Distribution in Commerce, and use Prohibitions

49 CFR 172.....Hazardous Material tables and Hazardous Material Communications Regulations

49 CFR 173.....Shippers - General Requirements for Shipments and Packaging

49 CRR 173.....Subpart A General

49 CFR 173.....Subpart B Preparation of Hazardous Material for Transportation

49 CFR 173.....Subpart J Other Regulated Material; Definitions and Preparation

TSCA.....Compliance Program Policy Nos. 6-PCB-6 and 6-PCB-7

**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.

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:

- 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 Contracting Officer’s Representative (COR). Existing work to be altered or extended and that is found to be defective in any way, shall be reported to the Contracting Officer’s Representative (COR) before it is disturbed. Materials and workmanship used in restoring work, shall conform in type and quality to that of original existing construction, except as otherwise shown or specified.

B. Upon completion of contract, deliver work complete and undamaged. Existing work (walls, ceilings, partitions, floors, mechanical and electrical work, lawns, paving, roads, walks, etc.) disturbed or removed as a result of performing required new work, shall be patched, repaired, reinstalled, or replaced with new work, and refinished and left in as good condition as existed before commencing work.

C. At Contractor's own expense, Contractor shall immediately restore to service and repair any damage caused by Contractor's workmen to existing piping and conduits, wires, cables, etc., of utility services or of fire protection systems and communications systems (including telephone) which are 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).

**1.12 PHYSICAL DATA**

A. Data and information furnished or referred to below is for the Contractor's information. The Government shall not be responsible for any interpretation of or conclusion drawn from the data or information by the Contractor.

1. The indications of physical conditions on the drawings and in the specifications are the result of site investigations by the project testing agency as identified by the Contracting Officer’s Representative (COR).

B. Subsurface conditions have been developed by core borings. Logs of subsurface exploration are shown diagrammatically in this specification section.

C. Not used.

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

**1.13 PROFESSIONAL SURVEYING SERVICES**

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

**1.14 LAYOUT OF WORK**

A. The Contractor shall establish base lines and bench marks and shall be responsible for all measurements in connection with the layout. The Contractor shall furnish, at Contractor's own expense, all stakes, templates, platforms, equipment, tools, materials, and labor required to lay out any part of the work. The Contractor shall also be responsible for maintaining and preserving all stakes and other marks established until authorized to remove them. If such marks are destroyed by the Contractor or through Contractor's negligence before their removal is authorized, the Contracting Officer may replace them and deduct the expense of the replacement from any amounts due or to become due to the Contractor.

B. Establish and plainly mark center lines for each building and/or addition to each existing building, and such other lines and grades that are reasonably necessary to properly assure that location, orientation, and elevations established for each such structure and/or

addition, roads, parking lots, are in accordance with lines and elevations shown on contract drawings.

C. Following completion of general mass excavation and before any other permanent work is performed, establish and plainly mark (through use of appropriate batter boards or other means) sufficient additional survey control points or system of points as may be necessary to assure proper alignment, orientation, and grade of all major features of work. Survey shall include, but not be limited to, location of lines and grades of footings, exterior walls, centerlines of columns in both directions, major utilities and elevations of floor slabs:
   1. Such additional survey control points or system of points thus established shall be checked and certified by a registered land surveyor or registered civil engineer. Furnish such certification to the Contracting Officer’s Representative (COR) before any work (such as footings, floor slabs, columns, walls, utilities and other major controlling features) is placed.

D. During progress of work, and particularly as work progresses from floor to floor, Contractor shall have line grades and plumbness of all major form work checked and certified by a registered land surveyor or registered civil engineer as meeting requirements of contract drawings. Furnish such certification to the Contracting Officer’s Representative (COR) before any major items of concrete work are placed. In addition, Contractor shall also furnish to the Contracting Officer’s Representative (COR) certificates from a registered land surveyor or registered civil engineer that the following work is complete in every respect as required by contract drawings.
   1. Lines of each building and/or addition.
   2. Elevations of bottoms of footings and tops of floors of each building and/or addition.
   3. Lines and elevations of sewers and of all outside distribution systems.

E. Whenever changes from contract drawings are made in line or grading requiring certificates, record such changes on a reproducible drawing bearing the registered land surveyor or registered civil engineer seal, and forward these drawings upon completion of work to Contracting Officer’s Representative (COR).

F. The Contractor shall perform the surveying and layout work of this and other articles and specifications in accordance with the provisions of Article "Professional Surveying Services".

**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 ensure compliance, as-built drawings shall be made available for the Contracting Officer’s Representative (COR)'s review, at any time.

C. Contractor shall deliver two approved completed sets of as-built drawings to the Contracting Officer’s Representative (COR) within 15 calendar days after each completed phase and after the acceptance of the project by the Contracting Officer’s Representative (COR).

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 property and, when authorized by the Contracting Officer’s Representative (COR), 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.

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 Contracting Officer's Representative (COR). If the equipment is not installed and maintained in accordance with the following provisions, the Contracting Officer's Representative (COR) will withdraw permission for use of the equipment.
2. Electrical installations used by the equipment shall be completed in accordance with the drawings and specifications to prevent damage to the equipment and the electrical systems, i.e. transformers, relays, circuit breakers, fuses, conductors, motor controllers and their overload elements shall be properly sized, coordinated and adjusted. 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. Boilers, pumps, feedwater heaters and auxiliary equipment must be operated as a complete system and be fully maintained by operating personnel. Boiler water must be given complete and continuous chemical treatment.

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 - NOT USED**

**1.20 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 Contracting Officer’s Representative (COR), 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.

**1.21 AVAILABILITY AND USE OF UTILITY SERVICES**

A. The Government shall make all reasonably required amounts of utilities available to the Contractor from existing outlets and supplies, as specified in the contract. The 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.

   a. Steam is available at Contractor’s expense.

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.
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. 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 Contracting Officer’s Representative (COR)'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.
   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 Contracting Officer’s Representative (COR)'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.

**1.22 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.

**1.23 TESTS**

A. Pre-test mechanical and electrical equipment and systems and make corrections required for proper operation of such systems before requesting final tests. Final test will not be conducted unless pre-tested.

B. Conduct final tests required in various sections of specifications in presence of an authorized representative of the Contracting Officer. Contractor shall furnish all labor, materials, equipment, instruments, and forms, to conduct and record such tests.

C. Mechanical and electrical systems shall be balanced, controlled and coordinated. A system is defined as the entire 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.

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.

**1.24 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 Contracting Officer’s Representative (COR) coincidental with the delivery of the equipment to the job site. Manuals shall be complete, detailed guides for the maintenance and operation of equipment. They shall include

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

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

**1.25 GOVERNMENT-FURNISHED PROPERTY**

A. Not used.

B. Equipment furnished by Government to be installed by Contractor will be furnished to Contractor at the Medical Center.

C. Storage space for equipment will be provided by the Government and the Contractor shall be prepared to unload and store such equipment therein upon its receipt at the Medical Center.

D. Notify Contracting Officer in writing, 60 days in advance, of date on which Contractor will be prepared to receive equipment furnished by Government. Arrangements will then be made by the Government for delivery of equipment.

1. Immediately upon delivery of equipment, Contractor shall arrange for a joint inspection thereof with a representative of the Government. At such time the Contractor shall acknowledge receipt of equipment described, make notations, and immediately furnish the Government representative with a written statement as to its condition or shortages.
2. Contractor thereafter is responsible for such equipment until such time as acceptance of contract work is made by the Government.

E. Equipment furnished by the Government will be delivered in a partially assembled (knock down) condition in accordance with existing standard commercial practices, complete with all fittings, fastenings, and appliances necessary for connections to respective services installed under contract. All fittings and appliances (i.e., couplings, ells, tees, nipples, piping, conduits, cables, and the like) necessary to make the connection between the Government furnished equipment item and the utility stub-up shall be furnished and installed by the contractor at no additional cost to the Government.

F. Completely assemble and install the Government furnished equipment in place ready for proper operation in accordance with specifications and drawings.

G. Furnish supervision of installation of equipment at construction site by qualified factory trained technicians regularly employed by the equipment manufacturer.

**1.26 RELOCATED EQUIPMENT AND ITEMS**

A. Contractor shall disconnect, dismantle as necessary, remove and reinstall in new location, all existing equipment and items shown to be relocated by the Contractor.

B. Perform relocation of such equipment or items at such times and in such a manner as directed by the Contracting Officer’s Representative (COR).

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. Contractor shall employ services of an installation engineer, who is an authorized representative of the manufacturer of this equipment to supervise assembly and installation of existing equipment, required to be relocated.

B. All service lines such as noted above for relocated equipment shall be in place at point of relocation ready for use before any existing equipment is disconnected. Make relocated existing equipment ready for operation or use immediately after reinstallation.

**1.27 STORAGE SPACE FOR DEPARTMENT OF VETERANS AFFAIRS EQUIPMENT - NOT USED**

**1.28 CONSTRUCTION SIGN**

A. Provide a Construction Sign where directed by the Contracting Officer’s Representative (COR). All wood members shall be of framing lumber. Cover sign frame with 0.7 mm (24 gage) galvanized sheet steel nailed securely around edges and on all bearings. Provide three 100 by 100 mm (4 inch by 4 inch) posts (or equivalent round posts) set 1200 mm (four feet) into ground. Set bottom of sign level at 900 mm (three feet) above ground and secure to posts with through bolts. Make posts full height of sign. Brace posts with 50 x 100 mm (two by four inch) material as directed.

B. Paint all surfaces of sign and posts two coats of white gloss paint. Border and letters shall be of black gloss paint, except project title which shall be blue gloss paint.

C. Maintain sign and remove it when directed by the Contracting Officer’s Representative (COR).

D. Submit the design of the construction sign to the Contracting Officer's Representative (COR) for approval. Provide all necessary project information.

**1.29 SAFETY SIGN**

A. Provide a Safety Sign where directed by Contracting Officer's Representative (COR). Face of sign shall be 19 mm (3/4 inch) thick exterior grade plywood. Provide two 100 mm by 100 mm (four by four inch) posts extending full height of sign and 900 mm (three feet) into ground. Set bottom of sign level at 1200 mm (four feet) above ground.

B. Paint all surfaces of Safety Sign and posts with one prime coat and two coats of white gloss paint. Letters and design shall be painted with gloss paint of colors noted.

C. Maintain sign and remove it when directed by Contracting Officer's Representative (COR).

D. Detail Drawing Number 45 of safety sign showing required legend and other characteristics of sign is shown on the drawings.

E. Post the number of accident free days on a daily basis.

**1.30 PHOTOGRAPHIC DOCUMENTATION**

A. During the construction period through completion, provide photographic documentation of construction progress and at selected milestones including electronic indexing, navigation, storage and remote access to the documentation, as per these specifications. The commercial photographer used for this work shall meet the following qualifications:

1. Demonstrable minimum experience of three (3) years in operation providing documentation and advanced indexing/navigation systems including a representative portfolio of construction projects of similar type, size, duration and complexity as the Project.
2. Demonstrable ability to service projects throughout North America, which shall be demonstrated by a representative portfolio of active projects of similar type, size, duration and complexity as the Project.

B. Photographic documentation elements:

1. Each digital image shall be taken with a professional grade camera with minimum size of 6 megapixels (MP) capable of producing 200x250mm (8 x 10 inch) prints with a minimum of 2272 x 1704 pixels

and 400x500mm (16 x 20 inch) prints with a minimum 2592 x 1944 pixels.

2. Indexing and navigation system shall utilize actual AUTOCAD construction drawings, making such drawings interactive on an on-line interface. For all documentation referenced herein, indexing and navigation must be organized by both time (date-stamped) and location throughout the project.
3. Documentation shall combine indexing and navigation system with inspection-grade digital photography designed to capture actual conditions throughout construction and at critical milestones. Documentation shall be accessible on-line through use of an internet connection. Documentation shall allow for secure multiple-user access, simultaneously, on-line.
4. Before construction, the building pad, adjacent streets, roadways, parkways, driveways, curbs, sidewalks, landscaping, adjacent utilities and adjacent structures surrounding the building pad and site shall be documented. Overlapping photographic techniques shall be used to insure maximum coverage. Indexing and navigation accomplished through interactive architectural drawings. If site work or pad preparation is extensive, this documentation may be required immediately before construction and at several pre-determined intervals before building work commences.
5. Construction progress for all trades shall be tracked at pre-determined intervals, but not less than once every thirty (30) calendar days ("Progressions"). Progression documentation shall track both the exterior and interior construction of the building. Exterior Progressions shall track 360 degrees around the site and each building. Interior Progressions shall track interior improvements beginning when stud work commences and continuing until Project completion.
6. As-built condition of pre-slab utilities and site utilities shall be documented prior to pouring slabs, placing concrete and/or backfilling. This process shall include all underground and in-slab utilities within the building(s) envelope(s) and utility runs in the immediate vicinity of the building(s) envelope(s). This may also include utilities enclosed in slab-on-deck in multi-story buildings. Overlapping photographic techniques shall be used to insure maximum

coverage. Indexing and navigation accomplished through interactive site utility plans.

7. As-built conditions of mechanical, electrical, plumbing and all other systems shall be documented post-inspection and pre-insulation, sheet rock or dry wall installation. This process shall include all finished systems located in the walls and ceilings of all buildings at the Project. Overlapping photographic techniques shall be used to insure maximum coverage. Indexing and navigation accomplished through interactive architectural drawings.
8. As-built conditions of exterior skin and elevations shall be documented with an increased concentration of digital photographs as directed by the Contracting Officer's Representative (COR) in order to capture pre-determined focal points, such as waterproofing, window flashing, radiused steel work, architectural or Exterior Insulation and Finish Systems (EIFS) detailing. Overlapping photographic techniques shall be used to insure maximum coverage. Indexing and navigation accomplished through interactive elevations or elevation details.
9. As-built finished conditions of the interior of each building including floors, ceilings and walls shall be documented at certificate of occupancy or equivalent, or just prior to occupancy, or both, as directed by the Contracting Officer's Representative (COR). Overlapping photographic techniques shall be used to insure maximum coverage. Indexing and navigation accomplished through interactive architectural drawings.
10. Miscellaneous events that occur during any Contractor site visit, or events captured by the Department of Veterans Affairs independently, shall be dated, labeled and inserted into a Section in the navigation structure entitled "Slideshows," allowing this information to be stored in the same "place" as the formal scope.
11. Customizable project-specific digital photographic documentation of other details or milestones. Indexing and navigation accomplished through interactive architectural plans.
12. Monthly (29 minimum) exterior progressions (360 degrees around the project) and slideshows (all elevations and building envelope). The slideshows allow for the inclusion of Department of Veterans Affairs

pictures, aerial photographs, and timely images which do not fit into any regular monthly photograph.

13. Weekly (21 minimum) Site Progressions - Photographic documentation capturing the project at different stages of construction. These progressions shall capture underground utilities, excavation, grading, backfill, landscaping and road construction throughout the duration of the project.
14. Regular (8 minimum) interior progressions of all walls of the entire project to begin at time of substantial framed or as directed by the Contracting Officer’s Representative (COR) through to completion.
15. Detailed Exact-Built of all Slabs for all project slab pours just prior to placing concrete or as directed by the Contracting Officer’s Representative (COR).
16. Detailed Interior exact built overlapping photos of the entire building to include documentation of all mechanical, electrical and plumbing systems in every wall and ceiling, to be conducted after rough-ins are complete, just prior to insulation and or drywall, or as directed by Contracting Officer’s Representative (COR).
17. Finished detailed Interior exact built overlapping photos of all walls, ceilings, and floors to be scheduled by Contracting Officer’s Representative (COR) prior to occupancy.
18. In event a greater or lesser number of images than specified above are required by the Contracting Officer’s Representative (COR), adjustment in contract price will be made in accordance with clause entitled "CHANGES" (FAR 52.243-4 and VAAR 852.236-88).

C. Images shall be taken by a commercial photographer and must show distinctly, at as large a scale as possible, all parts of work embraced in the picture.

D. Coordination of photo shoots is accomplished through Contracting Officer’s Representative (COR). Contractor shall also attend construction team meetings as necessary. Contractor’s operations team shall provide regular updates regarding the status of the documentation, including photo shoots concluded, the availability of new Progressions or Exact-Builts viewable on-line and anticipated future shoot dates.

E. Contractor shall provide all on-line domain/web hosting, security measures, and redundant server back-up of the documentation.

F. Contractor shall provide technical support related to using the system or service.

G. Upon completion of the project, final copies of the documentation (the "Permanent Record") with the indexing and navigation system embedded (and active) shall be provided in an electronic media format, typically a DVD or external hard-drive. Permanent Record shall have Building Information Modeling (BIM) interface capabilities. On-line access terminates upon delivery of the Permanent Record.

**1.31 FINAL ELEVATION DIGITAL IMAGES**

A. A minimum of four (4) images of each elevation shall be taken with a minimum 6 MP camera, by a professional photographer with different settings to allow the Contracting Officer's Representative (COR) to select the image to be printed. All images are provided to the RE and the architect on a flash drive.

B. Photographs shall be taken upon completion, including landscaping. They shall be taken on a clear sunny day to obtain sufficient detail to show depth and to provide clear, sharp pictures. Pictures shall be 400 mm x 500 mm (16 by 20 inches), printed on regular weight paper, matte finish archival grade photographic paper and produced by a RA4 process from the digital image with a minimum 300 PPI. Identifying data shall be carried on label affixed to back of photograph without damage to photograph and shall be similar to that provided for final construction photographs.

C. Furnish six (6) 400 mm x 500 mm (16 by 20 inch) color prints of the following buildings constructed under this project (elevations as selected by the RE from the images taken above). Photographs shall be artistically composed showing full front elevations. All images shall become property of the Government. Each of the selected six prints shall be place in a frame with a minimum of 2 inches of appropriate matting as a border. Provide a selection of a minimum of 3 different frames from which the SRE will select one style to frame all six prints. Photographs with frames shall be delivered to the Contracting Officer's Representative (COR) in boxes suitable for shipping.

**1.32 HISTORIC PRESERVATION - NOT USED**

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## TOPIC 11. NOISE TRANSMISSION CONTROL

**1. GENERAL:** Where rooms do not contribute to or are not affected by sound transmission from an adjacent space, conventional construction is satisfactory.

**2. PARTITION-CEILING-DOOR-DUCT SYSTEM ACOUSTIC DESIGN**

a. **Acoustical Isolation**. Design the sound resistant enclosures of the following spaces to suppress generated noise and provide a satisfactory degree of acoustical isolation for adjacent occupied spaces. Achieve a minimum Sound Transmission Class (STC) rating of 45.

***NOTE:*** *When the VA Hospital Building System (VAHBS) is used, achieve the required rating using construction such as a double layer of 16 mm (5/8 in.) gypsum board (GB) on both sides of 100 mm (4 in.) nominal metal studs and 64 mm (2 1/2 in.) sound attenuation blankets between the studs. These should extend above conventional lay-in ceilings to the underside of walk-on deck/platforms.*

(1) A/C and other mechanical equipment rooms.

(2) Manual arts therapy shops.

(3) Auditoriums.

(4) Multipurpose rooms.

(5) Mental Health and Behavioral Sciences Service i.e. group therapy rooms.

(6) Emergency generator rooms.

(7) Kitchen & Dishwashing spaces.

***NOTE:*** *Alternatively, provide a gypsum board ceiling or gypsum board lay-in panels both with a 65 mm (2 1/2 in.) sound attenuation blanket for non-VAHBS type of construction where ducts, pipes, etc., make it impractical to extend sound partitions to slabs or deck above. Where gypsum board ceilings with attenuation blankets are used, the double GB partitions and sound attenuation blanket should extend 100 mm (4 in.) above the ceiling. Studs should continue to the floor above. Give special attention to details shown on the construction documents to prevent possible flanking paths for noise transmission.*

b. **Speech Privacy**. Design the sound resistant enclosures of the following spaces to assure speech privacy and achieve an STC rating of 40 (45 for space marked with an asterisk).

(1) Conference rooms.

(2) Consultation offices.

(3) Examination and Treatment Rooms.

(4) Individual Offices in Mental Health and Behavioral Sciences Service.

(5) Audiology and Speech Pathology Areas.

(6) Medical Media Production Services* (Recording Areas).

***NOTE:*** *Partition and ceiling construction should be similar to Paragraph 1.a., except that for spaces requiring an STC value of 40, use only a single layer of gypsum board on both sides.*

c. **Sound Dampening**. Provide sound damping in libraries, chapels, quiet rooms, telephone operator's room, and similar areas by finish materials shown for these areas in Program Guide PG-18-14, "Room Finishes, Door, & Hardware Schedule".

***NOTE:*** *Where an area generating unusual noise or vibration is located adjacent to occupied spaces, the A/E should obtain the services of a professional acoustical consultant to design the sound suppression measures required to produce a comfortable working environment in the adjacent spaces.*

d. **Door Types**. Use door types 19 and 20 with mechanical seal at entrances to spaces where noise suppression or speech privacy is a requirement. See VA Standard Detail Nos. 08100-1.DWG and 08100-2.DWG.

***NOTE:*** *Duct system sound attenuation and room noise criteria are shown in the heating, ventilating, and air-conditioning (HVAC) design manual.*

**3. MECHANICAL AND ELECTRICAL ITEMS:** Properly locate, detail, and caulk or insulate penetrations of the sound resistant enclosure by electrical boxes, light fixtures, air conditioning or ventilating ducts and grills, and other mechanical and electrical components to suppress generated noise or provide speech privacy for the spaces listed in paragraph 2.a. and 2.b. Evaluate equipment and mechanical rooms for noise problems and provide recommendations during the design phase as to additional sound attenuation required. In the analysis, list the possible flanking paths for noise transmission and the methods recommended to prevent this leakage through the enclosure.

**4. EXTERIOR ENCLOSURES:** In the design of exterior building walls and fenestrations at sites near airports, freeways, or heavy city traffic, give consideration for the control of noise transmission from external sources.

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# SECTION 01 31 00.01
# PROJECT MANAGEMENT AND COORDINATION

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. Section includes administrative provision for coordinating construction operations on Project, including, but not limited to, the following:
   1. Web-based Project management software package.

B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.

### 1.3 DEFINITIONS

A. BIM: Building Information Modeling.

B. RFI: Request for Information. Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

### 1.4 DIGITAL PROJECT MANAGEMENT PROCEDURES

A. Web-Based Project Management Software Package: Provide, administer, and use web-based Project management software package for purposes of hosting and managing Project communication and documentation until Final Completion.
   1. Basis of Specification: Procore, Oracle Primavera Submittal Exchange, or other equivalent web-based project management software.
   2. Web-based Project management software includes, at a minimum, the following features:
      a. Compilation of Project data, including Contractor, subcontractors, Architect, Architect's consultants, Owner, and other entities involved in Project. Include names of individuals and contact information.
      b. Access control for each entity for each workflow process, to determine entity's digital rights to create, modify, view, and print documents.
      c. Document workflow planning, allowing customization of workflow

between project entities.

d. Creation, logging, tracking, and notification for Project communications required in other Specification Sections, including, but not limited to, RFIs, submittals, Minor Changes in the Work, Construction Change Directives, and Change Orders.

e. Track status of each Project communication in real time, and log time and date when responses are provided.

f. Procedures for handling PDFs or similar file formats, allowing markups by each entity. Provide security features to lock markups against changes once submitted.

g. Processing and tracking of payment applications.

h. Processing and tracking of contract modifications.

i. Creating and distributing meeting minutes.

j. Document management for Drawings, Specifications, and coordination drawings, including revision control.

k. Management of construction progress photographs.

l. Mobile device compatibility, including smartphones and tablets.

3. Provide Project management software user licenses for use of Owner, Architect, and Architect's consultants. Provide eight hours of software training for web-based Project software users.

4. At completion of Project, provide digital archive in format that is readable by common desktop software applications in format acceptable to Architect. Provide data in locked format to prevent further changes.

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

**PART 3 - EXECUTION (NOT USED)**

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# SECTION 01 32 16.15
# PROJECT SCHEDULES
# *(SMALL PROJECTS – DESIGN/BID/BUILD)*

## 1.1 DESCRIPTION

A. The Contractor will develop a fully Resource loaded (cost) Network Analysis System (NAS) plan/diagram and computer generated schedule demonstrating fulfillment of the entire contract requirements, will keep the plan and computer generated schedule up-to-date in accordance with the specification requirements of this section and will utilize the plan for scheduling, coordinating, mitigating and monitoring work under this contract (including all activities of subcontractors, equipment vendors and suppliers) and verification of every Periodic Progress Schedule Updates and Progress Payment Submission of the work under this contract.

## 1.2 PROJECT SCHEDULER

A. Designate a qualified 3rd-party scheduling consultant who will develop and maintain the project schedule.

B. The scheduling consultant must have five (5) years of experience as a lead project scheduler or previous scheduling experience on at least three (3) projects of similar size and scope.

C. The scheduling consultant must be prepared to discuss, in detail, the proposed sequence of work and methods of operation, and how that information will be communicated through the progress schedule at the preconstruction meeting.

D. The scheduling consultant is required to attend a monthly schedule meeting and make site visits to prepare, develop, and maintain the progress schedules.

## 1.3 SUBMITTALS

A. Initial Schedule:

1. Submit an initial schedule within 7 calendar days after Notice to Proceed (NTP).
   a. Include full schedule details for the first 60 calendar days of work starting on the NTP date and show the schedule ending on or before the Contract Completion Date (CCD).
   b. Provide a summary bar chart schedule (acceptable formats include, but are not limited to, Microsoft Excel, Microsoft Project, Oracle Primavera P6, and Gantt Chart).
   c. Show the proposed sequence, durations, early and late start dates for major work activities.

d. Show the proposed calendar dates for starting and finishing initial contract activities including, but not limited to, set up of construction site, site layouts, travel routes, waste, and staffing areas.

2. Conduct a schedule review meeting with the Government within 14 calendar days after NTP. At this meeting, plan to discuss the proposed schedule for the entire project, including both the detailed first 60-day period covered by the initial schedule as well as the following summary schedule. If deviations to the staging, phasing, or sequencing required by the contract documents are proposed, be prepared to discuss these deviations.
3. The Government will respond by approving the initial schedule, rejecting the schedule and identifying the reason for rejection, or by asking the contractor for additional information clarifying the proposed schedule activities and timelines.
4. The Government will use the approved initial schedule to monitor progress until the baseline schedule is approved.
5. The Government may withhold progress payments until the initial schedule is approved.

B. Schedule of Costs.

1. No more than 30 calendar days after receipt of the Notice to Proceed, prepare and submit a schedule of costs to the Government for review, in accordance with the technical and schedule submittal requirements listed in this is specification.
2. The approved Schedule of Costs will serve as a tool in addition to the required monthly schedule update to determine progress payments to the Contractor for work completed.
3. The costs shown on the Schedule of Costs must represent true costs and the work activities/events match the project schedule work activities/events. The VA Contracting Officers Representative (VA COR) may require the Contractor to submit its original estimate sheets or other supporting documentation to substantiate the detailed makeup of the cost schedule.
4. The total costs of all work activities/events listed on the Schedule of Costs must equal the total contract price. The breakdown must include all line items specified in the contract and work activities shown on the schedule.

5. The Contractor is responsible for regularly updating the Schedule of Costs to reflect any approved changes to the contract scope or cost structure. Updates must be submitted for approval to the Contracting Officer to ensure continued accuracy and compliance with contract requirements.
6. Failure to submit or maintain an accurate and approved Schedule of Costs may result in delayed progress payments and potential penalties as outlined in the contract agreement.
7. All documentation related to the Schedule of Costs, including original estimate sheets and cost substantiation documents, must be maintained and made available for review upon request by the Contracting Officer or VA COR.

C. Baseline Schedule.

1. No more than 30 calendar days after approval of the initial schedule, prepare and submit a baseline schedule to the Government for review, in accordance with the technical and schedule submittal requirements listed in this specification.
2. The Government will respond by accepting the baseline schedule, rejecting the schedule and identifying the reason for rejection, or by asking for more information.
3. Address the reasons for rejection or provide the information requested and resubmit the revised baseline schedule no more than 10 calendar days after the Government’s response.
4. The Government may withhold progress payments until the baseline schedule is approved.
5. No stored material work activities will be shown or approved be on the baseline schedule.
6. The Baseline Schedule Critical Path of the project shall be limited to:
   a. No more than 20% of the work activities shall be on the critical and near-critical path(s). Critical path is defined as activities with zero (0) day total float. Near-Critical path(s) is defined as activities with one (1) to twenty (20) days of total float.
   b. Multiple Critical paths will not be allowed.
7. The Baseline Schedule shall contain sufficient detail such that no more than 5% of work activities have durations exceeding 20 work days, in accordance with DCMA 14-point Schedule Assessment Guidelines.

D. Monthly Schedule Update.

1. Prepare and submit a monthly schedule update to the Government that depicts the status of the project as of the end of the month, in accordance with the technical and schedule submittal requirements listed in this specification.
2. The update must reflect a new data date, work performed up to, but not including, the new data date, and the plan for completing the project.
3. Submit the schedule update by the first Monday of the following month.
4. The Government may withhold progress payments until the monthly schedule update is approved.
5. Each monthly schedule update must be submitted with the associated schedule log.

E. Revised Schedule.

1. The Government has the right to request a revised schedule.
2. Circumstances leading to such a request include, but are not limited to:
   a. A projected or forecasted delay to scheduled interim or project completion dates.
   b. A significant difference between the actual sequence or duration of work and that depicted in the schedule.
3. Prepare and submit the revised schedule no more than 10 calendar days after the Government's request in accordance with the technical and schedule submittal requirements listed in this specification.
4. The Government will respond by accepting the revised schedule, rejecting the schedule and identifying the reasons for rejection, or by requesting more information. Address the reasons for rejection or submit the information requested no more than 10 calendar days after the Government's request.
5. The Government may withhold progress payments until the revised schedule is approved.

F. Final Schedule.

1. Within 30 calendar days of final acceptance of the project, submit a final schedule with actual start and finish dates for each activity.
2. Include with the submission a certification signed by a principal of the firm stating: "To the best of my knowledge, the enclosed final schedule reflects the actual start and finish dates of the activities contained herein."

G. The Government's approval of any schedule, whether initial, baseline, update, or revised, does not modify the contract or constitute endorsement

or validation by the Government of the Contractor's logic, activity durations, or assumptions in creating the schedule. By approving the schedule, the Government does not guarantee that the project can be performed or completed as scheduled. If the Contractor or the Government discover errors after the schedule has been approved, correct the error(s) in the next schedule submission.

**1.4 WORK ACTIVITY/EVENT COST DATA**

A. The Contractor shall cost load all work activities/events except procurement activities. The cumulative amount of all cost-loaded work activities/events (including alternates) shall equal the total contract price. Distribute overhead, profit, and general conditions proportionally across all work activities/events along the project's length (critical path). The contractor shall generate from this information cash flow curves indicating graphically the total percentage of work activity/event dollar value scheduled to be in place on early finish and late finish. These cash flow curves will be used by the Contracting Officer to assist him in determining approval or disapproval of the cost loading. Negative work activity/event cost data will not be acceptable, except on VA issued contract changes.

B. The Contractor shall cost load work activities/events for guarantee period services, test, balance and adjust various systems in accordance with the provisions in Article, FAR 52.232 – 5 (PAYMENT UNDER FIXED PRICE CONSTRUCTION CONTRACTS) and VAAR 852.232 – Article 70 Without NAS-CPM for PAYMENTS UNDER FIXED PRICE CONSTRUCTION.

C. In accordance with FAR 52.236 – 1 (PERFORMANCE OF WORK BY THE CONTRACTOR), the Contractor shall submit, simultaneously with the cost per work activity/event of the construction schedule required by this Section, a responsibility code for all activities/events of the project for which the Contractor's forces will perform the work.

D. The Contractor shall cost load work activities/events for all Bid Items. The sum of each Bid Item work shall equal the value of the bid item in the Contractors' bid.

E. With prior written approval from the Contracting Officer, the Contractor may request payment for suitably stored and maintained materials/equipment that conform to specifications and are ready for installation, in accordance with the provisions in VAAR 852.232 – Article 70 Without NAS-CPM for PAYMENTS UNDER FIXED PRICE CONSTRUCTION. Requests must include comprehensive documentation, such as invoices, proof of

payment, and evidence of secure storage with appropriate insurance. Upon approval, payment for materials will be made in accordance with contract provisions, and title to the materials shall vest in the Owner. The contractor is responsible for replacement of non-confirming or damaged materials at no additional cost to the owner. Payment for stored materials will be reflected on the schedule by cost-loading the delivery activity to represent payment upon material receipt at the site, while the installation activity will be separately cost-loaded to represent payment under completion of installation. These schedule will clearly delineate submittal, procurement, delivery (cost-loaded for stored material payment), and installation (cost-loaded for installed material payment) as distinct activities.

**1.5 PROJECT SCHEDULE REQUIREMENTS**

A. Show on the project schedule the sequence of work activities/events required for complete performance of all items of work. The Contractor shall:

1. Show activities/events as:
   a. Contractor's time required for submittal of shop drawings, templates, fabrication, delivery and similar pre-construction work.
   b. Contracting Officer's and Architect Engineer's review and approval of shop drawings, equipment schedules, samples, template, or similar items.
   c. Interruption of VA Facilities utilities, delivery of Government furnished equipment, and rough-in drawings, project phasing and any other specification requirements.
   d. Test, balance and adjust various systems and pieces of equipment, maintenance and operation manuals, instructions and preventive maintenance tasks.
   e. VA inspection and acceptance activity/event with a minimum duration of five work days at the end of each phase and immediately preceding any VA move activity/event required by the contract phasing for that phase.
2. Show not only the activities/events for actual construction work for each trade category of the project, but also trade relationships to indicate the movement of trades from one area, floor, or building, to another area, floor, or building, for at least five trades who are performing major work under this contract.

3. Break up the work into activities/events of a duration no longer than 20 work days each or one reporting period, except as to non construction activities/events (i.e., procurement of materials, delivery of equipment, concrete and asphalt curing) and any other activities/events for which the VA COR may approve the showing of a longer duration. The duration for VA approval of any required submittal, shop drawing, or other submittals will follow review requirements as specified in Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
4. Describe work activities/events clearly, so the work is readily identifiable for assessment of completion. Activities/events labeled "start," "continue," or "completion," are not specific and will not be allowed. Lead and lag time activities will not be acceptable.
5. The schedule shall be generally numbered in such a way to reflect either discipline, phase or location of the work.

B. The Contractor shall submit the following supporting data in addition to the project schedule:
   1. The appropriate project calendar including working days and holidays.
   2. The planned number of shifts per day.
   3. The number of hours per shift.

C. Failure of the Contractor to include this data shall delay the review of the submittal until the Contracting Officer is in receipt of the missing data.

D. To the extent that the Project Schedule or any revised Project Schedule shows anything not jointly agreed upon, it shall not be deemed to have been approved by the VA COR. Failure to include any element of work required for the performance of this contract shall not excuse the Contractor from completing all work required within any applicable completion date of each phase regardless of the VA COR’s approval of the Project Schedule.

E. Separate Cost-Loaded Activities for Adjusting and Testing Systems:
   1. The CPM shall include separate cost-loaded activities for the adjustment and testing of systems in accordance with the provisions in VAAR 852.232 – Article 70 Without NAS-CPM for PAYMENTS UNDER FIXED PRICE CONSTRUCTION. The percentages provided shall be used to determine the cost of adjust and test work activities/ events, identifying the value of the work for payment purposes.

**1.6 TECHNICAL REQUIREMENTS**

A. Software Compatibility Requirements.

1. The Government uses Oracle Primavera P6 Professional and Microsoft Project Professional to schedule and monitor its construction projects.
2. Prepare and maintain the schedule using one of the following software options:
   a. Oracle Primavera P6 Professional (Version 22 or higher unless pre-approved)
   b. Microsoft Project Professional (Version 2021 or Higher)

B. Schedule Requirements.

1. Calculate the schedule using the Retained Logic scheduling option unless written authorization is obtained from the Government to use the Progress Override scheduling option.
2. At least 90% of all schedule activities shall be assigned to Finish-to-Start (FS) relationships.
3. Do not use the following types of logic relationships:
   a. Negative lags
   b. Lead and lag time activities
   c. Start-to-finish or finish-to-finish relationships

   Open ends. Only the first activity will have no predecessor, and only the last activity will have no successor.

   d. Constraints (a limited number of constraints may be used only with the Government’s written authorization).
   e. Manually modified dates (manually modify dates may be used only with the Government’s written authorization).
4. For any logic relationships that do not meet the criteria above in 1.6.B.2, the contractor must provide justification for the noncompliance to obtain the Government’s authorization to proceed. If the Government does not provide written authorization, the contractor must resubmit the schedule submission.
5. Include the following work activities, as applicable:
   a. Work to be performed by the contractor, subcontractors, and suppliers.
   b. Work to be performed by the Government, other contractors, and third parties such as permitting authorities or other entities required for completion of the project.

c. The project start date, scheduled completion date, and other contractually mandated milestones, start and finish dates for phases, and site access or availability dates.
d. Submittals and Government review and approval of submittals (Reference specification section 01 33 23 for submission requirements).
e. Fabrication, delivery, installation, testing, and similar activities for materials, equipment, and related items.
f. Sampling and testing periods.
g. Settlement or surcharge periods.
h. Cure periods.
i. Utility notifications, shutdowns, relocations, and similar activities.
j. Installation, erection and removal, and similar activities related to temporary systems or structures such as temporary electrical systems or shoring.
k. Punch list, substantial completion, final cleanup, and similar activities.
l. Required acceptance testing, inspections, or similar activities.
m. Durations for receipt of permits or acquisition of rights of way.

6. Define the following attributes for each activity in the schedule:
   a. A unique alphanumeric Activity ID.
   b. A unique descriptive name, using such clear, concise attributes as work type, location so each activity is easily understood. Avoid name abbreviations or overly long activity names to ensure each activity can be objectively measured and clearly understood by all stakeholders.
   c. A duration stated in workdays of no more than 20 workdays unless a longer duration is requested by the contractor and approved by the Government.
   d. Uses codes for responsibility, phasing, and staging.

**1.7 SCHEDULE SUBMISSION REQUIREMENTS**

A. Preparing Schedule on Owner’s Database. If the schedule is prepared using My Primavera in the owner’s database, then for each schedule submission, submit the following items:
   1. A transmittal letter to the owner identifying which schedule in the database is being submitted for review.
   2. A narrative report.

B. Preparing Schedule on Separate Database. If the schedule is prepared using Primavera Version 6.0, Primavera for Contractors, or another software compatible with Primavera Version 6.0, then, for each schedule submission, submit the following items:

1. A transmittal letter
2. A narrative report
3. A Primavera Version 6.0 compatible electronic file of the schedule.
4. The critical path in bar chart format (Longest Path sort)
5. Work paths with total float values within 20 workdays of the critical path's total float value in bar chart format. For example, if the critical path has a total float value of zero, then show all the work paths with total float values of 20 or less.
6. An activity network diagram plotted in color, on E-size paper, with each sheet of the plot including a title, match data for diagram correlation, a page number, and a legend. The activity network diagram should only be submitted with schedules with revised relationships or activity durations.
7. An updated schedule log associated with each Monthly Schedule Update.
8. A project S-Curve in both graphical and tabular format, displaying both schedule and cost data.
9. A Predecessor/Successor report with the following items for each activity:

   Activity ID and description

   a. Original duration
   b. Remaining duration
   c. Calendar ID
   d. Predecessors and Successors
   e. Early start date
   f. Early finish date
   g. Late start date
   h. Late finish date
   i. Total float
   j. Relationship type
   k. Lags
   l. Constraints

C. Preparing Schedule on using Microsoft Project Professional, submit the following items:

1. A transmittal letter

2. A narrative report
3. A Microsoft Project Professional .mpp electronic file of the schedule.
   a. The critical path in bar chart format (Longest Path sort)
   b. Work paths with total float values within 20 workdays of the critical path's total float value in bar chart format. For example, if the critical path has a total float value of zero, then show all the work paths with total float values of 20 or less.
   c. An activity network diagram plotted in color, on E-size paper, with each sheet of the plot including a title, match data for diagram correlation, a page number, and a legend. The activity network diagram should only be submitted with schedules with revised relationships or activity durations.
   d. A project S-Curve in both graphical and tabular format, displaying both schedule and cost data.
   e. A Predecessor/Successor report with the following items for each activity:
      1) WBS and Task Name
      2) Baseline duration
      3) Remaining duration
      4) Predecessors and Successors
      5) Early start date
      6) Early finish date
      7) Late start date
      8) Late finish date
      9) Total slack
      10) Constraints
   f. A Lag report displaying all lags within the project schedule.

D. Narrative Reports for the Initial and Baseline Schedule. For each submission of the initial and baseline schedule provide a narrative report that includes the following information:
   1. Explanation of the overall plan to complete the project, including where the work will begin and how the work and crews will flow through the project
   2. Use and application of the workdays per week, number of shifts per day, number of hours per shift, holidays observed, and how the schedule accommodates adverse weather days for each month of activity
   3. If the project is a multi-year project, then identify the work to be completed in each construction season

4. A statement explaining why the scheduled completion date is forecast to occur before or after the contract completion date.
5. An explanation stating why any of the contract milestone dates are forecast to occur late.
6. A description of problems or issues anticipated
7. A description of anticipated delays, including:
   a. Identification of the delayed activity by activity ID and description
   b. Type of delay
   c. Cause of the delay
   d. Effect of the delay on other activities, milestones, and completion dates
   e. Identification of the actions needed to avoid or mitigate the delay
   f. A description of the critical path
   g. A description of work paths with total float values within 20 workdays of the critical path's total float value. For example, if the critical path has a total float value of zero, then describe all the work paths with total float values of 20 or less.
   h. A statement identifying constraints and an explanation of the reason for and purpose of each constraint.
   i. A statement describing the status of required permits.
   j. The statement describing the reason for the use of each lag.

E. Narrative Reports for the Monthly Schedule Update and Revised Schedule. For each submission of the monthly schedule update and revised schedule provide a narrative report that includes the following information:
1. A description of the status of the scheduled completion date (and any contract milestone date(s)) since the last schedule submitted
2. A statement explaining why the scheduled completion date is forecast to occur before or after the contract completion date. An explanation stating why any of the contract milestone dates are forecasted to occur late
3. A description of the work performed since the last schedule update
4. A description of unusual labor, shift, equipment, or material conditions or restrictions encountered or anticipated
5. A description of the problems encountered or anticipated since the last schedule submission
6. A statement that identifies and describes any current and anticipated delays. A discussion of delays in the narrative report does not

constitute notice and does not replace the need for the contractor to provide notice as required by the contract. Include the following:

a. Identification of the delayed activity by activity ID and description
b. Type of delay
c. Cause of the delay
d. Effect of the delay on other activities, milestones, and completion dates
e. Identification of the actions needed to avoid or mitigate the delay
f. A description of the critical path
g. A description of changes in the critical path and schedule completion date (for the project or its milestones) from the last schedule submission
h. Descriptions of the status of work paths that have total float values within 20 workdays of the critical path identified in the previous schedule submission
i. Descriptions of work paths with total float values within 20 workdays of the critical path's total float value. For example, if the critical path has a total float value of negative 25, then show all the near-critical paths with total float values of negative 5 or less.
j. A statement or Schedule Comparison Report that identifies the changes made between the previous schedule submission and the current proposed schedule, including, but not limited to:
   1) Data date
   2) Completion date
   3) Activity code assignments
   4) Scheduling options
   5) Activity descriptions
   6) Added activities
   7) Deleted activities
   8) Added activity relationships
   9) Deleted activity relationships
   10) Activity original durations
   11) Activity remaining durations
   12) Activity actual start and finishes
   13) Percent complete
   14) Constraints

15) Activity resources
16) Activity costs
17) Activity coding

k. A statement providing the status of pending items, including, but not limited to:
1) Permits
2) Change orders
3) Time extension requests
4) Noncompliance or similar notices are indicating deficiencies in the contractor's performance.

7. Prior to Baseline Schedule Acceptance.
a. At the time of the Pre-Construction Conference, prior to the issuance of the project Notice to Proceed, the Contractor and the Contractor's Scheduling Consultant, will arrange a separate meeting with the Contracting Officer and/or the VA COR to discuss the requirements of this specification in detail. The Contractor and the Contractor's scheduling consultant, will acknowledge, in writing, their understanding and compliance with the requirement of this specification.
b. With exception of bonds, insurance, and limited mobilization cost associated with preparatory work such as site trailers, staging areas, haul roads etc., the approval of the baseline NAS schedule is a condition precedent to:
1) Processing of contractor's pay request(s) for any construction activities/items of work.
2) Review of any schedule updates.
c. Government review comments on the contractor's schedule will not relieve the contractor from compliance with requirements of this specification section and the remaining contract documents.

**1.8 QUALITY ASSURANCE**

A. Quality assurance of the schedule must conform to the following standards
1. DCMA 14-point Schedule Assessment Guidelines
2. GAO's Schedule assessment guide - Best Practices for Project Schedules Appendix II.

**1.9 PAYMENT TO THE CONTRACTOR**

A. Monthly, the contractor shall submit an application and certificate for payment using VA Form 10-6001a reflecting updated schedule activities and cost data in accordance with the provisions of the following Article,

PAYMENT AND PROGRESS REPORTING, as the basis upon which progress payments will be made pursuant to Article, FAR 52.232 – 5 (PAYMENT UNDER FIXED-PRICE CONSTRUCTION CONTRACTS) and VAAR 852.232 – Article 70 Without NAS-CPM for PAYMENTS UNDER FIXED PRICE CONSTRUCTION. The Contractor shall be entitled to a monthly progress payment upon approval of estimates as determined from the currently approved updated project schedule. Monthly payment requests shall include: a listing of all agreed upon project schedule changes and associated data; and electronic files of the resulting monthly updated schedule, provided in both PDF and native scheduling software formats.

B. Approval of the Contractor's monthly Application for Payment shall be contingent, among other factors, on the submittal of a satisfactory monthly update of the project schedule.

C. Payment for adjust and test activities will be made only after the Contractor has demonstrated that each of the systems is substantially complete and operates as required by the contract. The Contractor must adequately document

**1.10 PAYMENT AND PROGRESS REPORTING**

A. Monthly schedule update meetings will be held on dates mutually agreed to by the VA COR and the Contractor. Contractor and their scheduling consultant shall attend all monthly schedule update meetings. The Contractor shall accurately update the Project Schedule and all other data required and provide this information to the VA COR three work days in advance of the schedule update meeting. Job progress will be reviewed to verify:

1. Actual start and/or finish dates for updated/completed activities/events.
2. Remaining duration for each activity/event started, or scheduled to start, but not completed.
3. Logic, time and cost data for change orders, and supplemental agreements that are to be incorporated into the Project Schedule.
4. Changes in activity/event sequence and/or duration which have been made, pursuant to the provisions of following Article, ADJUSTMENT OF CONTRACT COMPLETION.
5. Completion percentage for all completed and partially completed activities/events.
6. Logic and duration revisions required by this section of the specifications.

7. Activity/event duration and percent complete shall be updated independently.

B. After completion of the joint review, the contractor shall generate an updated computer-produced calendar-dated schedule and supply the VA COR with reports in accordance with the Article, PROJECT SCHEDULE REQUIREMENTS, specified.

C. After completing the monthly schedule update, the contractor's representative or scheduling consultant shall rerun all current period contract change(s) against the prior approved monthly project schedule. The analysis shall only include original workday durations and schedule logic agreed upon by the contractor and COR for the contract change(s). When there is a disagreement on logic and/or durations, the Contractor shall use the schedule logic and/or durations provided and approved by the COR. After each rerun update, the resulting electronic project schedule data file shall be appropriately identified and submitted to the VA in accordance to the requirements listed in articles 1.3 and 1.7. This electronic submission is separate from the regular monthly project schedule update requirements and shall be submitted to the COR within fourteen (14) calendar days of completing the regular schedule update. Before inserting the contract changes durations, care must be taken to ensure that only the original durations will be used for the analysis, not the reported durations after progress. In addition, once the final network diagram is approved, the contractor must recreate all manual progress payment updates on this approved network diagram and associated reruns for contract changes in each of these update periods as outlined above for regular update periods. This will require detailed record keeping for each of the manual progress payment updates.

D. Following approval of the Baseline Schedule, the VA, the General Contractor, its approved CPM Consultant, VA COR, and all subcontractors needed, as determined by the SRE, shall meet to discuss the monthly updated schedule. The main emphasis shall be to address work activities to avoid slippage of project schedule and to identify any necessary actions required to maintain project schedule during the reporting period. The Government representatives and the Contractor should conclude the meeting with a clear understanding of those work and administrative actions necessary to maintain project schedule status during the reporting period. This schedule coordination meeting will occur after each monthly project schedule update meeting utilizing the resulting schedule reports

from that schedule update. If the project is behind schedule, discussions should include ways to prevent further slippage as well as ways to improve the project schedule status, when appropriate.

**1.11 RESPONSIBILITY FOR COMPLETION**

A. If it becomes apparent from the current revised monthly progress schedule that phasing or contract completion dates will not be met, the Contractor shall execute some or all the following remedial actions:

1. Increase construction manpower in such quantities and crafts as necessary to eliminate the backlog of work.
2. Increase the number of working hours per shift, shifts per working day, working days per week, the amount of construction equipment, or any combination of the foregoing to eliminate the backlog of work.
3. Reschedule the work in conformance with the specification requirements.

B. Prior to proceeding with any of the above actions, the Contractor shall notify and obtain approval from the VA Contracting Officer for the proposed schedule changes. If such actions are approved, the representative schedule revisions shall be incorporated by the Contractor into the Project Schedule before the next update, at no additional cost to the Government.

**1.12 ADJUSTMENT OF CONTRACT COMPLETION**

A. The contract completion time will be adjusted only for causes specified in this contract. Request for an extension of the contract completion date by the Contractor shall be supported with a clearly explained narrative justification, CPM data and supporting evidence as the VA COR may deem necessary for determination as to whether or not the Contractor is entitled to an extension of time under the provisions of the contract. Submission of proof based on revised activity/event logic, durations (in work days) and costs is obligatory to any approvals. The schedule must clearly display that the Contractor has used, in full, all the float time available for the work involved in this request. The Contracting Officer's determination as to the total number of days of contract extension will be based upon the current computer produced calendar dated schedule for the time period in question and all other relevant information.

B. Actual delays in activities/events which, according to the computer produced calendar dated schedule, do not affect the extended and predicted contract completion dates shown by the critical path in the network, will not be the basis for a change to the contract completion date. The Contracting Officer will within a reasonable time after receipt of such

justification and supporting evidence, review the facts and advise the Contractor in writing of the Contracting Officer's decision.

C. The Contractor shall submit each request for a change in the contract completion date to the Contracting Officer in accordance with the provisions specified under FAR 52.243 – 4 (Changes). The Contractor shall include, as a part of each change order proposal, a sketch showing all CPM logic revisions, duration (in work days) changes, and cost changes, for work in question and its relationship to other activities on the approved network diagram.

D. All delays due to non-work activities/events such as RFI’s, WEATHER, STRIKES, and similar non-work activities/events shall be analyzed on a month-by-month basis.

- - - END - - -

**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 (including any laboratory samples to be tested) will not serve as a basis for extending contract time for completion.

1-5. Shop drawings received after 3:00 PM Monday through Thursday will be logged in as received the next day of business. Shop drawings received after 3:00 PM on Friday will be logged in as received on the following Monday.

1-6. Submittals will be reviewed **only** for compliance with contract requirements by Architect-Engineer, and action thereon will be taken by Contracting Officer's Representative (COR) on behalf of the Contracting Officer.

1-7. Upon receipt of submittals, **Architect-Engineer will utilize the shop drawing number assigned by the Contractor.** Contractor, in any subsequent correspondence, shall refer to this file and identification number to expedite replies relative to previously approved or disapproved submittals.

1-8. 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.

1-9. 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.

**1-10. Submittals must be submitted by Contractor only as follows:**

**A - Samples shall be shipped prepaid or hand delivered to the Architect / Engineer of record.**

**B - All other shop drawings shall be submitted through the Architects share site. Access to the share site will be provided to the successful bidder. Access to the share site will be provided for the duration of construction as defined by the original schedule. The contractor will be responsible for paying the Architect for use of the site due to construction delays beyond the original schedule.**

A. Submit samples required for scheduled finishes, in quadruplicate. Submit 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 posted on the Architects share site for each item submitted or attached to samples submitted or hand delivered** 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 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 **upload** a copy of transmittal letter to both Contracting Officer’s Representative (COR) and to Architect-Engineer simultaneously **using the Architects share site** with submission of material to a commercial testing laboratory.
5. Laboratory test reports shall be sent directly to Contracting Officer’s Representative (COR) for appropriate action **using the Architects share site**.
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 Contracting Officer’s Representative (COR) 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 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. **The General Contractors review stamp shall be included on each submittal, the stamp shall contain the words "reviewed for accuracy, completeness and compliance with the contract documents". The submittals shall contain the general contractors redline comments.**

1. **All submittals uploaded to the architects share site shall be submitted as PDF's.**
2. 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.
3. 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.
4. **Submit samples, fully protected for shipment or hand delivery.**
5. When work is directly related and involves more than one trade, shop drawings shall be submitted to Architect-Engineer under one cover.

1-11. Samples (except laboratory samples), shop drawings, test reports, certificates and manufacturers' literature and data, shall be submitted for approval to

**Enapay, LLC; 207 West Main, Mesquite, Texas 75149.**
**(Mr. Roger Stephens, AIA)**

1-12. At the time of transmittal to the Architect-Engineer, the Contractor shall also **notify the Contracting Officer's Representative (COR) using the architects share site.**

**1-13 Review times: Submittal response time shall be 21 calendar days.**

**RFI response time shall be 14 calendar days.**

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**SECTION 01 35 26**
**SAFETY REQUIREMENTS**

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**SECTION 01 35 26**
**SAFETY REQUIREMENTS**

**1.1 APPLICABLE PUBLICATIONS:**

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

B. American Society of Safety Engineers (ASSE):

A10.1-2011.....Pre-Project & Pre-Task Safety and Health Planning

A10.34-2012.....Protection of the Public on or Adjacent to Construction Sites

A10.38-2013.....Basic Elements of an Employer's Program to Provide a Safe and Healthful Work Environment American National Standard Construction and Demolition Operations

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

E84-2013.....Surface Burning Characteristics of Building Materials

D. The Facilities Guidelines Institute (FGI):

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

E. National Fire Protection Association (NFPA):

10-2018.....Standard for Portable Fire Extinguishers

30-2018.....Flammable and Combustible Liquids Code

51B-2019.....Standard for Fire Prevention During Welding, Cutting and Other Hot Work

70-2020.....National Electrical Code

70B-2019.....Recommended Practice for Electrical Equipment Maintenance

70E-2018 .....Standard for Electrical Safety in the Workplace

99-2018.....Health Care Facilities Code

241-2019.....Standard for Safeguarding Construction, Alteration, and Demolition Operations

F. The Joint Commission (TJC)

TJC Manual .....Comprehensive Accreditation and Certification Manual

G. U.S. Nuclear Regulatory Commission

10 CFR 20 .....Standards for Protection Against Radiation

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

29 CFR 1910 .....Safety and Health Regulations for General Industry

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

**1.2 DEFINITIONS:**

A. Critical Lift. A lift with the hoisted load exceeding 75% of the crane's maximum capacity; lifts made out of the view of the operator (blind picks); lifts involving two or more cranes; personnel being hoisted; and special hazards such as lifts over occupied facilities, loads lifted close to powerlines, and lifts in high winds or where other adverse environmental conditions exist; and any lift which the crane operator believes is critical.

B. OSHA "Competent Person" (CP). One who is capable of identifying existing and predictable hazards in the surroundings and working conditions which are unsanitary, hazardous, or dangerous to employees, and who has the authorization to take prompt corrective measures to eliminate them (see 29 CFR 1926.32(f)).

C. "Qualified Person" means one who, by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training, and experience, has successfully demonstrated his ability to

solve or resolve problems relating to the subject matter, the work, or the project.

D. High Visibility Accident. Any mishap which may generate publicity or high visibility.

E. Accident/Incident Criticality Categories:

1. No impact - near miss incidents that should be investigated but are not required to be reported to the VA.

2. Minor incident/impact - incidents that require first aid or result in minor equipment damage (less than $5000). These incidents must be investigated but are not required to be reported to the VA.

3. Moderate incident/impact - Any work-related injury or illness that results in:

   a. Days away from work (any time lost after day of injury/illness onset).

   b. Restricted work.

   c. Transfer to another job.

   d. Medical treatment beyond first aid.

   e. Loss of consciousness.

4. A significant injury or illness diagnosed by a physician or other licensed health care professional, even if it did not result in (1) through (5) above or,

5. Any incident that leads to major equipment damage (greater than $5000).

F. These incidents must be investigated and are required to be reported to the VA.

1 Major incident/impact - Any mishap that leads to fatalities, hospitalizations, amputations, and losses of an eye because of contractors' activities. Or any incident which leads to major property damage (greater than $20,000) and/or may generate publicity

or high visibility. These incidents must be investigated and are required to be reported to the VA as soon as practical, but not later than 2 hours after the incident.

G. Medical Treatment. Treatment administered by a physician or by registered professional personnel under the standing orders of a physician. Medical treatment does not include first aid treatment even through provided by physician or registered personnel.

**1.3 REGULATORY REQUIREMENTS:**

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

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

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

B. The APP shall be prepared as follows:

1. Written in English by a qualified person who is employed by the Prime Contractor articulating the specific work and hazards

pertaining to the contract (model language can be found in ASSE A10.33). Specifically articulating the safety requirements found within these VA contract safety specifications.

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

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

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

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

      1) Plan preparer (Qualified Person such as corporate safety staff person or contracted Certified Safety Professional with construction safety experience.

      2) Plan approver (company/corporate officers authorized to obligate the company.

      3) Plan concurrence (e.g., Chief of Operations, Corporate Chief of Safety, Corporate Industrial Hygienist, project manager or superintendent, project safety professional). Provide concurrence of other applicable corporate and project personnel (Contractor).

   b. **BACKGROUND INFORMATION**. List the following:

      1) Contractor.

      2) Contract number.

      3) Project name.

      4) Brief project description, description of work to be performed, and location; phases of work anticipated (these will require an AHA).

   c. **STATEMENT OF SAFETY AND HEALTH POLICY**. Provide a copy of current corporate/company Safety and Health Policy Statement, detailing commitment to providing a safe and healthful workplace for all

employees. The Contractor's written safety program goals, objectives, and accident experience goals for this contract should be provided.

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

1) A statement of the employer's ultimate responsibility for the implementation of his SOH program;

2) Identification and accountability of personnel responsible for safety at both corporate and project level. Contracts specifically requiring safety or industrial hygiene personnel shall include a copy of their resumes.

3) The names of Competent and/or Qualified Person(s) and proof of competency/qualification to meet specific OSHA Competent/Qualified Person(s) requirements must be attached.;

4) Requirements that no work shall be performed unless a designated competent person is present on the job site;

5) Requirements for pre-task Activity Hazard Analysis (AHAs);

6) Lines of authority;

7) Policies and procedures regarding noncompliance with safety requirements (to include disciplinary actions for violation of safety requirements) should be identified;

**e. SUBCONTRACTORS AND SUPPLIERS.** If applicable, provide procedures for coordinating SOH activities with other employers on the job site:

1) Identification of subcontractors and suppliers (if known);

2) Safety responsibilities of subcontractors and suppliers.

f. **TRAINING.**

1) Site-specific SOH orientation training at the time of initial hire or assignment to the project for every employee before working on the project site is required.

2) Mandatory training and certifications that are applicable to this project (e.g., explosive actuated tools, crane operator, rigger, crane signal person, fall protection, electrical lockout/NFPA 70E, machine/equipment lockout, confined space, etc…) and any requirements for periodic retraining/recertification are required.

3) Procedures for ongoing safety and health training for supervisors and employees shall be established to address changes in site hazards/conditions.

4) OSHA 10-hour training is required for all workers on site and the OSHA 30-hour training is required for Trade Competent Persons (CPs)

**g. SAFETY AND HEALTH INSPECTIONS.**

1) Specific assignment of responsibilities for a minimum daily job site safety and health inspection during periods of work activity: Who will conduct (e.g., "Site Safety and Health CP"), proof of inspector's training/qualifications, when inspections will be conducted, procedures for documentation, deficiency tracking system, and follow-up procedures.

2) Any external inspections/certifications that may be required (e.g., contracted CSP or CSHT)

**h. ACCIDENT/INCIDENT INVESTIGATION & REPORTING.** The Contractor shall conduct mishap investigations of all Moderate and Major as well as all High Visibility Incidents. The APP shall include accident/incident investigation procedure and identify person(s) responsible to provide the following to the Contracting Officer Representative or Government Designated Authority:

1) Exposure data (man-hours worked);

2) Accident investigation reports;

3) Project site injury and illness logs.

i. **PLANS (PROGRAMS, PROCEDURES) REQUIRED.** Based on a risk assessment of contracted activities and on mandatory OSHA compliance programs, the Contractor shall address all applicable occupational, patient, and public safety risks in site-specific compliance and accident prevention plans. These Plans shall include but are not be limited to procedures for addressing the risks associates with the following:

1) Emergency response;

2) Contingency for severe weather;

3) Fire Prevention;

4) Medical Support;

5) Posting of emergency telephone numbers;

6) Prevention of alcohol and drug abuse;

7) Site sanitation(housekeeping, drinking water, toilets);

8) Night operations and lighting;

9) Hazard communication program;

10) Welding/Cutting "Hot" work;

11) Electrical Safe Work Practices (Electrical LOTO/NFPA 70E);

12) General Electrical Safety;

13) Hazardous energy control (Machine LOTO);

14) Site-Specific Fall Protection & Prevention;

15) Excavation/trenching;

16) Asbestos abatement;

17) Lead abatement;

18) Crane Critical lift;

19) Respiratory protection;

20) Health hazard control program;

21) Radiation Safety Program;

22) Abrasive blasting;

23) Heat/Cold Stress Monitoring;

24) Crystalline Silica Monitoring (Assessment);

25) Demolition plan (to include engineering survey);

26) Formwork and shoring erection and removal;

27) Precast Concrete;

28) Public (Mandatory compliance with ANSI/ASSE A10.34-2012).

C. Submit the APP to the Contracting Officer Representative or Government Designated Authority for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES 15 calendar days prior to the date of the preconstruction conference for acceptance. Work cannot proceed without an accepted APP.

D. Once accepted by the Contracting Officer Representative or Government Designated Authority, the APP and attachments will be enforced as part of the contract. Disregarding the provisions of this contract or the accepted APP will be cause for stopping of work, at the discretion of the Contracting Officer in accordance with FAR Clause 52.236-13, *Accident Prevention*, until the matter has been rectified.

E. Once work begins, changes to the accepted APP shall be made with the knowledge and concurrence of the Contracting Officer Representative or Government Designated Authority. Should any severe hazard exposure, i.e., imminent danger, become evident, stop work in the area, secure the area, and develop a plan to remove the exposure and control the hazard. Notify the Contracting Officer within 24 hours of discovery. Eliminate/remove the hazard. In the interim, take all necessary action to restore and maintain safe working conditions to safeguard onsite personnel, visitors, the public and the environment.

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

A. AHAs are also known as Job Hazard Analyses, Job Safety Analyses, and Activity Safety Analyses. Before beginning each work activity involving a type of work presenting hazards not experienced in previous project operations or where a new work crew or sub-contractor is to perform the work, the Contractor(s) performing that work activity shall prepare an AHA (Example electronic AHA forms can be found on the US Army Corps of Engineers web site)

B. AHAs shall define the activities being performed and identify the work sequences, the specific anticipated hazards, site conditions, equipment, materials, and the control measures to be implemented to eliminate or reduce each hazard to an acceptable level of risk.

C. Work shall not begin until the AHA for the work activity has been accepted by the Contracting Officer Representative or Government Designated Authority and discussed with all engaged in the activity, including the Contractor, subcontractor(s), and Government on-site representatives at preparatory and initial control phase meetings.

1. The names of the Competent/Qualified Person(s) required for a particular activity (for example, excavations, scaffolding, fall protection, other activities as specified by OSHA and/or other State and Local agencies) shall be identified and included in the AHA. Certification of their competency/qualification shall be submitted to the Government Designated Authority (GDA) for acceptance prior to the start of that work activity.

2. The AHA shall be reviewed and modified as necessary to address changing site conditions, operations, or change of competent/qualified person(s).

a. If more than one Competent/Qualified Person is used on the AHA activity, a list of names shall be submitted as an attachment to the AHA. Those listed must be Competent/Qualified for the type of work involved in the AHA and familiar with current site safety issues.

b. If a new Competent/Qualified Person (not on the original list) is added, the list shall be updated (an administrative action not requiring an updated AHA). The new person shall acknowledge in writing that he or she has reviewed the AHA and is familiar with current site safety issues.

3. Submit AHAs to the Contracting Officer Representative or Government Designated Authority for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES for review at least 15 calendar days prior to the start of each phase. Subsequent AHAs as shall be formatted as amendments to the APP. The analysis should be used during daily inspections to ensure the implementation and effectiveness of the activity's safety and health controls.

4. The AHA list will be reviewed periodically (at least monthly) at the Contractor supervisory safety meeting and updated as necessary when procedures, scheduling, or hazards change.

5. Develop the activity hazard analyses using the project schedule as the basis for the activities performed. All activities listed on the project schedule will require an AHA. The AHAs will be developed by the contractor, supplier, or subcontractor and provided to the prime contractor for review and approval and then submitted to the Contracting Officer Representative or Government Designated Authority.

**1.6 PRECONSTRUCTION CONFERENCE:**

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

B. Discuss the details of the submitted APP to include incorporated plans, programs, procedures, and a listing of anticipated AHAs that will be developed and implemented during the performance of the contract. This list of proposed AHAs will be reviewed at the conference and an agreement will be reached between the Contractor and the Contracting Officer's representative as to which phases will require an analysis. In addition, establish a schedule for the preparation, submittal, review, and acceptance of AHAs to preclude project delays.

C. Deficiencies in the submitted APP will be brought to the attention of the Contractor within 14 days of submittal, and the Contractor shall revise the plan to correct deficiencies and re-submit it for acceptance. Do not begin work until there is an accepted APP.

**1.7 "SITE SAFETY AND HEALTH OFFICER" (SSHO) AND "COMPETENT PERSON" (CP):**

A. The Prime Contractor shall designate a minimum of one SSHO at each project site that will be identified as the SSHO to administer the Contractor's safety program and government-accepted Accident Prevention Plan. Each subcontractor shall designate a minimum of one CP in compliance with 29 CFR 1926.20 (b)(2) that will be identified as a CP to administer their individual safety programs.

B. Further, all specialized Competent Persons for the work crews will be supplied by the respective contractor as required by 29 CFR 1926 (i.e. Asbestos, Electrical, Cranes, & Derricks, Demolition, Fall Protection, Fire Safety/Life Safety, Ladder, Rigging, Scaffolds, and Trenches/Excavations).

C. These Competent Persons can have collateral duties as the subcontractor's superintendent and/or work crew lead persons as well as fill more than one specialized CP role (i.e. Asbestos, Electrical, Cranes, & Derricks, Demolition, Fall Protection, Fire Safety/Life Safety, Ladder, Rigging, Scaffolds, and Trenches/Excavations). Verify with the COR if the SSHO has be a separate qualified individual from the Prime Contractor's Superintendent and/or Quality Control Manager with duties only as the SSHO.

D. The SSHO or an equally qualified Designated Representative/alternate will maintain a presence on the site during construction operations in

accordance with FAR Clause 52.236-6: *Superintendence by the Contractor*. CPs will maintain presence during their construction activities in accordance with above mentioned clause. A listing of the designated SSHO and all known CPs shall be submitted prior to the start of work as part of the APP with the training documentation and/or AHA as listed in Section 1.8 below.

E. The repeated presence of uncontrolled hazards during a contractor's work operations will result in the designated CP as being deemed incompetent and result in the required removal of the employee in accordance with FAR Clause 52.236-5: Material and Workmanship, Paragraph (c).

**1.8 TRAINING:**

A. The designated Prime Contractor SSHO must meet the requirements of all applicable OSHA standards and be capable (through training, experience, and qualifications) of ensuring that the requirements of 29 CFR 1926.16 and other appropriate Federal, State, and local requirements are met for the project. As a minimum the SSHO must have completed the OSHA 30-hour Construction Safety class and have five (5) years of construction industry safety experience or three (3) years if he/she possesses a Certified Safety Professional (CSP) or certified Construction Safety and Health Technician (CSHT) certification or have a safety and health degree from an accredited university or college.

B. All designated CPs shall have completed the OSHA 30-hour Construction Safety course within the past 5 years.

C. In addition to the OSHA 30 Hour Construction Safety Course, all CPs with high hazard work operations such as operations involving asbestos, electrical, cranes, demolition, work at heights/fall protection, fire safety/life safety, ladder, rigging, scaffolds, and trenches/excavations shall have a specialized formal course in the hazard recognition & control associated with those high hazard work operations. Documented "repeat" deficiencies in the execution of safety requirements will require retaking the requisite formal course.

D. All other construction workers shall have the OSHA 10-hour Construction Safety Outreach course and any necessary safety training to be able to identify hazards within their work environment.

E. Submit training records associated with the above training requirements to the Contracting Officer Representative or Government Designated Authority for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES 15 calendar days prior to the date of the preconstruction conference for acceptance.

F. Prior to any worker for the contractor or subcontractors beginning work, they shall undergo a safety briefing provided by the SSHO or his/her designated representative. As a minimum, this briefing shall include information on the site-specific hazards, construction limits, VAMC safety guidelines, means of egress, break areas, work hours, locations of restrooms, use of VAMC equipment, emergency procedures, accident reporting etc... Documentation shall be provided to the Contracting Officer Representative that individuals have undergone contractor's safety briefing.

G. Ongoing safety training will be accomplished in the form of weekly documented safety meeting.

**1.9 INSPECTIONS:**

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

B. A Certified Safety Professional (CSP) with specialized knowledge in construction safety or a certified Construction Safety and Health Technician (CSHT) shall randomly conduct a monthly site safety inspection. The CSP or CSHT can be a corporate safety professional or

independently contracted. The CSP or CSHT will provide their certificate number on the required report for verification as necessary.

1. Results of the inspection will be documented with tracking of the identified hazards to abatement.

2. The Contracting Officer Representative or Government Designated Authority will be notified immediately prior to start of the inspection and invited to accompany the inspection.

3. Identified hazard and controls will be discussed to come to a mutual understanding to ensure abatement and prevent future reoccurrence.

4. A report of the inspection findings with status of abatement will be provided to the Contracting Officer Representative or Government Designated Authority within one week of the onsite inspection.

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

A. The prime contractor shall establish and maintain an accident reporting, recordkeeping, and analysis system to track and analyze all injuries and illnesses, high visibility incidents, and accidental property damage (both government and contractor) that occur on site. Notify the Contracting Officer Representative or Government Designated Authority as soon as practical, but no more than four hours after any accident meeting the definition of a Moderate or Major incidents, High Visibility Incidents, , or any weight handling and hoisting equipment accident. Within notification include contractor name; contract title; type of contract; name of activity, installation, or location where accident occurred; date and time of accident; names of personnel injured; extent of property damage, if any; extent of injury, if known, and brief description of accident (to include type of construction equipment used, PPE used, etc.). Preserve the conditions and evidence on the accident site until the Contracting Officer Representative or Government Designated Authority determine whether a government investigation will be conducted.

B. Conduct an accident investigation for all Minor, Moderate and Major incidents as defined in paragraph DEFINITIONS, and property damage

accidents resulting in at least $20,000 in damages, to establish the root cause(s) of the accident. Complete the VA Form 2162 (or equivalent) and provide the report to the Contracting Officer Representative or Government Designated Authority within 5 calendar days of the accident. The Contracting Officer Representative or Government Designated Authority will provide copies of any required or special forms.

C. A summation of all man-hours worked by the contractor and associated sub-contractors for each month will be reported to the Contracting Officer Representative or Government Designated Authority monthly.

D. A summation of all Minor, Moderate, and Major incidents experienced on site by the contractor and associated sub-contractors for each month will be provided to the Contracting Officer Representative or Government Designated Authority monthly. The contractor and associated sub-contractors' OSHA 300 logs will be made available to the Contracting Officer Representative or Government Designated Authority as requested.

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

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

B. Mandatory PPE includes:

1. Hard Hats - unless written authorization is given by the Contracting Officer Representative or Government Designated Authority in circumstances of work operations that have limited potential for falling object hazards such as during finishing work or minor remodeling. With authorization to relax the requirement of hard hats, if a worker becomes exposed to an overhead falling object hazard, then hard hats would be required in accordance with the OSHA regulations.

2. Safety glasses - unless written authorization is given by the Contracting Officer Representative or Government Designated

Authority in circumstances of no eye hazards, appropriate safety glasses meeting the ANSI Z.87.1 standard must be worn by each person on site.

3. Appropriate Safety Shoes - based on the hazards present, safety shoes meeting the requirements of ASTM F2413-11 shall be worn by each person on site unless written authorization is given by the Contracting Officer Representative or Government Designated Authority in circumstances of no foot hazards.

4. Hearing protection - Use personal hearing protection at all times in designated noise hazardous areas or when performing noise hazardous tasks.

**1.12 INFECTION CONTROL**

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

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

1. Class I requirements:

   a. During Construction Work:

      1) Notify the Contracting Officer Representative or Government Designated Authority

      2) Execute work by methods to minimize raising dust from construction operations.

      3) Ceiling tiles: Immediately replace a ceiling tile displaced for visual inspection.

   b. Upon Completion:

      1) Clean work area upon completion of task

      2) Notify the Contracting Officer Representative or Government Designated Authority

2. Class II requirements:

   a. During Construction Work:

      1) Notify the Contracting Officer Representative or Government Designated Authority

      2) Provide active means to prevent airborne dust from dispersing into atmosphere such as wet methods or tool mounted dust collectors where possible.

      3) Water mist work surfaces to control dust while cutting.

      4) Seal unused doors with duct tape.

      5) Block off and seal air vents.

      6) Remove or isolate HVAC system in areas where work is being performed.

   b. Upon Completion:

1) Wipe work surfaces with cleaner/disinfectant.

2) Contain construction waste before transport in tightly covered containers.

3) Wet mop and/or vacuum with HEPA filtered vacuum before leaving work area.

4) Upon completion, restore HVAC system where work was performed

5) Notify the Contracting Officer Representative or Government Designated Authority

3. Class III requirements:

a. During Construction Work:

1) Obtain permit from the Contracting Officer Representative or Government Designated Authority

2) Remove or Isolate HVAC system in area where work is being done to prevent contamination of duct system.

3) Complete all critical barriers i.e., sheetrock, plywood, plastic, to seal area from non-work area or implement control cube method (cart with plastic covering and sealed connection to work site with HEPA vacuum for vacuuming prior to exit) before construction begins. Install construction barriers and ceiling protection carefully, outside of normal work hours.

4) Maintain negative air pressure, 0.01 inches of water gauge, within work site utilizing HEPA equipped air filtration units and continuously monitored with a digital display, recording and alarm instrument, which must be calibrated on installation, maintained with periodic calibration, and monitored by the contractor.

5) Contain construction waste before transport in tightly covered containers.

6) Cover transport receptacles or carts. Tape covering unless solid lid.

b. Upon Completion:

1) Do not remove barriers from work area until completed project is inspected by the Contracting Officer Representative or Government Designated Authority and thoroughly cleaned by the VA Environmental Services Department.

2) Remove construction barriers and ceiling protection carefully to minimize spreading of dirt and debris associated with construction, outside of normal work hours.

3) Vacuum work area with HEPA filtered vacuums.

4) Wet mop area with cleaner/disinfectant.

5) Upon completion, restore HVAC system where work was performed.

6) Return permit to the Contracting Officer Representative or Government Designated Authority

4. Class IV requirements:

a. During Construction Work:

1) Obtain permit from the Contracting Officer Representative or Government Designated Authority

2) Isolate HVAC system in area where work is being done to prevent contamination of duct system.

3) Complete all critical barriers i.e., sheetrock, plywood, plastic, to seal area from non-work area or implement control cube method (cart with plastic covering and sealed connection to work site with HEPA vacuum for vacuuming prior to exit) before construction begins. Install construction barriers and ceiling protection carefully, outside of normal work hours.

4) Maintain negative air pressure, 0.01 inches of water gauge, within work site utilizing HEPA equipped air filtration units and continuously monitored with a digital display, recording and alarm instrument, which must be calibrated on

installation, maintained with periodic calibration, and monitored by the contractor.

5) Seal holes, pipes, conduits, and punctures.

6) Construct anteroom and require all personnel to pass through this room so they can be vacuumed using a HEPA vacuum cleaner before leaving work site or they can wear cloth or paper coveralls that are removed each time they leave work site.

7) All personnel entering work site are required to wear shoe covers. Shoe covers must be changed each time the worker exits the work area.

b. Upon Completion:

1) Do not remove barriers from work area until completed project is inspected by the Contracting Officer Representative or Government Designated Authority with thorough cleaning by the VA Environmental Services Dept.

2) Remove construction barriers and ceiling protection carefully to minimize spreading of dirt and debris associated with construction, outside of normal work hours.

3) Contain construction waste before transport in tightly covered containers.

4) Cover transport receptacles or carts. Tape covering unless solid lid.

5) Vacuum work area with HEPA filtered vacuums.

6) Wet mop area with cleaner/disinfectant.

7) Upon completion, restore HVAC system where work was performed.

8) Return permit to the Contracting Officer Representative or Government Designated Authority

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

1. Class III and IV - closed door with masking tape applied over the frame and door is acceptable for projects that can be contained in a single room.

2. Construction, demolition, or reconstruction not capable of containment within a single room must have the following barriers erected and made presentable on hospital occupied side:

   a. Class III & IV (where dust control is the only hazard, and an agreement is reached with the Resident Engineer and Medical Center) - Airtight plastic barrier that extends from the floor to ceiling. Seams must be sealed with duct tape to prevent dust and debris from escaping

   b. Class III & IV - Drywall barrier erected with joints covered or sealed to prevent dust and debris from escaping.

   c. Class III & IV - Seal all penetrations in existing barrier airtight

   d. Class III & IV - Barriers at penetration of ceiling envelopes, chases, and ceiling spaces to stop movement air and debris

   e. Class IV only - Anteroom or double entrance openings that allow workers to remove protective clothing or vacuum off existing clothing

   f. Class III & IV - At elevators shafts or stairways within the field of construction, overlapping flap minimum of two feet wide of polyethylene enclosures for personnel access.

D. Products and Materials:

1. Sheet Plastic: Fire retardant polyethylene, 6-mil thickness meeting local fire codes

2. Barrier Doors: Self Closing One-hour fire-rated solid core wood in steel frame, painted

3. Dust proof one-hour fire-rated drywall

4. High Efficiency Particulate Air-Equipped filtration machine rated at 95% capture of 0.3 microns including pollen, mold spores and dust particles. HEPA filters should have ASHRAE 85 or other prefilter to extend the useful life of the HEPA. Provide both primary and secondary filtrations units. Maintenance of equipment and replacement of the HEPA filters and other filters will be in accordance with manufacturer's instructions.

5. Exhaust Hoses: Heavy duty, flexible steel reinforced; Ventilation Blower Hose

6. Adhesive Walk-off Mats: Provide minimum size mats of 24 inches x 36 inches

7. Disinfectant: Hospital-approved disinfectant or equivalent product

8. Portable Ceiling Access Module

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

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

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

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

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

2. Exhaust hoses shall be exhausted so that dust is not reintroduced to the medical center.

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

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

5. The contractor shall not haul debris through patient-care areas without prior approval of the 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.

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

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

I. Final Cleanup:

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

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

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

J. Exterior Construction

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

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

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

**1.13 TUBERCULOSIS SCREENING**

A. Contractor shall provide written certification that all contract employees assigned to the work site have had a pre-placement tuberculin screening within 90 days prior to assignment to the worksite and been found have negative TB screening reactions. Contractors shall be required to show documentation of negative TB screening reactions for any additional workers who are added after the 90-day requirement before they will be allowed to work on the work site. NOTE: This can be the Center for Disease Control (CDC) and Prevention and two-step skin testing or a Food and Drug Administration (FDA)-approved blood test.

1. Contract employees manifesting positive screening reactions to the tuberculin shall be examined according to current CDC guidelines prior to working on VHA property.

2. Subsequently, if the employee is found without evidence of active (infectious) pulmonary TB, a statement documenting examination by a physician shall be on file with the employer (construction contractor), noting that the employee with a positive tuberculin screening test is without evidence of active (infectious) pulmonary TB.

3. If the employee is found with evidence of active (infectious) pulmonary TB, the employee shall require treatment with a subsequent statement to the fact on file with the employer before being allowed to return to work on VHA property.

**1.14 FIRE SAFETY**

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

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

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

D. Temporary Construction Partitions:

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 one-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.

E. Temporary Heating and Electrical: Install, use and maintain installations in accordance with 29 CFR 1926, NFPA 241 and NFPA 70.

F. Means of Egress: Do not block exiting for occupied buildings, including paths from exits to roads. Minimize disruptions and coordinate with Contracting Officer Representative or Government Designated Authority.

G. Egress Routes for Construction Workers: Maintain free and unobstructed egress. Inspect daily. Report findings and corrective actions weekly to Contracting Officer Representative or Government Designated Authority.

H. Fire Extinguishers: Provide and maintain extinguishers in construction areas and temporary storage areas in accordance with 29 CFR 1926, NFPA 241 and NFPA 10.

I. Flammable and Combustible Liquids: Store, dispense and use liquids in accordance with 29 CFR 1926, NFPA 241 and NFPA 30.

J. Not used.

K. Not used.

L. Existing Fire Protection: Do not impair automatic sprinklers, smoke and heat detection, and fire alarm systems, except for portions immediately under construction, and temporarily for connections. Provide fire watch for impairments more than 4 hours in a 24-hour period. Request interruptions in accordance with Article, OPERATIONS AND STORAGE AREAS, and coordinate with Contracting Officer Representative or Government Designated Authority. 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 Contracting Officer Representative or Government Designated Authority.

N. Hot Work: Perform and safeguard hot work operations in accordance with NFPA 241 and NFPA 51B. Coordinate with COR. Obtain permits from facility Safety Manager at least 72 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 Contracting Officer Representative or Government Designated Authority.

P. Smoking: Smoking is prohibited in and adjacent to construction areas inside existing buildings and additions under construction. In separate and detached buildings under construction, smoking is prohibited except in designated smoking rest areas.

Q. Dispose of waste and debris in accordance with NFPA 241. Remove from buildings daily.

R. If required, submit documentation to the COR or other Government Designated Authority that personnel have been trained in the fire safety aspects of working in areas with impaired structural or compartmentalization features.

**1.15 ELECTRICAL**

A. All electrical work shall comply with NFPA 70 (NEC), NFPA 70B, NFPA 70E, 29 CFR Part 1910 Subpart J - General Environmental Controls, 29 CFR Part 1910 Subpart S - Electrical, and 29 CFR 1926 Subpart K in addition to other references required by contract.

B. All qualified persons performing electrical work under this contract shall be licensed journeyman or master electricians. All apprentice electricians performing under this contract shall be deemed unqualified persons unless they are working under the immediate supervision of a licensed electrician or master electrician.

C. All electrical work will be accomplished de-energized and in the Electrically Safe Work Condition (refer to NFPA 70E for Work Involving Electrical Hazards, including Exemptions to Work Permit). Any Contractor, subcontractor or temporary worker who fails to fully comply with this requirement is subject to immediate termination in accordance with FAR clause 52.236-5(c). Only in rare circumstance where achieving an electrically safe work condition prior to beginning work would increase or cause additional hazards or is infeasible due to equipment design or operational limitations is energized work permitted. The Contracting Officer Representative or Government Designated Authority with approval of the Medical Center Director will make the determination if the circumstances would meet the exception outlined above. An AHA and permit specific to energized work activities will be developed, reviewed, and accepted by the VA prior to the start of that activity.

1. Development of a Hazardous Electrical Energy Control Procedure is required prior to de-energization. A single Simple Lockout/Tagout Procedure for multiple work operations can only be used for work involving qualified person(s) de-energizing one set of conductors or circuit part source. Task specific Complex Lockout/Tagout Procedures are required at all other times.

2. Verification of the absence of voltage after de-energization and lockout/tagout is considered "energized electrical work" (live work) under NFPA 70E, and shall only be performed by qualified persons

wearing appropriate shock protective (voltage rated) gloves and arc rate personal protective clothing and equipment, using Underwriters Laboratories (UL) tested and appropriately rated contact electrical testing instruments or equipment appropriate for the environment in which they will be used.

3. Personal Protective Equipment (PPE) and electrical testing instruments will be readily available for inspection by the Contracting Officer Representative or Government Designated Authority.

D. Before beginning any electrical work, an Activity Hazard Analysis (AHA) will be conducted to include Shock Hazard and Arc Flash Hazard analyses (NFPA Tables can be used only as a last alterative and it is strongly suggested a full Arc Flash Hazard Analyses be conducted). Work shall not begin until the AHA for the work activity and permit for energized work has been reviewed and accepted by the Contracting Officer Representative or Government Designated Authority and discussed with all engaged in the activity, including the Contractor, subcontractor(s), and Government on-site representatives at preparatory and initial control phase meetings.

E. Ground-fault circuit interrupters. GFCI protection shall be provided where an employee is operating or using cord- and plug-connected tools related to construction activity supplied by 125-volt, 15-, 20-, or 30-ampere circuits. Where employees operate or use equipment supplied by greater than 125-volt, 15-, 20-, or 30- ampere circuits, GFCI protection or an assured equipment grounding conductor program shall be implemented in accordance with NFPA 70E - 2015, Chapter 1, Article 110.4(C)(2).

**1.16 FALL PROTECTION**

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

1. The use of a Safety Monitoring System (SMS) as a fall protection method is prohibited.

2. The use of Controlled Access Zone (CAZ) as a fall protection method is prohibited.

3. A Warning Line System (WLS) may ONLY be used on floors or flat or low-sloped roofs (between 0 - 18.4 degrees or 4:12 slope) and shall be erected around all sides of the work area (See 29 CFR 1926.502(f) for construction of WLS requirements). Working within the WLS does not require FP. No worker shall be allowed in the area between the roof or floor edge and the WLS without FP. FP is required when working outside the WLS.

4. Fall protection while using a ladder will be governed by the OSHA requirements.

**1.17 SCAFFOLDS AND OTHER WORK PLATFORMS**

A. All scaffolds and other work platforms construction activities shall comply with 29 CFR 1926 Subpart L.

B. The fall protection (FP) threshold height requirement is 6 ft (1.8 m) as stated in Section 1.16.

C. The following hierarchy and prohibitions shall be followed in selecting appropriate work platforms.

1. Scaffolds, platforms, or temporary floors shall be provided for all work except that can be performed safely from the ground or similar footing.

2. Ladders less than 20 feet may be used as work platforms only when use of small hand tools or handling of light material is involved.

3. Ladder jacks, lean-to, and prop-scaffolds are prohibited.

4. Emergency descent devices shall not be used as working platforms.

D. Contractors shall use a scaffold tagging system in which all scaffolds are tagged by the Competent Person. Tags shall be color-coded: green indicates the scaffold has been inspected and is safe to use; red indicates the scaffold is unsafe to use. Tags shall be readily visible,

made of materials that will withstand the environment in which they are used, be legible and shall include:

1. The Competent Person's name and signature;

2. Dates of initial and last inspections.

E. Mast Climbing work platforms: When access ladders, including masts designed as ladders, exceed 20 ft (6 m) in height, positive fall protection shall be used.

**1.18 EXCAVATION AND TRENCHES**

A. All excavation and trenching work shall comply with 29 CFR 1926 Subpart P. Excavations less than 5 feet in depth require evaluation by the contractor's "Competent Person" (CP) for determination of the necessity of an excavation protective system where kneeing, laying in, or stooping within the excavation is required.

B. All excavations and trenches 24 inches in depth or greater shall require a written trenching and excavation permit (NOTE - some States and other local jurisdictions require separate state/jurisdiction-issued excavation permits). The permit shall have two sections, one section will be completed prior to digging or drilling and the other will be completed prior to personnel entering the excavations greater than 5 feet in depth. Each section of the permit shall be provided to the Resident Engineer and/or Facility Safety Manager and/or other Government Designated Authority prior to proceeding with digging or drilling and prior to proceeding with entering the excavation. After completion of the work and prior to opening a new section of an excavation, the permit shall be closed out and provided to the Resident Engineer, Facility Safety Manager and/or other Government Designated Authority. The permit shall be maintained onsite, and the first section of the permit shall include the following:

1. Estimated start time & stop time2. Specific location and nature of the work.

2. Indication of the contractor's "Competent Person" (CP) in excavation safety with qualifications and signature. Formal course in excavation safety is required by the contractor's CP.

3. Indication of whether soil or concrete removal to an offsite location is necessary.

4. Indication of whether soil samples are required to determined soil contamination.

5. Indication of coordination with local authority (i.e. "One Call") or contractor's effort to determine utility location with search and survey equipment.

6. Indication of review of site drawings for proximity of utilities to digging/drilling.

C. The second section of the permit for excavations greater than five feet in depth shall include the following:

1. Determination of OSHA classification of soil. Soil samples will be from freshly dug soil with samples taken from different soil type layers as necessary and placed at a safe distance from the excavation by the excavating equipment. A pocket penetrometer will be utilized in determination of the unconfined compression strength of the soil for comparison against OSHA table (Less than 0.5 Tons/FT2 - Type C, 0.5 Tons/FT2 to 1.5 Tons/FT2 - Type B, greater than 1.5 Tons/FT2 - Type A without condition to reduce to Type B).

2. Indication of selected protective system (sloping/benching, shoring, shielding). When soil classification is identified as "Type A" or "Solid Rock", only shoring or shielding or Professional Engineer designed systems can be used for protection. A Sloping/Benching system may only be used when classifying the soil as Type B or Type C. Refer to Appendix B of 29 CFR 1926, Subpart P for further information on protective systems designs.

3. Indication of the spoil pile being stored at least 2 feet from the edge of the excavation and safe access being provided within 25 feet of the workers.

4. Indication of assessment for a potential toxic, explosive, or oxygen deficient atmosphere where oxygen deficiency (atmospheres containing less than 19.5 percent oxygen) or a hazardous atmosphere exists or

could reasonably be expected to exist. Internal combustion engine equipment is not allowed in an excavation without providing force air ventilation to lower the concentration to below OSHA PELs, providing sufficient oxygen levels, and atmospheric testing as necessary to ensure safe levels are maintained.

D As required by OSHA 29 CFR 1926.651(b)(1), the estimated location of utility installations, such as sewer, telephone, fuel, electric, water lines, or any other underground installations that reasonably may be expected to be encountered during excavation work, shall be determined prior to opening an excavation.

1. The planned dig site will be outlined/marked in white prior to locating the utilities.

2. Used of the American Public Works Association Uniform Color Code is required for the marking of the proposed excavation and located utilities.

3. 811 will be called two business days before digging on all local or State lands and public Right-of Ways.

4. Digging will not commence until all known utilities are marked.

5. Utility markings will be maintained

E. Excavations will be hand dug or excavated by other similar safe and acceptable means as excavation operations approach within 3 to 5 feet of identified underground utilities. Exploratory bar or other detection equipment will be utilized as necessary to further identify the location of underground utilities.

F. Excavations greater than 20 feet in depth require a Professional Engineer designed excavation protective system.

**1.19 CRANES**

A. All crane work shall comply with 29 CFR 1926 Subpart CC.

B. Prior to operating a crane, the operator must be licensed, qualified, or certified to operate the crane. Thus, all the provisions contained with Subpart CC are effective and there is no “Phase In” date.

C. A detailed lift plan for all lifts shall be submitted to the Resident Engineer and/or Facility Safety Manager and/or other Government Designated Authority 14 days prior to the scheduled lift complete with route for truck carrying load, crane load analysis, siting of crane and path of swing and all other elements of a critical lift plan where the lift meets the definition of a critical lift. Critical lifts require a more comprehensive lift plan to minimize the potential of crane failure and/or catastrophic loss. The plan must be reviewed and accepted by the General Contractor before being submitted to the VA for review. The lift will not be allowed to proceed without prior acceptance of this document.

D. Crane operators shall not carry loads

1. over the general public or VAMC personnel

2. over any occupied building unless

a. the top two floors are vacated

b. or overhead protection with a design live load of 300 psf is provided

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

A. All installation, maintenance, and servicing of equipment or machinery shall comply with 29 CFR 1910.147 except for specifically referenced operations in 29 CFR 1926 such as concrete & masonry equipment [1926.702(j)], heavy machinery & equipment [1926.600(a)(3)(i)], and process safety management of highly hazardous chemicals (1926.64). Control of hazardous electrical energy during the installation, maintenance, or servicing of electrical equipment shall comply with Section 1.15 to include NFPA 70E and other VA specific requirements discussed in the section.

**1.21 CONFINED SPACE ENTRY**

A. All confined space entry shall comply with 29 CFR 1926, Subpart AA except for specifically referenced operations in 29 CFR 1926 such as excavations/trenches [1926.651(g)].

B. A site-specific Confined Space Entry Plan (including permitting process) shall be developed and submitted to the Resident Engineer and/or Facility Safety Manager and/or other Government Designated Authority.

**1.22 WELDING AND CUTTING**

As specified in section 1.14, Hot Work: Perform and safeguard hot work operations in accordance with NFPA 241 and NFPA 51B. Coordinate with Resident Engineer and/or Facility Safety and/or other Government Designated Authority. Obtain permits from Resident and/or Facility Safety Manager and/or other Government Designated Authority at least 72 hours in advance. Designate contractor's responsible project-site fire prevention program manager to permit hot work.

**1.23 LADDERS**

A. All Ladder use shall comply with 29 CFR 1926 Subpart X.

B. All portable ladders shall be of sufficient length and shall be placed so that workers will not stretch or assume a hazardous position.

C. Manufacturer safety labels shall be in place on ladders

D. Step Ladders shall not be used in the closed position

E. Top steps or cap of step ladders shall not be used as a step

F. Portable ladders, used as temporary access, shall extend at least 3 ft (0.9 m) above the upper landing surface.

1. When a 3 ft (0.9-m) extension is not possible, a grasping device (such as a grab rail) shall be provided to assist workers in mounting and dismounting the ladder.

2. In no case shall the length of the ladder be such that ladder deflection under a load would, by itself, cause the ladder to slip from its support.

G. Ladders shall be inspected for visible defects daily and after any occurrence that could affect their safe use. Broken or damaged ladders shall be immediately tagged "DO NOT USE," or with similar wording, and

withdrawn from service until restored to a condition meeting their original design.

**1.24 FLOOR & WALL OPENINGS**

A. All floor and wall openings shall comply with 29 CFR 1926 Subpart M.

B. Floor and roof holes/openings are any that measure over 2 in (51 mm) in any direction of a walking/working surface which persons may trip or fall into or where objects may fall to the level below. Skylights located in floors or roofs are considered floor or roof hole/openings.

C. All floor, roof openings or hole into which a person can accidentally walk or fall through shall be guarded either by a railing system with toe boards along all exposed sides or a load-bearing cover. When the cover is not in place, the opening or hole shall be protected by a removable guardrail system or shall be attended when the guarding system has been removed, or other fall protection system.

1. Covers shall be capable of supporting, without failure, at least twice the weight of the worker, equipment and material combined.

2. Covers shall be secured when installed, clearly marked with the word "HOLE", "COVER" or "Danger, Roof Opening-Do Not Remove" or color-coded or equivalent methods (e.g., red or orange "X"). Workers must be made aware of the meaning for color coding and equivalent methods.

3. Roofing material, such as roofing membrane, insulation, or felts, covering or partly covering openings or holes, shall be immediately cut out. No hole or opening shall be left unattended unless covered.

4. Non-load-bearing skylights shall be guarded by a load-bearing skylight screen, cover, or railing system along all exposed sides.

5. Workers are prohibited from standing/walking on skylights.

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# SECTION 01 42 19
# REFERENCE STANDARDS

## PART 1 - GENERAL

### 1.1 DESCRIPTION

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

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

A. The GSA Index of Federal Specifications, Standards and Commercial Item Descriptions, FPMR Part 101-29 and copies of specifications, standards, and commercial item descriptions cited in the solicitation may be obtained for a fee by submitting a request to - GSA Federal Supply Service, Specifications Section, Suite 8100, 470 East L'Enfant Plaza, SW, Washington, DC 20407, Telephone (202) 619-8925, Facsimile (202) 619-8978.

B. If the General Services Administration, Department of Agriculture, or Department of Veterans Affairs issued this solicitation, a single copy of specifications, standards, and commercial item descriptions cited in this solicitation may be obtained free of charge by submitting a request to the addressee in paragraph (a) of this provision. Additional copies will be issued for a fee.

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

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

DEPARMENT 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.

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

AABC Associated Air Balance Council
http://www.aabchq.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

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| AISC | American Institute of Steel Construction<br>http://www.aisc.org |
| AISI | American Iron and Steel Institute<br>http://www.steel.org |
| AITC | American Institute of Timber Construction<br>http://www.aitc-glulam.org |
| AMCA | Air Movement and Control Association, Inc.<br>http://www.amca.org |
| ANLA | American Nursery & Landscape Association<br>http://www.anla.org |
| ANSI | American National Standards Institute, Inc.<br>http://www.ansi.org |
| APA | The Engineered Wood Association<br>http://www.apawood.org |
| ARI | Air-Conditioning and Refrigeration Institute<br>http://www.ari.org |
| ASAE | American Society of Agricultural Engineers<br>http://www.asae.org |
| ASCE | American Society of Civil Engineers<br>http://www.asce.org |
| ASHRAE | American Society of Heating, Refrigerating, and Air-Conditioning Engineers<br>http://www.ashrae.org |
| ASME | American Society of Mechanical Engineers<br>http://www.asme.org |
| ASSE | American Society of Sanitary Engineering<br>http://www.asse-plumbing.org |
| ASTM | American Society for Testing and Materials<br>http://www.astm.org |
| AWI | Architectural Woodwork Institute<br>http://www.awinet.org |
| AWS | American Welding Society<br>http://www.aws.org |
| AWWA | American Water Works Association<br>http://www.awwa.org |
| BHMA | Builders Hardware Manufacturers Association<br>http://www.buildershardware.com |

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| BIA | Brick Institute of America<br>http://www.bia.org |
| CAGI | Compressed Air and Gas Institute<br>http://www.cagi.org |
| CGA | Compressed Gas Association, Inc.<br>http://www.cganet.com |
| CI | The Chlorine Institute, Inc.<br>http://www.chlorineinstitute.org |
| CISCA | Ceilings and Interior Systems Construction Association<br>http://www.cisca.org |
| CISPI | Cast Iron Soil Pipe Institute<br>http://www.cispi.org |
| CLFMI | Chain Link Fence Manufacturers Institute<br>http://www.chainlinkinfo.org |
| CPMB | Concrete Plant Manufacturers Bureau<br>http://www.cpmb.org |
| CRA | California Redwood Association<br>http://www.calredwood.org |
| CRSI | Concrete Reinforcing Steel Institute<br>http://www.crsi.org |
| CTI | Cooling Technology Institute<br>http://www.cti.org |
| DHI | Door and Hardware Institute<br>http://www.dhi.org |
| EGSA | Electrical Generating Systems Association<br>http://www.egsa.org |
| EEI | Edison Electric Institute<br>http://www.eei.org |
| EPA | Environmental Protection Agency<br>http://www.epa.gov |
| ETL | ETL Testing Laboratories, Inc.<br>http://www.et1.com |
| FAA | Federal Aviation Administration<br>http://www.faa.gov |
| FCC | Federal Communications Commission<br>http://www.fcc.gov |

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| FPS | The Forest Products Society<br>http://www.forestprod.org |
| GANA | Glass Association of North America<br>http://www.cssinfo.com/info/gana.html/ |
| FM | Factory Mutual Insurance<br>http://www.fmglobal.com |
| GA | Gypsum Association<br>http://www.gypsum.org |
| GSA | General Services Administration<br>http://www.gsa.gov |
| HI | Hydraulic Institute<br>http://www.pumps.org |
| HPVA | Hardwood Plywood & Veneer Association<br>http://www.hpva.org |
| ICBO | International Conference of Building Officials<br>http://www.icbo.org |
| ICEA | Insulated Cable Engineers Association Inc.<br>http://www.icea.net |
| \ICAC | Institute of Clean Air Companies<br>http://www.icac.com |
| IEEE | Institute of Electrical and Electronics Engineers<br>http://www.ieee.org\ |
| IMSA | International Municipal Signal Association<br>http://www.imsasafety.org |
| IPCEA | Insulated Power Cable Engineers Association |
| NBMA | Metal Buildings Manufacturers Association<br>http://www.mbma.com |
| MSS | Manufacturers Standardization Society of the Valve and Fittings Industry Inc.<br>http://www.mss-hq.com |
| NAAMM | National Association of Architectural Metal Manufacturers<br>http://www.naamm.org |
| NAPHCC | Plumbing-Heating-Cooling Contractors Association<br>http://www.phccweb.org.org |
| NBS | National Bureau of Standards<br>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

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<br>http://www.rfci.com |
| RIS | Redwood Inspection Service<br>See - CRA |
| RMA | Rubber Manufacturers Association, Inc.<br>http://www.rma.org |
| SCMA | Southern Cypress Manufacturers Association<br>http://www.cypressinfo.org |
| SDI | Steel Door Institute<br>http://www.steeldoor.org |
| IGMA | Insulating Glass Manufacturers Alliance<br>http://www.igmaonline.org |
| SJI | Steel Joist Institute<br>http://www.steeljoist.org |
| SMACNA | Sheet Metal and Air-Conditioning Contractors<br>National Association, Inc.<br>http://www.smacna.org |
| SSPC | The Society for Protective Coatings<br>http://www.sspc.org |
| STI | Steel Tank Institute<br>http://www.steeltank.com |
| SWI | Steel Window Institute<br>http://www.steelwindows.com |
| TCA | Tile Council of America, Inc.<br>http://www.tileusa.com |
| TEMA | Tubular Exchange Manufacturers Association<br>http://www.tema.org |
| TPI | Truss Plate Institute, Inc.<br>583 D'Onofrio Drive; Suite 200<br>Madison, WI 53719<br>(608) 833-5900 |
| UBC | The Uniform Building Code<br>See ICBO |
| UL | Underwriters' Laboratories Incorporated<br>http://www.ul.com |
| ULC | Underwriters' Laboratories of Canada<br>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

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

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# SECTION 01 45 00
# QUALITY CONTROL

## PART 1 - GENERAL

### 1.1 DESCRIPTION

This section specifies requirements for Contractor Quality Control (CQC) for Design-Bid-Build (DBB) or Design-Build (DB) construction projects. This section can be used for both project types.

### 1.2 APPLICABLE PUBLICATIONS

A. The publication listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

B. ASTM International (ASTM)

1. D3740 - (2012a) Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
2. E329 - (2014a) Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction

### 1.3 SUBMITTALS

Government approval is required for all submittals. CQC inspection reports shall be submitted under this Specification section and follow the [Applicable CQC Control Phase (Preparatory, Initial, or Follow-Up)]: [Applicable Specification section] naming convention.

1. Preconstruction Submittals
   a. Interim CQC Plan
   b. CQC Plan
   c. Additional Requirements for Design Quality Control (DQC) Plan
2. Design Data
   a. Discipline-Specific Checklists
   b. Design Quality Control
3. Test Reports
   a. Verification Statement
4. GC to submit a Project Management Plan and a QA/QC Plan within **15** calendar days after NTP.

**PART 2 PRODUCTS – NOT USED**

**PART 3 – EXECUTION**

**3.1 GENERAL REQUIREMENTS**

Establish and maintain an effective quality control (QC) system. that complies with the FAR Clause 52.246.12 titled "Inspection of Construction". QC consists of plans, procedures, and organization necessary to produce an end product which complies with the Contract requirements. The QC system covers all design and construction operations, both onsite and offsite, and be keyed to the proposed design and construction sequence. The project superintendent will be held responsible for the quality of work and is subject to removal by the Contracting Office or Authorized designee for non-compliance with the quality requirements specified in the Contract. In this context the highest level manager responsible for the overall construction activities at the site, including quality and production is the project superintendent. The project superintendent maintains a physical presence at the site at all times and is responsible for all construction and related activities at the site, except as otherwise acceptable to the Contracting Officer.

**3.2 CQC PLAN:**

A. Submit the CQC Plan no later than 15 days after receipt of Notice to Proceed (NTP) proposed to implement the requirements of the FAR Clause 52.246.12 titled "Inspection of Construction". The Government will consider an Interim CQC Plan for the first 15 days of operation, which must be accepted within 5 business days of NTP. Design and/or construction will be permitted to begin only after acceptance of the CQC Plan or acceptance of an Interim plan applicable to the particular feature of work to be started. Work outside of the accepted Interim CQC Plan will not be permitted to begin until acceptance of a CQC Plan or another Interim CQC Plan containing the additional work scope is accepted.

B. Content of the CQC Plan: Include, as a minimum, the following to cover all design and construction operations, both onsite and offsite, including work by subcontractors, designers of record consultants,

architects/engineers (A/E), fabricators, suppliers, and purchasing agents:

1. A description of the QC organization, including a chart showing lines of authority and acknowledgement that the CQC staff will implement the three phase control system for all aspects of the work specified. Include a CQC System Manager that reports to the project superintendent.
2. The name, qualifications (in resume format) duties, responsibilities, and authorities of each person assigned a CQC function.
3. A copy of the letter to the CQC System Manager signed by an authorized official of the firm which describes the responsibilities and delegates sufficient authorities to adequately perform the functions of the CQC System Manager, including authority to stop work which is not in compliance with the Contract. Letters of direction to all other various quality control representatives outlining duties, authorities, and responsibilities will be issued by the CQC System Manager. Furnish copies of these letters to the Contracting Officer or Authorized designee.
4. Procedures for scheduling, reviewing, certifying, and managing submittals including those of subcontractors, designers of record, consultants, A/E's offsite fabricators, suppliers and purchasing agents. These procedures must be in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples.
5. Control, verification, and acceptance of testing procedures for each specific test to include the test name, specification paragraph requiring test, feature of work to be tested, test frequency, and person responsible for each test. (Laboratory facilities approved by the Contracting Officer or Authorized designee are required to be used)
6. Procedures for tracking Preparatory, Initial, and Follow-Up control phases and control, verification, and acceptance tests including documentation.
7. Procedures for tracking design and construction deficiencies from identification through acceptable corrective action. Establish

verification procedures that identified deficiencies have been corrected.

8. Reporting procedures, including proposed reporting formats.
9. A list of the definable features of work. A definable feature of work is a task which is separate and distinct from other tasks has separate control requirements, and is identified by different trades or disciplines, or it is work by the same trade in a different environment. Although each section of specifications can generally be considered as a definable feature of work, there are frequently more than one definable feature under a particular section. This list will be agreed upon during the Coordination meeting.
10. Coordinate schedule work with Special Inspections required by Section 01 45 35 Special Inspections, the Statement of Special Inspections and Schedule of Special Inspections. Where the applicable Code issue by the International Code Council (ICC) calls for inspections by the Building Official, the Contractor must include the inspections in the CQC Plan and must perform the inspections required by the applicable ICC. The Contractor must perform these inspections using independent qualified inspectors. Include the Special Inspection Plan requirements in the CQC Plan.

C. Additional Requirements for Design Quality Control (DQC) Plan: The following additional requirements apply to the DQC Plan for DB projects only and not DBB projects:

1. Submit and maintain a DQC Plan as an effective QC program which assures that all services required by this contract are performed and provided in a manner that meets professional architectural and engineering quality standards. As a minimum, all documents must be technically reviewed by competent, independent reviewers identified in the DQC Plan. The same element that produced the product may not perform the independent technical review (ITR). Correct errors and deficiencies in the design documents prior to submitting them to the Government.
2. Include the design schedule in the master project schedule, showing the sequence of events involved in carrying out the project design tasks within the specific Contract period. This should be at a detailed level of scheduling sufficient to identify all major design

tasks, including those that control the flow of work. Include review and correction periods associated with each item. This should be a forward planning as well as a project monitoring tool. The schedule reflects calendar days and not dates for each activity. If the schedule is changed, submit a revised schedule reflecting the change within 7 calendar days. Include in the DQC Plan the discipline-specific checklists to be used during the design and quality control of each submittal. Submit at each design phase as part of the project documentation these completed discipline-specific checklists.

3. Implement the DQC Plan by a DQC Manager who has the responsibility of being cognizant of and assuring that all documents on the project have been coordinated. This individual must be a person who has verifiable engineering or architectural design experience and is a Professional Engineer or Registered Architect within the state of Construction location. Notify the Contracting Officer or Authorized designee, in writing, of the name of the individual, and the name of an alternate person assigned to the position.

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

E. Notification of Changes: After acceptance of the CQC Plan, notify the Contracting Officer or Authorized designee in writing of any proposed change. Proposed changes are subject to acceptance by the Government prior to implementation by the Contractor.

**3.3 COORDINATION MEETING:**

After the Preconstruction Conference Post-award Conference before start of design or construction, and prior to acceptance by the Government of the CQC Plan, meet with the Contracting Officer or Authorized designee to discuss the Contractor’s quality control system. Submit the CQC Plan a minimum of 5 business days prior to the Coordination Meeting. During the meeting, a mutual understanding of the system details must be

developed, including the forms for recording the CC operations, design activities (if applicable), control activities, testing, administration of the system for both onsite and offsite work, and the interrelationship of Contractor's Management and control with the Government's Quality Assurance. Minutes of the meeting will be prepared by the Government, signed by both the Contractor and Contracting Officer or Authorized designee and will become a part of the contract file. There can be occasions when subsequent conferences will be called by either party to reconfirm mutual understandings or address deficiencies in the CQC system or procedures which can require corrective action by the Contractor.

**3.4 QUALITY CONTROL ORGANIZATION:**

A. Personnel Requirements: The requirements for the CQC organization are a Safety and Health Manager, CQC System Manager, a Design Quality Manager (if applicable), and sufficient number of additional qualified personnel to ensure safety and Contract compliance. The Safety and Health Manager shall satisfy the requirements of Specification 01 35 26 Safety Requirements and reports directly to a senior project (or corporate) official independent from the CQC System Manager. The Safety and Health Manager will also serve as a member of the CQC Staff. Personnel identified in the technical provisions as requiring specialized skills to assure the required work is being performed properly will also be included as part of the CQC organization. The Contractor's CQC staff maintains a presence at the site at all times during progress of the work and have complete authority and responsibility to take any action necessary to ensure Contract compliance. The CQC staff will be subject to acceptance by the Contracting Officer or Authorized designee. Provide adequate office space, filing systems, and other resources as necessary to maintain an effective and fully functional CQC organization. Promptly complete and furnish all letters, material submittals, shop drawings submittals, schedules and all other project documentation to the CQC organization. The CQC organization is responsible to maintain these documents and records at the site at all times, except as otherwise acceptable to the Government.

B. CQC System Manager: Identify as CQC System Manager an individual within the onsite work organization that is responsible for overall management of CQC and has the authority to act in all CQC matters for the Contractor. The CQC system Manager is required to be a graduate engineer, graduate architect, or a graduate of construction management, with a minimum of 10 years construction experience on construction similar to the scope of this Contract. This CQC System manager is on the site at all times during construction and is employed by the General Contractor. The CQC System Manger is assigned as CQC System Manager but has duties as project superintendent in addition to quality control. Identify in the plan an alternate to serve in the event of the CDQC System Manager's absence. The requirements for the alternate are the same as the CQC System Manager.

C. CQC Personnel: In addition to CQC personnel specified elsewhere in the contract, provide as part of the CQC organization specialized personnel to assist in the CQC System Manager for the following areas, as applicable: electrical, mechanical, civil, structural, environmental, architectural, materials technician submittals clerk, Commissioning Agent/LEED specialist, and low voltage systems. These individuals or specified technical companies are employees of the prime or subcontractor; be responsible to the CQC System Manager; be physically present at the construction site during work on the specialized personnel's areas of responsibility; have the necessary education or experience in accordance with the Experience Matrix listed herein. These individuals can perform other duties but need to be allowed sufficient time to perform the specialized personnel's assigned quality controls duties as described in the CQC Plan. A single person can cover more than one area provided that the single person is qualified to perform QC activities in each designated and that workload allows.

**EXPERIENCE MATRIX**

| Area | Qualifications |
|---|---|
| Civil | Graduate Civil Engineer or Construction Manager with 2 years experience in the type of work being performed on this project or technician with 5 years related experience. |

| Area | Qualifications |
|---|---|
| Mechanical | Graduate Mechanical Engineer with 2 years experience or construction professional with 5 years of experience supervising mechanical features of work in the field with a construction company. |
| Electrical | Graduate Electrical Engineer with 2 years related experience or construction professional with 5 years of experience supervising electrical features of work in the field with a construction company. |
| Structural | Graduate Civil Engineer (with Structural Track or Focus), Structural Engineer, or Construction Manager with 2 years experience or construction professional with 5 years experience supervising structural features of work in the field with a construction company. |
| Architectural | Graduate Architect with 2 years experience or construction professional with 5 years of related experience. |
| Environmental | Graduate Environmental Engineer with 3 years experience. |
| Submittals | Submittal Clerk with 1 year experience. |
| Concrete, Pavement, and Soils | Materials Technician with 2 years experience for the appropriate area. |
| Testing, Adjusting, and Balancing (TAB) | Specialist must be a member of AABC or an experienced technicaion of the firm certified by the NEBB. |
| Design Quality Control Manager | Registered Architect or Professional Engineer |

D. Additional Requirements: In addition to the above experience and education requirements, the CQC System Manager and Alternate CQC System Manager are required to have completed the Construction Quality Management (CQM) for Construction course. If the CQC System Manager does not have a current specification, obtain the CQM for Contractors course identification within 90 days of award. This course is periodically offered by the Naval Facilities Engineering Command and the Army Corps of Engineers. Contact the Contracting Officer or Authorized designee for information on the next scheduled class.

E. Organizational Changes: Maintain the CQC staff at full strength at all times. When it is necessary to make changes to the CQC staff, revise the CQC Plan to reflect the changes and submit the changes to the Contracting Officer or Authorized designee for acceptance.

3.5 **SUBMITTALS AND DELIVERABLES:** Submittals have to comply with the requirements in Section 01 33 23 Shop Drawings, Product Data, and Samples. The CQC organization is responsible for certifying that all submittals and deliverables are in compliance with the contract requirements. When Section 01 91 00 General Commissioning Requirements is included in the contract, the submittals required by the section have to be coordinated with the Section 01 33 23 Shop Drawings, Product Data, and Samples to ensure adequate time is allowed for each type of submittal required.

**3.6 CONTROL:**

A. CQC is the means by which the Contractor ensures that the construction, to include that of subcontractors and suppliers, complies with the requirements of the contract.

**3.7 TESTS**

A. Testing Procedure: Perform specified or required tests to verify that control measures are adequate to provide a product which conforms to contract requirements. Upon request, furnish to the Government duplicate samples of test specimens for possible testing by the Government. Testing includes operation and acceptance test when specified. Procure the services of a Department of Veteran Affairs approved testing laboratory or establish an approved testing laboratory at the project site. Perform the following activities and record and provide the following data:

1. Verify that testing procedures comply with contract requirements.
2. Verify that facilities and testing equipment are available and comply with testing standards.
3. Check test instrument calibration data against certified standards.
4. Verify that recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.

5. Record results of all tests taken, both passing and failing on the CQC report for the date taken. Specification paragraph reference, location where tests were taken, and the unique sequential control number identifying the test. If approved by the Contracting Officer or Authorized designee, actual test reports are submitted later with a reference to the test number and date taken. Provide an information copy of tests performed by an offsite or commercial test facility directly to the Contracting Officer or Authorized designee. Failure to submit timely test reports as stated results in nonpayment for related work performed and disapproval of the test facility for this Contract.

B. Testing Laboratories: All testing laboratories must be validated through the procedures contained in Specification section 01 45 29 Testing Laboratory Services.

1. Capability Check: The Government reserves the right to check laboratory equipment in the proposed laboratory for compliance with the standards set forth in the contract specifications and to check the laboratory technician's testing procedures and techniques. Laboratories utilized for testing soils, concrete, asphalt and steel is required to meet criteria detailed in ASTM D3740 and ASTM E329.
2. Capability Recheck: If the selected laboratory fails the capability check, the Contractor will be assessed a charge equal to value of recheck to reimburse the Government for each succeeding recheck of the laboratory or the checking of a subsequently selected laboratory. Such costs will be deducted from the Contract amount due the Contractor.

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

## 3.7 COMPLETION INSPECTION

A. Punch-Out Inspection: Conduct an inspection of the work by the CQC system Manager near the end of the work, or any increment of the work established by the specifications. Prepare and include in the CQC documentation a punch list of items which do not conform to the approved drawings and specifications. Include within the list of

deficiencies the estimated date by which the deficiencies will be corrected. Make a second inspection the CQC System Manager or staff to ascertain that all deficiencies have been corrected. Once this is accomplished, notify the Government that the facility is ready for the Government Pre-Final Inspection.

B. Pre-Final Inspection: The Government will perform the Pre-Final Inspection to verify that the facility is complete and ready to be occupied. A Government Pre-Final Punch List may be developed as a result of this inspection. Ensure that all items on this list have been corrected before notifying the Government, so that a Final Acceptance Inspection with the customer can be scheduled. Correct any items noted on the Pre-Final Inspection in a timely manner. These inspections and any deficiency corrections required by this paragraph need to be accomplished within the time slated for completion of the entire work or any particular increment of the work if the project is divided into increments by separate construction completion dates.

C. Final Acceptance Inspection: The Contractor's QC Inspection personnel, plus the superintendent or other primary management person, and the Contracting Officer's Authorized designee is required to be in attendance at the Final Acceptance Inspection. Additional Government personnel can also be in attendance. The Final Acceptance Inspection will be formally scheduled by the Contracting Officer's or Authorized designee based upon results of the Pre-Final Inspection. Notify the Contracting Officer through the Resident Engineer office at least 14 days prior to the Final Acceptance Inspection and include the Contractor's assurance that all specific items previously identified to the Contractor as being unacceptable, along with all remaining work performed under the contract, will be complete and acceptable by the date schedule for the Final Acceptance Inspection. Failure of the Contractor to have all contract work acceptably complete for this inspection will be cause for the Contracting Officer to bill the Contractor for the Government's additional inspection cost in accordance with FAR Clause 52.246-12 titled "Inspection of Construction".

3.8 DOCUMENTATION

A. Quality Control Activities: Maintain current records providing factual evidence that required QC activities and tests have been performed. Include in these records the work of subcontractors and suppliers on an acceptable form that includes, as a minimum, the following information:
   1. The name and area of responsibility of the Contractor/Subcontractor
   2. Operating plant/equipment with hours worked, idle, or down for repair.
   3. Work performed each day, giving location, description, and by whom. When Network Analysis (NAS) is used, identify each phase of work performed each day by NAS activity number.
   4. Test and control activities performed with results and references to specification/drawing requirements. Identify the Control Phase. List deficiencies noted, along with corrective action.
   5. Quantity of materials received at the site with statement as to acceptability, storage, and reference to specification/drawing requirements.
   6. Submittals and deliverables reviewed, with Contract reference, by whom, and action taken.
   7. Offsite surveillance activities, including actions taken.
   8. Job safety evaluations stating what was checked, results, and instructions or corrective actions.
   9. Instructions given/received and conflicts in plans and specifications.
   10. Provide documentation of design quality control activities. For independent design reviews, provide, as a minimum, identification of the Independent Technical Reviewer (ITR) team, the ITR review comments, responses, and the record of resolution of the comments.

B. Verification Statement: Indicate a description of trades working on the project; the number of personnel working; weather conditions encountered; and any delays encountered. Cover both conforming and deficient features and include a statement that equipment and materials incorporated in the work and workmanship comply with the Contract. Furnish the original and one copy of these records in report form to the Government daily with 1 week after the date covered by the report, except that reports need not be submitted for days on which no work is

performed. As a minimum, prepare and submit on report for every 7 days of no work and on the last day of a no work period. All calendar days need to be accounted for throughout the life of the contract. The first report following a day of no work will be for that day only. Reports need to be signed and dated by the CQC System Manager. Include copies of test reports and copies of reports prepared by all subordinate QC personnel within the CQC System Manager Report.

**3.9 SAMPLE FORMS**

Not used.

3.10 **NOTIFICATION OF NONCOMPLIANCE:** The Contracting Officer or Authorized designee will notify the Contractor of any detected noncompliance with the foregoing requirements. The Contractor should take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site will be deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the Contracting Officer can issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders will be made the subject of claim for extension of time or for excess costs or damages by the Contractor.

--- End of Section ---

# SECTION 01 45 29
# TESTING LABORATORY SERVICES

## PART 1 - GENERAL

### 1.1 DESCRIPTION:

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

### 1.2 APPLICABLE PUBLICATIONS:

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

B. American Association of State Highway and Transportation Officials (AASHTO):

T27-11.....Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates

T96-02 (R2006).....Standard Method of Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

T99-10.....Standard Method of Test for Moisture-Density Relations of Soils Using a 2.5 Kg (5.5 lb.) Rammer and a 305 mm (12 in.) Drop

T104-99 (R2007).....Standard Method of Test for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate

T180-10.....Standard Method of Test for Moisture-Density Relations of Soils using a 4.54 kg (10 lb.) Rammer and a 457 mm (18 in.) Drop

T191-02(R2006).....Standard Method of Test for Density of Soil In-Place by the Sand-Cone Method

T310-13.....Standard Method of Test for In-place Density and Moisture Content of Soil and Soil-aggregate by Nuclear Methods (Shallow Depth)

C. American Concrete Institute (ACI):

506.4R-94 (R2004).....Guide for the Evaluation of Shotcrete

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

A370-12.....Standard Test Methods and Definitions for Mechanical Testing of Steel Products

A416/A416M-10.....Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete

C31/C31M-10.....Standard Practice for Making and Curing Concrete Test Specimens in the Field

C33/C33M-11a.....Standard Specification for Concrete Aggregates

C39/C39M-12.....Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

C109/C109M-11b.....Standard Test Method for Compressive Strength of Hydraulic Cement Mortars

C136-06.....Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates

C138/C138M-10b.....Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete

C140-12.....Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units

C143/C143M-10a.....Standard Test Method for Slump of Hydraulic Cement Concrete

C172/C172M-10.....Standard Practice for Sampling Freshly Mixed Concrete

C173/C173M-10b.....Standard Test Method for Air Content of freshly Mixed Concrete by the Volumetric Method

C330/C330M-09.....Standard Specification for Lightweight Aggregates for Structural Concrete

C567/C567M-11.....Standard Test Method for Density Structural Lightweight Concrete

C780-11.....Standard Test Method for Pre-construction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry

C1019-11.....Standard Test Method for Sampling and Testing Grout

C1064/C1064M-11.....Standard Test Method for Temperature of Freshly Mixed Portland Cement Concrete

C1077-11c.....Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation

C1314-11a.....Standard Test Method for Compressive Strength of Masonry Prisms

D422-63(2007).....Standard Test Method for Particle-Size Analysis of Soils

D698-07e1.....Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort

D1140-00(2006).....Standard Test Methods for Amount of Material in Soils Finer than No. 200 Sieve

D1143/D1143M-07e1.....Standard Test Methods for Deep Foundations Under Static Axial Compressive Load

D1188-07e1.....Standard Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Coated Samples

D1556-07.....Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method

D1557-09.....Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000ft lbf/ft3 (2,700 KNm/m3))

D2166-06.....Standard Test Method for Unconfined Compressive Strength of Cohesive Soil

D2167-08).....Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method

D2216-10.....Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

D2974-07a.....Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils

D3666-11.....Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials

D3740-11.....Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection

of Soil and Rock as used in Engineering Design and Construction

D6938-10.....Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

E94-04(2010).....Standard Guide for Radiographic Examination

E164-08.....Standard Practice for Contact Ultrasonic Testing of Weldments

E329-11c.....Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection

E543-09.....Standard Specification for Agencies Performing Non-Destructive Testing

E605-93(R2011).....Standard Test Methods for Thickness and Density of Sprayed Fire Resistive Material (SFRM) Applied to Structural Members

E709-08.....Standard Guide for Magnetic Particle Examination

E1155-96(R2008).....Determining FF Floor Flatness and FL Floor Levelness Numbers

F3125/F3125M-15.....Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions

E. American Welding Society (AWS):

D1.D1.1M-10.....Structural Welding Code-Steel

**1.3 REQUIREMENTS:**

A. Accreditation Requirements: Construction materials testing laboratories must be accredited by a laboratory accreditation authority and will be required to submit a copy of the Certificate of Accreditation and Scope of Accreditation. The laboratory's scope of accreditation must include the appropriate ASTM standards (i.e., E329, C1077, D3666, D3740, A880, E543) listed in the technical sections of the specifications. Laboratories engaged in Hazardous Materials Testing shall meet the requirements of OSHA and EPA. The policy applies to the specific

laboratory performing the actual testing, not just the "Corporate Office."

B. Inspection and Testing: Testing laboratory shall inspect materials and workmanship and perform tests described herein and additional tests requested by Resident Engineer. When it appears materials furnished, or work performed by Contractor fail to meet construction contract requirements, Testing Laboratory shall direct attention of Resident Engineer to such failure.

C. Written Reports: Testing laboratory shall submit test reports to Resident Engineer, Contractor, unless other arrangements are agreed to in writing by the Resident Engineer. Submit reports of tests that fail to meet construction contract requirements on colored paper.

D. Verbal Reports: Give verbal notification to Resident Engineer immediately of any irregularity.

**PART 2 – PRODUCTS (NOT USED)**

**PART 3 – EXECUTION**

**3.1 EARTHWORK:**

Not used.

**3.2 FOUNDATION PILES:**

Not used.

**3.3 FOUNDATION CAISSONS:**

Not used.

**3.4 LANDSCAPING:**

Not used.

**3.5 ASPHALT CONCRETE PAVING:**

Not used.

**3.6 SITE WORK CONCRETE:**

Not used.

**3.7 POST-TENSIONING OF CONCRETE:**

Not used.

**3.8 CONCRETE:**

Not used.

**3.9 REINFORCEMENT:**

Not used.

**3.11 PRESTRESSED CONCRETE:**

Not used.

**3.12 ARCHITECTURAL PRECAST CONCRETE:**

Not used.

**3.13 MASONRY:**

Not used.

**3.14 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 D1.1 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 D1.1 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 AWS D1.1.
j. Testing and inspection do not relieve the Contractor of the responsibility for providing materials and fabrication procedures in compliance with the specified requirements.

2. Bolt Inspection:
   a. Inspect high-strength bolted connections in accordance AISC Specifications for Structural Joints Using ASTM F3125 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 F3125 Bolts. Inspect all bolts in connection when one or more are rejected.
   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 F3125 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 Resident Engineer.

**3.15 STEEL DECKING:**

Not used.

**3.17 SPRAYED-ON FIREPROOFING:**

Not used.

- - - E N D - - -

# SECTION 01 45 35
# SPECIAL INSPECTIONS

## PART 1 - GENERAL

### 1.1 DESCRIPTION

A. This guide specification will be applicable to both new buildings and existing building rehabilitations/renovations. In addition to the Special Inspection and testing specified requirements, a registered design professional must perform structural observations during construction. All observed deficiencies will be immediately reported to the Contracting Officer. The registered design professional performing these observations will be a representative of the Designer of Record (DOR) for the building being constructed.

B. Structural observations are required for the following project conditions per IBC Chapter 17:

1. Seismic Design Category D, E or F; and assigned to Risk Cat III, IV or V.
2. Seismic Design Category D, E or F; and with a height greater than 22860 mm 75 ft.
3. Seismic Design Category E, assigned to Risk Category I or II and the building is greater than two stories above grade plane.
4. Nominal design wind speed in excess of 49 m/sec 110 mph; and assigned to Risk Cat III, IV or V.
5. Nominal design wind speed in excess of 49 m/sec 110 mph; and with a height greater than 23 m 75 ft.

### 1.2 APPLICABLE PUBLICATIONS

A. The publication listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

B. American Society of Civil Engineers (ASCE)

1. ASCE 7 - (2010; Errata 2011; Supp 2 2013) Minimum Design Loads for Buildings and Other Structures

C. International Code Council (ICC)

2. ICC IBC - (2015) International Building Code

1.3 **GENERAL REQUIREMENTS**

A. Perform Special Inspections in accordance with the Statement of Special Inspections, Schedule of Special Inspections and Chapter 17 of ICC IBC. The Statement of Special Inspections and Schedule of Special Inspections are included as an attachment to this specification. Special Inspections are to be performed by an independent third party and are intended to ensure that the work of the prime contractor is in accordance with the Contract Documents and applicable building codes. Special inspections do not take the place of the three phases of control inspections performed by the Contractor's QC Manager or any testing and inspections required by other sections of the specifications.

B. Structural observations will be performed by the Government. The contractor must provide notification to the Contracting Officer 14 days prior to the following points of construction that structural observations need to occur. Refer to the Special Inspections & Testing notes on sheet S111 of the Contract Documents.

1.4 **DEFINITIONS**

A. Continuous Special Inspections - The constant monitoring of specific tasks by a special inspector. These inspections must be carried out continuously over the duration of the tasks.

B. Periodic Special Inspections - Special Inspections by the special inspector who is intermittently present where the work to be inspected has been or is being performed. Specific time interval on a specific Special Inspection should be indicated on the Schedule of Special Inspections.

C. Perform - Perform these Special Inspections tasks for each welded joint or member.

D. Observe - Observe these Special Inspections items on a random daily basis. Operations need not be delayed pending these inspections.

E. Special Inspector (SI) - A qualified person retained by the contractor and approved by the Contracting Officer as having the competence necessary to inspect a particular type of construction requiring Special Inspections. The SI must be an independent third party hired directly by the Prime Contractor.

F. Associate Special Inspector (ASI) - A qualified person who assists the SI in performing Special Inspections but must perform inspection under

the direct supervision of the SI and cannot perform inspections without the SI on site.

G. Third Party - A third party inspector must not be company employee of the Contractor or any Sub-Contractor performing the work to be inspected.

H. Special Inspector of Record (SIOR) - SIOR must be an independent third party hired directly by the Prime Contractor and is required for the following project conditions:

1. Seismic Design Category D, E, or F; and assigned to Risk Category III, IV, or V.
2. Seismic Design Category D, E, or F; and with a height greater than 22860mm 75 ft.
3. Seismic Design Category E, assigned to Risk Category I or II and the building is greater than two (2) stories above grade plane.
4. Nominal design wind speed more than 49 m/sec 100 mph; and assigned to Risk Category III, IV, or V.
5. Nominal design wind speed more than 49 mm/sec 100mph; and with a height greater than 23m 75ft.
6. In addition to these conditions, the DOR is encouraged to consider using an SIOR on large magnitude or critical projects where this additional level of quality control is affordable.

I. Contracting Officer - The Government official having overall authority for administrative contracting actions. Certain contracting actions may be delegated to the Contracting Officer's Representative (COR).

J. Contractor’s Quality Control (QC) Manager - An individual retained by the prime contractor and qualified in accordance with the Section 01 45 00.00 10 QUALITY CONTROL having the overall responsibility for the contractor's QC organization.

K. Designer of Record (DOR) - A registered design professional is contracted by the Government as an A/E responsible for the overall design and review of submittal documents prepared by others. The DOR is registered or licensed to practice their respective design profession as defined by the statutory requirements of the professional registration laws in state in which the design professional works. The DOR is also referred to as the Engineer of Record (EOR) in design code documents.

L. Statement of Special Inspections (SSI) - A document developed by the DOR identifying the material, systems, components, and work required to have Special Inspections and covering the following:
   1. List of the Architectural Designated Seismic Systems - these components are in or attached to a Risk Category IV or V structure and are needed for continued operation of the facility or their failure could impair the continued operation of the facility.
   2. List of the Mechanical Designated Seismic Systems
      a. For Seismic Design Category C or Risk V, list the following:
         1) Heating, ventilation, and air-conditioning (HVAC) ductwork containing hazardous materials and anchorage of such ductwork
         2) Piping systems and mechanical units containing flammable, combustible, or highly toxic materials.
      b. For Seismic Design Category D, E, or F or Risk Category V list mechanical system that meet one of the following:
         1) Life safety component required to function after an earthquake
         2) Component that contains hazardous content,
         3) All components in an essential facility needed for continued operation after an earthquake.
   3. List of the Electrical Designated Systems
      a. For Seismic Design Category C or Risk V, list the anchorage of electrical equipment used for emergency or standby power systems.
      b. For Seismic Design Category D, E or F list electrical system that meet one of the following:
         1) Life safety component required to function after an earthquake
         2) Component that contains hazardous content,
         3) All components in an essential facility needed for continued operation after an earthquake.
   4. List of elements that are part of the progressive collapse resistance system.
      a. Provide a description of the following as they apply:
         1) Elements of the tie force system consisting of internal longitudinal and transverse, vertical, and peripheral tie.

2) Elements of the alternate path system.

3) Elements having enhanced local resistance. The Statement of Special Inspections and the Schedule of Special Inspections will be included as an attachment to this specification

a) Schedule of Special Inspections - A schedule which lists each of the required Special Inspections, the extent to which each Special Inspections is to be performed, and the required frequency for each in accordance with ICC IBC Chapter 17. Template found here:

SECTION 01 45 35 Schedule of SI Temp

SECTION 01 45 35 Statement of SI Tem

b) Designated Seismic System - Those nonstructural components that require design in accordance with ASCE 7 Chapter 13 and for which the component importance factor, Ip, is greater than 1.0. This designation applies to systems that are required to be operational following the Design Earthquake for RC I - IV structures and following the MCER for RC V structures. All systems in RC V facilities designated as MC-1 in accordance with UFC 3-310-04 are considered part of the Designated Seismic Systems. Designated Seismic Systems will be identified by Owner and will have an Importance Factor Ip = 1.5

M. Submittals: Government approval is required for all submittals. CQC Special Inspection reports shall be submitted under this Specification section and follow the [Special Inspection]: [Applicable Specification section or description] naming convention. Submit the following:

1. SD-01 Preconstruction Submittals;
2. SIOR Letter of Acceptance;
3. Special Inspections Project Manual;
4. Special Inspections Agency's Written Practices
5. NDT Procedures and Equipment' Calibration Records;
6. SD-06 Test Reports;
7. Special Inspections
8. Daily Reports;
9. Special Inspections; Biweekly Reports;

10. SD-07 Certificates;
11. Fabrication Plant
12. Steel Truss Plant;
13. Wood Truss Plant;
14. AC472 Accreditation;
15. Steel Joist Institute Membership;
16. Precast Concrete Institute (PCI) Certified Plant;
17. Certificate of Compliance;
18. Special Inspector of Record Qualifications;
19. Special Inspector Qualifications;
20. Qualification Records for NDT technicians;
21. SD-11 Closeout Submittals;
22. Interim Final Report of Special Inspections;
23. Comprehensive Final Report of Special Inspections;

N. Special Inspector Qualifications: Submit qualifications for each SI, ASI, and the SIOR from the following certifying associations: Associated Air Balance Council (AABC); American Concrete Institute (ACI); Association of the Wall and Ceiling Industry (AWCI); American Welding Society (AWS); Factory Mutual (FM); International Code Council (ICC); Nondestructive Testing (NDT); National Institute for Certification in Engineering Technologies (NICET); Precast/Prestressed Concrete Institute (PCI); Post-Tensioning Institute (PTI); Underwriters Laboratories (UL). Qualifications should be in accordance with the following minimums; PM or SRE can restrict qualifications to the higher standards shown if multiple options are shown for a role based on complexity of project.

**QUALIFICATIONS**

| Area | Special Inspector | Associated Special Inspector | SIOR |
|---|---|---|---|
| Steel Construction and High Strength Bolting | ICC Structural Steel and Bolting Special Inspector certificate with on year of related experience, or Registered Professional Engineer with related experience. | Engineer-In-Training with one year of related experience. | |
| Welding Structural Steel (For highly complex steel use only AWS Certified Welding Inspectors) | ICC Welding Special Inspector certificate with one year of related experience or AWS Certified Welding Inspector | AWS Certified Associate Welding Inspector | |
| Nondestructive Testing of Welds | NDT Level II Certificate | NDT Level II Certificate plus one year of related experience | |
| Cold Formed Steel Framing | ICC Structural Steel and Bolting Special Inspector certificate with on year of related experience, or ICC Commercial Building Inspector with one year of experience; or Registered Professional Engineer with related experience. | Engineer-In-Training with one year of related experience. | |

| Area | Special Inspector | Associated Special Inspector | SIOR |
|---|---|---|---|
| Concrete Construction | ICC Reinforced Concrete Special Inspector Certificate with one year of related experience, or ACI Concrete Construction Special Inspector, or NICET Concrete Technician Level III Certificate in Construction Materials Testing, or, Registered Professional Engineer with related experience | ACI Concrete Construction Special Inspector in Training, or Engineer-In-Training with one year of related experience | |
| Prestressed Concrete Construction | ICC Pre-stressed Special Inspector Certificate with one year of related experience, or PCI Quality Control Technician/ Inspector Level II Certificate with one year of related experience, or Registered Professional Engineer with related experience. | PCI Quality Control Technician/ Inspector Level I Certificate with one year of related experience, or Engineer-In-Training with one year of related experience | |
| Post-Tensioned Concrete Construction | PTI Level 2 Unbonded PT Inspector Certificate, or Registered Professional Engineer with related experience | PTI Level 1 Unbonded PT Inspector Certificate with one year of related experience, or Engineer-In-Training with one year of related experience | |
| Masonry Construction | ICC Structural Masonry Special Inspector Certificate with one year of related experience, or Registered Professional Engineer with related experience | Engineer-In-Training with one year of related experience | |

| Area | Special Inspector | Associated Special Inspector | SIOR |
|---|---|---|---|
| Wood | ICC Commercial Building Inspector Certificate with one year of related experience, or ICC Residential Building Inspector with on year of experience, or Registered Professional Engineer with related experience | Engineer-In-Training with one year of related experience | |
| Verification of Site Soil Condition, Fill Placement, and Load-Bearing Requirements | ICC Soils Special Inspector Certificate with one year of related experience, or NICET Soils Technician Level II Certificate in Construction Material Testing, or NICET Geotechnical Engineering Technician Level II Construction or Generalist Certificate, or Geologist-In-Training with one year of related experience, or Registered Professional Engineer with related experience | NICET Soils Technician Level I Certificate in Construction Material Testing with one year of related experience, or NICET Geotechnical Engineering Technician Level I Construction, or Generalist Certificate with one year of related experience, or Engineer-In-Training with one year of related experience | |

| Area | Special Inspector | Associated Special Inspector | SIOR |
|---|---|---|---|
| Deep Foundations | NICET Soils Technician Level II Certificate in Construction Material Testing, or NICET Geotechnical Engineering Technician Level II Construction or Generalist Certificate, or Geologist-In-Training with one year of related experience, or Registered Professional Engineer with related experience | NICET Soils Technician Level I Certificate in Construction Material Testing with one year of related experience, or NICET Geotechnical Engineering Technician Level I Construction or Generalist Certificate with one year of related experience, or Engineer-In-Training with one year of related experience | |
| Sprayed Fire Resistant Manual | ICC Spray-applied Fireproofing Special Inspector Certificate, or ICC Fire Inspector I Certificate with one year of related experience, or Registered Professional Engineer with related experience | Engineer-In-Training with one year of related experience | |
| Mastic and Intumescent Fire Resistant Coatings | ICC Spray-applied Fireproofing Special Inspector Certificate, or ICC Fire Inspector I Certificate with one year of related experience, or Registered Professional Engineer with related experience | Engineer-In-Training with one year of related experience. | |

| Area | Special Inspector | Associated Special Inspector | SIOR |
|---|---|---|---|
| Exterior Insulation and Finish Systems (EIFS) | AWCI EIFS Inspector Certificate, or Exterior Design Institute Certificate, or Registered Professional Engineer with related experience | Engineer-In-Training with one year of related experience | |
| Fire-Resistant Penetrations and Joints | Passed the UL Firestop Exam with one year of related experience, or Passed the FM Firestop Exam with one year of related experience, or Registered Professional Engineer with related experience | Engineer-In-Training with one year of related experience. | |
| Smoke Control | AABC Technician Certification with one year of related experience, or Registered Professional Engineer with related experience | Engineer-In-Training with one year of related experience. | |
| SIOR | | | Registered Professional Engineer |

**PART 2 - PRODUCTS**

**2.1 FABRICATORS SPECIAL INSPECTION**

A. Special Inspections of fabricator's work performed in the fabricator's shop is required to be inspected in accordance with the Statement of Special Inspections and the Schedule of Special Inspections unless the fabricator is certified by the approved agency to perform such work without Special Inspections. Submit the applicable certification(s) from the following list to the Contracting Officer for information to

allow work performed in the fabricator's shop to not be subjected to Special Inspections.

B. The following certifications meet the requirements for fabricator approval in accordance with paragraph 1704.2.5.2 of IBC:
   1. American Institute of Steel Construction (AISC) Certified Fabrication Plant, Category STD.
   2. Truss Plate Institute (TPI) steel truss plate quality assurance program certification.
   3. Truss Plate Institute (TPI) wood truss plate quality assurance program certification.
   4. International Accreditation Service, AC472 Accreditation Steel Joist Institute Membership
   5. Precast Concrete Institute (PCI) Certified Plant, Group C

C. At the completion of fabrication, submit a certificate of compliance, to be included with the comprehensive final report of Special Inspections, stating that the materials supplied, and work performed by the fabricator are in accordance the construction documents.

**PART 3 - EXECUTION**

**3.1 RESPONSIBILIES MATRIX**

| Inspector | Responsibility | Condition |
|---|---|---|
| SIOR | a. Supervise all Special Inspectors required by the contract documents and the IBC.<br>b. Submit a SIOR Letter of Acceptance to the Contracting Officer attesting to acceptance of the duties of SIOR, signed and sealed by the SIOR.<br>c. Verify the qualifications of all of the Special Inspectors.<br>d. Verify the qualifications of fabricators. | Applicable when SIOR is required |
| | e. Submit Special Inspections agency's written practices for the monitoring and control of the agency's operations to include the following:<br>1. The agency's procedures for the selection and administration of inspection personnel, describing the training, experience and examination requirements for qualifications and certification of inspection personnel. | Applicable when SIOR is required and when the structural design is required to follow AISC341 for |

| Inspector | Responsibility | Condition |
|---|---|---|
| | 2. The agency's inspection procedures, including general inspection, material controls, and visual welding inspection.<br>f. Submit qualification records for nondestructive testing (NDT) technicians designated for the project. Submit NDT procedures and equipment calibration records for NDT to be performed and equipment to be used for the project. | seismic design of steel structures |
| | g. Prepare a Special Inspections Project Manual, which will cover the following:<br>1. Roles and responsibilities of the following individuals during Special Inspections: SIOR, SI, General Contractor, Subcontractors, QC Manager, and DOR.<br>2. Organizational chart and/or communication plan, indicating lines of communication<br>3. Contractor's internal plan for scheduling inspections. Address items such as timeliness of inspection requests, who to contact for inspection requests, and availability of alternate inspectors. Contractor's internal plan for scheduling inspections. Address items such as timeliness of inspection requests, who to contact for inspection requests, and availability of alternate inspectors.<br>4. Indicate the government reporting procedures.<br>5. Propose forms or templates to be used by SI and SIOR to document inspections.<br>6. Indicate procedures for tracking nonconforming work and verification that corrective work is complete.<br>7. Indicate how the SIOR and/or SI will participate in weekly QC meetings.<br>8. Indicate how Special Inspections of shop fabricated items will be handled when the fabricator's shop is not certified per paragraph FABRICATOR SPECIAL INSPECTIONS.<br>9. Include a section in the manual that covers each specific item requiring Special Inspections that is indicated on the Schedule of Special Inspections. Provide names and qualifications of each special inspector who will be performing the Special Inspections for each specific item. Provide detail on how the Special Inspections are to be carried out | Applicable when SIOR is required |

| Inspector | Responsibility | Condition |
|---|---|---|
| | for each item so that the expectations are clear for the General Contractor and the Subcontractor performing the work. Make a copy of the Special Inspections Project Manual available on the job site during construction. Submit a copy of the Special Inspections Project Manual for approval.<br>h. Attend coordination and mutual understanding meeting where the information in the Special Inspections Project Manual will be reviewed to verify that all parties have a clear understanding of the Special Inspections provisions and the individual duties and responsibilities of each party.<br>i. Maintain a 3- ring binder for the Special Inspector's daily and biweekly reports and the Special Inspections Project Manual. This file must be located in a conspicuous place in the project trailer/office to allow review by the Contracting Officer and the DOR.<br>j. Submit a copy of the Special Inspector's daily reports to the QC Manager.<br>k. Discrepancies that are observed during Special Inspections must be reported to the QC Manager for correction. If discrepancies are not corrected before the special inspector leaves the site the observed discrepancies must be documented in the daily report.<br>l. Submit a biweekly Special Inspections report until all work requiring Special Inspections is complete. A report is required for each biweekly period in which Special Inspections activity occurs, and must include the following:<br>1. A brief summary of the work performed during the reporting time frame.<br>2. Changes and/or discrepancies with the drawings, specifications, and mechanical or electrical component certification if they require seismic systems, that were observed during the reporting period.<br>3. Discrepancies which were resolved or corrected.<br>4. A list of nonconforming items requiring resolution.<br>5. All applicable test results including nondestructive testing reports. | |

| Inspector | Responsibility | Condition |
|---|---|---|
| | m. For large, complex projects, at the completion of each Definable Feature of Work (DFOW) requiring Special Inspections, submit an interim final report of Special Inspections that documents the Special Inspections completed for that DFOW and corrections of all discrepancies noted in the daily reports. The interim final report of Special Inspections must be signed, dated and bear the seal of the SIOR. | |
| QC Manager | a. If there is no SIOR, QC Manager must Supervise all Special Inspectors required by the contract documents and the IBC; Verify the qualifications of all of the Special Inspectors; Verify the qualifications of fabricators; Maintain a 3-ring binder for the Special Inspector's daily and biweekly reports. This file must be located in a conspicuous place in the project trailer/office to allow review by the Contracting Officer and the DOR. | Applicable when SIOR is not required |
| | b. Maintain a rework items list that includes discrepancies noted on the Special Inspectors daily report. | n/a |
| Special Inspectors | a. Inspect all elements of the project for which the special inspector is qualified to inspect and are identified in the Schedule of Special Inspections.<br>b. Attend preparatory phase meetings related to the Definable Feature of Work (DFOW) for which the special inspector is qualified to inspect. | |
| | c. Submit Special Inspections agency's written practices for the monitoring and control of the agency's operations to include the following:<br>1. The agency's procedures for the selection and administration of inspection personnel, describing the training, experience and examination requirements for qualifications and certification of inspection personnel.<br>2. The agency's inspection procedures, including general inspection, material controls, and visual welding inspection.<br>d. Submit qualification records for nondestructive testing (NDT) technicians designated for the project. | Applicable when SIOR is NOT required and when the structural design is required to follow AISC 341 for seismic design of steel structures |

| Inspector | Responsibility | Condition |
|---|---|---|
| | e. Submit NDT procedures and equipment calibration records for NDT to be performed and equipment to be used for the project.] | |
| | f. Submit a copy of the daily reports to the QC Manager.<br>g. Discrepancies that are observed during Special Inspections must be reported to the QC Manager for correction. If discrepancies are not corrected before the special inspector leaves the site the observed discrepancies must be documented in the daily report.<br>h. Submit a biweekly Special Inspection Report until all inspections are complete. A report is required for each biweekly period in which Special Inspections activity occurs, and must include the following:<br>1. A brief summary of the work performed during the reporting time frame<br>2. Changes and/or discrepancies with the drawings, specifications, and mechanical or electrical component certification if they require seismic systems that were observed during the reporting period.<br>3. Discrepancies which were resolved or corrected.<br>4. A list of nonconforming items requiring resolution.<br>5. All applicable test result including nondestructive testing reports.<br>i. For large, complex projects, at the completion of each Definable Feature of Work (DFOW) requiring Special Inspections, submit an interim final report of Special Inspections that documents the Special Inspections completed for that DFOW and corrections of all discrepancies noted in the daily reports. The interim final report of Special Inspections must be signed, dated and bear the seal of the SIOR.<br>j. At the completion of the project submit a comprehensive final report of Special Inspections that documents the Special Inspections completed for the project and corrections of all discrepancies noted in the daily reports. The comprehensive final report of Special Inspections must be signed, dated and | Applicable when SIOR is not required |

| Inspector | Responsibility | Condition |
|---|---|---|
| | indicate the certification of the special inspector qualifying them to conduct the inspection. | |
| | k. Submit daily reports to the SIOR | Applicable when SIOR is required |

**3.2 DEFECTIVE WORK**

Check work as it progresses, but failure to detect any defective work or materials must in no way prevent later rejection if defective work or materials are discovered, nor obligate the Government to accept such work.

-- End of Section -

# SECTION 01 57 19
# TEMPORARY ENVIRONMENTAL CONTROLS

## EP-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.

**EP-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.

**EP-3. REFERENCES**

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

B. U.S. National Archives and Records Administration (NARA):
33 CFR 328.....Definitions

**EP-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 for approval, a written and/or graphic Environmental Protection Plan including, but not limited to, the following:
      a. Name(s) of person(s) within the Contractor's organization who is (are) responsible for ensuring adherence to the Environmental Protection Plan.
      b. Name(s) and qualifications of person(s) responsible for manifesting hazardous waste to be removed from the site.
      C. Name(s) and qualifications of person(s) responsible for training the Contractor's environmental protection personnel.
      d. Description of the Contractor's environmental protection personnel training program.

e. A list of Federal, State, and local laws, regulations, and permits concerning environmental protection, pollution control, noise control and abatement that are applicable to the Contractor's proposed operations and the requirements imposed by those laws, regulations, and permits.

f. Methods for protection of features to be preserved within authorized work areas including trees, shrubs, vines, grasses, ground cover, landscape features, air and water quality, fish and wildlife, soil, historical, and archeological and cultural resources.

g. Procedures to provide the environmental protection that comply with the applicable laws and regulations. Describe the procedures to correct pollution of the environment due to accident, natural causes, or failure to follow the procedures as described in the Environmental Protection Plan.

h. Permits, licenses, and the location of the solid waste disposal area.

i. Drawings showing locations of any proposed temporary excavations or embankments for haul roads, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials. Include as part of an Erosion Control Plan approved by the District Office of the U.S. Soil Conservation Service and the Department of Veterans Affairs.

j. Environmental Monitoring Plans for the job site including land, water, air, and noise.

k. Work Area Plan showing the proposed activity in each portion of the area and identifying the areas of limited use or nonuse. Plan should include measures for marking the limits of use areas. This plan may be incorporated within the Erosion Control Plan.

B. Approval of the Contractor's Environmental Protection Plan will not relieve the Contractor of responsibility for adequate and continued control of pollutants and other environmental protection measures.

**EP-5. PROTECTION OF ENVIRONMENTAL RESOURCES**

A. Protect environmental resources within the project boundaries and those affected outside the limits of permanent work during the entire period of this contract. Confine activities to areas defined by the specifications and drawings.

B. Protection of Land Resources: Prior to construction, identify all land resources to be preserved within the work area. Do not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, top soil, and land forms without permission from the Resident Engineer. Do not fasten or attach ropes, cables, or guys to trees for anchorage unless specifically authorized, or where special emergency use is permitted.

1. Work Area Limits: Prior to any construction, mark the areas that require work to be performed under this contract. Mark or fence isolated areas within the general work area that are to be saved and protected. Protect monuments, works of art, and markers before construction operations begin. Convey to all personnel the purpose of marking and protecting all necessary objects.
2. Protection of Landscape: Protect trees, shrubs, vines, grasses, land forms, and other landscape features shown on the drawings to be preserved by marking, fencing, or using any other approved techniques.
   a. Box and protect from damage existing trees and shrubs to remain on the construction site.
   b. Immediately repair all damage to existing trees and shrubs by trimming, cleaning, and painting with antiseptic tree paint.
   c. Do not store building materials or perform construction activities closer to existing trees or shrubs than the farthest extension of their limbs.
3. Reduction of Exposure of Unprotected Erodible Soils: Plan and conduct earthwork to minimize the duration of exposure of unprotected soils. Clear areas in reasonably sized increments only as needed to use. Form earthwork to final grade as shown. Immediately protect side slopes and back slopes upon completion of rough grading.
4. Temporary Protection of Disturbed Areas: Construct diversion ditches, benches, and berms to retard and divert runoff from the construction site to protected drainage areas approved under paragraph 208 of the Clean Water Act.
   a. Sediment Basins: Trap sediment from construction areas in temporary or permanent sediment basins that accommodate the runoff of a local 100 (design year) storm. After each storm, pump

the basins dry and remove the accumulated sediment. Control overflow/drainage with paved weirs or by vertical overflow pipes, draining from the surface.

b. Reuse or conserve the collected topsoil sediment as directed by the Resident Engineer.

c. Institute effluent quality monitoring programs as required by Federal, State, and local environmental agencies.

5. Erosion and Sedimentation Control Devices: The erosion and sediment controls selected and maintained by the Contractor shall be such that water quality standards are not violated as a result of the Contractor's activities. Construct or install all temporary and permanent erosion and sedimentation control features on the Environmental Protection Plan. Maintain temporary erosion and sediment control measures such as berms, dikes, drains, sedimentation basins, grassing, and mulching, until permanent drainage and erosion control facilities are completed and operative.

6. Manage borrow areas on Government property to minimize erosion and to prevent sediment from entering nearby water courses or lakes.

7. Manage and control spoil areas on Government property to limit spoil to areas on the Environmental Protection Plan and prevent erosion of soil or sediment from entering nearby water courses or lakes.

8. Protect adjacent areas from despoilment by temporary excavations and embankments.

9. Handle and dispose of solid wastes in such a manner that will prevent contamination of the environment. Place solid wastes (excluding clearing debris) in containers that are emptied on a regular schedule. Transport all solid waste off Government property and dispose of waste in compliance with Federal, State, and local requirements.

10. Store chemical waste away from the work areas in corrosion resistant containers and dispose of waste in accordance with Federal, State, and local regulations.

11. Handle discarded materials other than those included in the solid waste category as directed by the Resident Engineer.

C. Protection of Water Resources: Keep construction activities under surveillance, management, and control to avoid pollution of surface and ground waters and sewer systems. Implement management techniques to

control water pollution by the listed construction activities that are included in this contract.

1. Washing and Curing Water: Do not allow wastewater directly derived from construction activities to enter water areas. Collect and place wastewater in retention ponds allowing the suspended material to settle, the pollutants to separate, or the water to evaporate.
2. Control movement of materials and equipment at stream crossings during construction to prevent violation of water pollution control standards of the Federal, State, or local government.
3. Monitor water areas affected by construction.

D. 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 Oklahoma and applicable State Air Pollution Statue, Rule, or Regulation 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 6:00 p.m unless otherwise permitted by local ordinance or the Resident Engineer. Repetitive impact noise on the property shall not exceed the following dB limitations:

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

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

| EARTHMOVING | | MATERIALS HANDLING | |
|---|---|---|---|
| FRONT LOADERS | 75 | CONCRETE MIXERS | 75 |
| BACKHOES | 75 | CONCRETE PUMPS | 75 |
| DOZERS | 75 | CRANES | 75 |
| TRACTORS | 75 | DERRICKS IMPACT | 75 |
| SCAPERS | 80 | PILE DRIVERS | 95 |
| GRADERS | 75 | JACK HAMMERS | 75 |
| TRUCKS | 75 | ROCK DRILLS | 80 |
| PAVERS, STATIONARY | 80 | PNEUMATIC TOOLS | 80 |
| PUMPS | 75 | BLASTING | //--// |

| | | | |
|---|---|---|---|
| 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.

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 58 16
# TEMPORARY INTERIOR SIGNAGE

## PART 1 GENERAL

### DESCRIPTION

This section specifies temporary interior signs.

## PART 2 PRODUCTS

### 2.1 TEMPORARY SIGNS

A. Fabricate from 50 Kg (110 pound) mat finish white paper.

B. Cut to 100 mm (4-inch) wide by 300 mm (12 inch) long size tag.

C. Punch 3 mm (1/8-inch) diameter hole centered on 100 mm (4-inch) dimension of tag. Edge of Hole spaced approximately 13 mm (1/2-inch) from one end on tag.

D. Reinforce hole on both sides with gummed cloth washer or other suitable material capable of preventing tie pulling through paper edge.

E. Ties: Steel wire 0.3 mm (0.0120-inch) thick, attach to tag with twist tie, leaving 150 mm (6-inch) long free ends.

## PART 3 EXECUTION

### 3.1 INSTALLATION

A. Install temporary signs attached to room door frame or room door knob, lever, or pull for doors on corridor openings.

B. Mark on signs with felt tip marker having approximately 3 mm (1/8-inch) wide stroke for clearly legible numbers or letters.

C. Identify room with numbers as designated on floor plans.

### 3.2 LOCATION

A. Install on doors that have room, corridor, and space numbers shown.

B. Doors that do not require signs are as follows:

1. Corridor barrier doors (cross-corridor) in corridor with same number.
2. Folding doors or partitions.
3. Toilet or bathroom doors within and between rooms.
4. Communicating doors in partitions between rooms with corridor entrance doors.
5. Closet doors within rooms.

C. Replace missing, damaged, or illegible signs.

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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, at least 50% of non-hazardous waste material shall be salvaged, recycled or reused in order to comply with Executive Order 13514.

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.

B. Section 01 00 00, GENERAL REQUIREMENTS.

**1.3 QUALITY ASSURANCE**

A. Contractor shall practice efficient waste management when sizing, cutting and installing building products. Processes shall be employed to ensure the generation of as little waste as possible. Construction /Demolition waste includes products of the following:
   1. Excess or unusable construction materials.
   2. Packaging used for construction products.
   3. Poor planning and/or layout.
   4. Construction error.
   5. Over ordering.
   6. Weather damage.
   7. Contamination.
   8. Mishandling.
   9. Breakage.

B. Establish and maintain the management of non-hazardous building construction and demolition waste set forth herein. Conduct a site assessment to estimate the types of materials that will be generated by demolition and construction.

C. Contractor shall develop and implement procedures to 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 **VA**.

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 contains information on companies that haul. Collect, and process recyclable debris from construction projects.

F. Contractor shall assign a specific area to facilitate separation of materials for reuse, salvage, recycling, and return. Such areas are to be kept neat and clean and clearly marked in order to avoid contamination or mixing of materials.

G. Contractor shall provide on-site instructions and supervision of separation, handling, salvaging, recycling, reuse and return methods to be used by all parties during waste generating stages.

H. Record on daily reports any problems in complying with laws, regulations and ordinances with corrective action taken.

**1.4 TERMINOLOGY**

A. Class III Landfill: A landfill that accepts non-hazardous resources such as household, commercial and industrial waste resulting from construction, remodeling, repair and demolition operations.

B. Clean: Untreated and unpainted; uncontaminated with adhesives, oils, solvents, mastics and like products.

C. Construction and Demolition Waste: Includes all non-hazardous resources resulting from construction, remodeling, alterations, repair and demolition operations.

D. Dismantle: The process of parting out a building in such a way as to preserve the usefulness of its materials and components.

E. Disposal: Acceptance of solid wastes at a legally operating facility for the purpose of land filling (includes Class III landfills and inert fills).

F. Inert Backfill Site: A location, other than inert fill or other disposal facility, to which inert materials are taken for the purpose of filling an excavation, shoring or other soil engineering operation.

G. Inert Fill: A facility that can legally accept inert waste, such as asphalt and concrete exclusively for the purpose of disposal.

H. Inert Solids/Inert Waste: Non-liquid solid resources including, but not limited to, soil and concrete that does not contain hazardous waste or soluble pollutants at concentrations in excess of water-quality objectives established by a regional water board, and does not contain significant quantities of decomposable solid resources.

I. Mixed Debris: Loads that include commingled recyclable and non-recyclable materials generated at the construction site.

J. Mixed Debris Recycling Facility: A solid resource processing facility that accepts loads of mixed construction and demolition debris for the purpose of recovering re-usable and recyclable materials and disposing non-recyclable materials.

K. Permitted Waste Hauler: A company that holds a valid permit to collect and transport solid wastes from individuals or businesses for the purpose of recycling or disposal.

L. Recycling: The process of sorting, cleansing, treating, and reconstituting materials for the purpose of using the altered form in the manufacture of a new product. Recycling does not include burning, incinerating or thermally destroying solid waste.

1. On-site Recycling - Materials that are sorted and processed on site for use in an altered state in the work, i.e. concrete crushed for use as a sub-base in paving.
2. Off-site Recycling - Materials hauled to a location and used in an altered form in the manufacture of new products.

M. Recycling Facility: An operation that can legally accept materials for the purpose of processing the materials into an altered form for the manufacture of new products. Depending on the types of materials accepted and operating procedures, a recycling facility may or may not be required to have a solid waste facilities permit or be regulated by the local enforcement agency.

N. Reuse: Materials that are recovered for use in the same form, on-site or off-site.

O. Return: To give back reusable items or unused products to vendors for credit.

P. Salvage: To remove waste materials from the site for resale or re-use by a third party.

Q. Source-Separated Materials: Materials that are sorted by type at the site for the purpose of reuse and recycling.

R. Solid Waste: Materials that have been designated as non-recyclable and are discarded for the purposes of disposal.

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

**1.5 SUBMITTALS**

A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES, furnish the following:

B. Prepare and submit to the Contracting Officer's Representative (COR) a written demolition debris management plan. The plan shall include, but not be limited to, the following information:
   1. Procedures to be used for debris management.
   2. Techniques to be used to minimize waste generation.
   3. Analysis of the estimated job site waste to be generated:
      a. List of each material and quantity to be salvaged, reused, recycled.
      b. List of each material and quantity proposed to be taken to a landfill.
   4. Detailed description of the Means/Methods to be used for material handling.
      a. On site: Material separation, storage, protection where applicable.
      b. Off site: Transportation means and destination. Include list of materials.
         1) Description of materials to be site-separated and self-hauled to designated facilities.
         2) Description of mixed materials to be collected by designated waste haulers and removed from the site.
      c. The names and locations of mixed debris reuse and recycling facilities or sites.
      d. The names and locations of trash disposal landfill facilities or sites.
      e. Documentation that the facilities or sites are approved to receive the materials.

B. Designated Manager responsible for instructing personnel, supervising, documenting and administer over meetings relevant to the Waste Management Plan.

C. 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**

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.

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

**1.7 RECORDS**

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

**PART 2 - PRODUCTS**

**2.1 MATERIALS**

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

**PART 3 - EXECUTION**

**3.1 COLLECTION**

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

**3.2 DISPOSAL**

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

**3.3 REPORT**

A. With each application for progress payment, submit a summary of construction and demolition debris diversion and disposal including beginning and ending dates of period covered.

B. Quantify all materials diverted from landfill disposal through salvage or recycling during the period with the receiving parties, dates removed, transportation costs, weight tickets, manifests, invoices. Include the net total costs or savings for each salvaged or recycled material.

C. Quantify all materials disposed of during the period with the receiving parties, dates removed, transportation costs, weight tickets, tipping fees, manifests, invoices. Include the net total costs for each disposal.

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# SECTION 01 91 00
# GENERAL COMMISSIONING REQUIREMENTS

## PART 1 – GENERAL

### 1.1 COMMISSIONING DESCRIPTION

A. This Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS shall form the basis of the construction phase commissioning process and procedures. The Commissioning Agent shall add, modify, and refine the commissioning procedures, as approved by the Department of Veterans Affairs (VA), to suit field conditions and actual manufacturer's equipment, incorporate test data and procedure results, and provide detailed scheduling for all commissioning tasks.

B. Various sections of the project specifications require equipment startup, testing, and adjusting services. Requirements for startup, testing, and adjusting services specified in the Division 7, Division 21, Division 22, Division 23, Division 26, Division 27, Division 28, and Division 31 series sections of these specifications are intended to be provided in coordination with the commissioning services and are not intended to duplicate services. The Contractor shall coordinate the work required by individual specification sections with the commissioning services requirements specified herein.

C. Where individual testing, adjusting, or related services are required in the project specifications and not specifically required by this commissioning requirements specification, the specified services shall be provided and copies of documentation, as required by those specifications shall be submitted to the VA and the Commissioning Agent to be indexed for future reference.

D. Where training or educational services for VA are required and specified in other sections of the specifications, including but not limited to Division 7, Division 8, Division 21, Division 22, Division 23, Division 26, Division 27, Division 28, and Division 31 series sections of the specification, these services are intended to be provided in addition to the training and educational services specified herein.

E. Commissioning is a systematic process of verifying that the building systems perform interactively according to the construction documents and the VA’s operational needs. The commissioning process shall encompass and coordinate the system documentation, equipment startup,

control system calibration, testing and balancing, performance testing and training. Commissioning during the construction and post-occupancy phases is intended to achieve the following specific objectives according to the contract documents:

1. Verify that the applicable equipment and systems are installed in accordance with the contact documents and according to the manufacturer's recommendations.
2. Verify and document proper integrated performance of equipment and systems.
3. Verify that Operations & Maintenance documentation is complete.
4. Verify that all components requiring servicing can be accessed, serviced, and removed without disturbing nearby components including ducts, piping, cabling, or wiring.
5. Verify that the VA’s operating personnel are adequately trained to enable them to operate, monitor, adjust, maintain, and repair building systems in an effective and energy-efficient manner.
6. Document the successful achievement of the commissioning objectives listed above.

F. The commissioning process does not take away from or reduce the responsibility of the Contractor to provide a finished and fully functioning product.

**1.2 CONTRACTUAL RELATIONSHIPS**

A. For this construction project, the Department of Veterans Affairs contracts with a Contractor to provide construction services. The contracts are administered by the VA Contracting Officer and the Resident Engineer as the designated representative of the Contracting Officer. On this project, the authority to modify the contract in any way is strictly limited to the authority of the Contracting Officer.

B. In this project, only two contract parties are recognized and communications on contractual issues are strictly limited to VA Resident Engineer and the Contractor. It is the practice of the VA to require that communications between other parties to the contracts (Subcontractors and Vendors) be conducted through the Resident Engineer and Contractor. It is also the practice of the VA that communications between other parties of the project (Commissioning Agent and Architect/Engineer) be conducted through the Resident Engineer.

C. Whole Building Commissioning is a process that relies upon frequent and direct communications, as well as collaboration between all parties to the construction process. By its nature, a high level of communication and cooperation between the Commissioning Agent and all other parties (Architects, Engineers, Subcontractors, Vendors, third party testing agencies, etc.) is essential to the success of the Commissioning effort.

D. With these fundamental practices in mind, the commissioning process described herein has been developed to recognize that, in the execution of the Commissioning Process, the Commissioning Agent must develop effective methods to communicate with every member of the construction team involved in delivering commissioned systems while simultaneously respecting the exclusive contract authority of the Contracting Officer and Resident Engineer. Thus, the procedures outlined in this specification must be executed within the following limitations:

1. No communications (verbal or written) from the Commissioning Agent shall be deemed to constitute direction that modifies the terms of any contract between the Department of Veterans Affairs and the Contractor.
2. Commissioning Issues identified by the Commissioning Agent will be delivered to the Resident Engineer and copied to the designated Commissioning Representatives for the Contractor and subcontractors on the Commissioning Team for information only to expedite the communication process. These issues must be understood as the professional opinion of the Commissioning Agent and as suggestions for resolution.
3. If any Commissioning Issues and suggested resolutions are deemed by the Resident Engineer to require either an official interpretation of the construction documents or require a modification of the contract documents, the Contracting Officer or Resident Engineer will issue an official directive to this effect.
4. All parties to the Commissioning Process shall be individually responsible for alerting the Resident Engineer of any issues that they deem to constitute a potential contract change prior to acting on these issues.
5. Authority for resolution or modification of design and construction issues rests solely with the Contracting Officer or Resident

Engineer, with appropriate technical guidance from the Architect/Engineer and/or Commissioning Agent.

**1.3 RELATED WORK**

A. Section 01 00 00 GENERAL REQUIREMENTS.
B. Section 01 32 16.01 ARCHITECTURAL AND ENGINEERING CPM SCHEDULES
C. Section 01 32.16.15 PROJECT SCHEDULES (SMALL PROJECTS - DESIGN/BID/BUILD)
D. Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES
E. Section 01 81 13 SUSTAINABLE CONSTRUCTION REQUIREMENTS
F. Section 07 08 00 FACILITY EXTERIOR CLOSURE COMMISSIONING.
G. Section 21 08 00 COMMISSIONING OF FIRE PROTECTION SYSTEMS.
H. Section 22 08 00 COMMISSIONING OF PLUMBING SYSTEMS.
I. Section 23 08 00 COMMISSIONING OF HVAC SYSTEMS.
J. Section 26 08 00 COMMISSIONING OF ELECTRICAL SYSTEMS.
K. Section 27 08 00 COMMISSIONING OF COMMUNICATIONS SYSTEMS.
L. Section 28 08 00 COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS.
M. Section 33 08 00 COMMISSIONING OF SITE UTILITIES.

**1.4 SUMMARY**

A. This Section includes general requirements that apply to implementation of commissioning without regard to systems, subsystems, and equipment being commissioned.
B. The commissioning activities have been developed to support the VA requirements to meet guidelines for Federal Leadership in Environmental, Energy, and Economic Performance.
C. The commissioning activities have been developed to support the United States Green Building Council's (USGBC) LEED ™ rating program and to support delivery of project performance in accordance with the VA requirements developed for the project to support the following credits:
   1. Commissioning activities and documentation for the LEED™ section on "Energy and Atmosphere" and the prerequisite of "Fundamental Building Systems Commissioning."
   2. Commissioning activities and documentation for the LEED™ section on "Energy and Atmosphere" requirements for the "Enhanced Building System Commissioning" credit.

3. Activities and documentation for the LEED™ section on "Measurement and Verification" requirements for the Measurement and Verification credit.

D. The commissioning activities have been developed to support the Green Buildings Initiative's Green Globes rating program and to support delivery of project performance in accordance with the VA requirements developed for the project.

**1.5 ACRONYMS**

| List of Acronyms | |
|---|---|
| Acronym | Meaning |
| A/E | Architect / Engineer Design Team |
| AHJ | Authority Having Jurisdiction |
| ASHRAE | Association Society for Heating Air Condition and Refrigeration Engineers |
| BOD | Basis of Design |
| BSC | Building Systems Commissioning |
| CCTV | Closed Circuit Television |
| CD | Construction Documents |
| CMMS | Computerized Maintenance Management System |
| CO | Contracting Officer (VA) |
| COR | Contracting Officer's Representative (see also VA-RE) |
| COBie | Construction Operations Building Information Exchange |
| CPC | Construction Phase Commissioning |
| Cx | Commissioning |
| CxA | Commissioning Agent |
| CxM | Commissioning Manager |
| CxR | Commissioning Representative |
| DPC | Design Phase Commissioning |
| FPT | Functional Performance Test |
| GBI-GG | Green Building Initiative - Green Globes |
| HVAC | Heating, Ventilation, and Air Conditioning |
| LEED | Leadership in Energy and Environmental Design |
| NC | Department of Veterans Affairs National Cemetery |
| NCA | Department of Veterans Affairs National Cemetery Administration |
| NEBB | National Environmental Balancing Bureau |

| List of Acronyms | |
|---|---|
| Acronym | Meaning |
| O&M | Operations & Maintenance |
| OPR | Owner's Project Requirements |
| PFC | Pre-Functional Checklist |
| PFT | Pre-Functional Test |
| SD | Schematic Design |
| SO | Site Observation |
| TAB | Test Adjust and Balance |
| VA | Department of Veterans Affairs |
| VAMC | VA Medical Center |
| VA CFM | VA Office of Construction and Facilities Management |
| VACO | VA Central Office |
| VA PM | VA Project Manager |
| VA-RE | VA Resident Engineer |
| USGBC | United States Green Building Council |

**1.6 DEFINITIONS**

**Acceptance Phase Commissioning:** Commissioning tasks executed after most construction has been completed, most Site Observations and Static Tests have been completed and Pre-Functional Testing has been completed and accepted. The main commissioning activities performed during this phase are verification that the installed systems are functional by conducting Systems Functional Performance tests and Owner Training.

**Accuracy:** The capability of an instrument to indicate the true value of a measured quantity.

**Back Check:** A back check is a verification that an agreed upon solution to a design comment has been adequately addressed in a subsequent design review

**Basis of Design (BOD):** The Engineer's Basis of Design is comprised of two components: the Design Criteria and the Design Narrative, these documents record the concepts, calculations, decisions, and product selections used to meet the Owner's Project Requirements (OPR) and to satisfy applicable regulatory requirements, standards, and guidelines.

**Benchmarks:** Benchmarks are the comparison of a building's energy usage to other similar buildings and to the building itself. For example,

ENERGY STAR Portfolio Manager is a frequently used and nationally recognized building energy benchmarking tool.

**Building Information Modeling (BIM):** Building Information Modeling is a parametric database which allows a building to be designed and constructed virtually in 3D and provides reports both in 2D views and as schedules. This electronic information can be extracted and reused for pre-populating facility management CMMS systems. Building Systems Commissioning (BSC): NEBB acronym used to designate its commissioning program.

**Calibrate:** The act of comparing an instrument of unknown accuracy with a standard of known accuracy to detect, correlate, report, or eliminate by adjustment any variation in the accuracy of the tested instrument.

**CCTV:** Closed circuit Television. Normally used for security surveillance and alarm detections as part of a special electrical security system.

**COBie:** Construction Operations Building Information Exchange (COBie) is an electronic industry data format used to transfer information developed during design, construction, and commissioning into the Computer Maintenance Management Systems (CMMS) used to operate facilities. See the Whole Building Design Guide website for further information (http://www.wbdg.org/resources/cobie.php)

**Commissionability:** Defines a design component or construction process that has the necessary elements that will allow a system or component to be effectively measured, tested, operated, and commissioned

**Commissioning Agent (CxA):** The qualified Commissioning Professional who administers the Cx process by managing the Cx team and overseeing the Commissioning Process. Where CxA is used in this specification it means the Commissioning Agent, members of his staff or appointed members of the commissioning team. Note that LEED uses the term Commissioning Authority in lieu of Commissioning Agent.

**Commissioning Checklists:** Lists of data or inspections to be verified to ensure proper system or component installation, operation, and function. Verification checklists are developed and used during all phases of the commissioning process to verify that the Owner’s Project Requirements (OPR) is being achieved.

**Commissioning Design Review:** The commissioning design review is a collaborative review of the design professionals design documents for

items pertaining to the following: owner's project requirements; basis of design; operability and maintainability (O&M) including documentation; functionality; training; energy efficiency, control systems' sequence of operations including building automation system features; commissioning specifications and the ability to functionally test the systems.

**Commissioning Issue:** A condition identified by the Commissioning Agent or other member of the Commissioning Team that adversely affects the commissionability, operability, maintainability, or functionality of a system, equipment, or component. A condition that conflicts with the Contract Documents and/or performance requirements of the installed systems and components. (See also - Commissioning Observation).

**Commissioning Manager (CxM):** A qualified individual appointed by the Contractor to manage the commissioning process on behalf of the Contractor.

**Commissioning Observation:** An issue identified by the Commissioning Agent or other member of the Commissioning Team that does not conform to the project OPR, contract documents or standard industry best practices. (See also Commissioning Issue)

**Commissioning Plan:** A document that outlines the commissioning process, commissioning scope and defines responsibilities, processes, schedules, and the documentation requirements of the Commissioning Process.

**Commissioning Process:** A quality focused process for enhancing the delivery of a project. The process focuses upon verifying and documenting that the facility and all its systems, components, and assemblies are planned, designed, installed, tested, can be operated, and maintained to meet the Owner's Project Requirements.

**Commissioning Report:** The final commissioning document which presents the commissioning process results for the project. Cx reports include an executive summary, the commissioning plan, issue log, correspondence, and all appropriate check sheets and test forms.

**Commissioning Representative (CxR): An individual appointed by a sub-contractor to manage the commissioning process on behalf of the sub-contractor.**

**Commissioning Specifications:** The contract documents that detail the objective, scope and implementation of the commissioning process as developed in the Commissioning Plan.

**Commissioning Team:** Individual team members whose coordinated actions are responsible for implementing the Commissioning Process.

**Construction Phase Commissioning:** All commissioning efforts executed during the construction process after the design phase and prior to the Acceptance Phase Commissioning.

**Contract Documents (CD):** Contract documents include design and construction contracts, price agreements and procedure agreements. Contract Documents also include all final and complete drawings, specifications and all applicable contract modifications or supplements.

**Construction Phase Commissioning (CPC):** All commissioning efforts executed during the construction process after the design phase and prior to the Acceptance Phase Commissioning.

**Coordination Drawings:** Drawings showing the work of all trades that are used to illustrate that equipment can be installed in the space allocated without compromising equipment function or access for maintenance and replacement. These drawings graphically illustrate and dimension manufacturers' recommended maintenance clearances. On mechanical projects, coordination drawings include structural steel, ductwork, major piping and electrical conduit and show the elevations and locations of the above components.

**Data Logging:** The monitoring and recording of temperature, flow, current, status, pressure, etc. of equipment using stand-alone data recorders.

**Deferred System Test:** Tests that cannot be completed at the end of the acceptance phase due to ambient conditions, schedule issues or other conditions preventing testing during the normal acceptance testing period.

**Deficiency:** See "Commissioning Issue".

**Design Criteria:** A listing of the VA Design Criteria outlining the project design requirements, including its source. These are used during the design process to show the design elements meet the OPR.

**Design Intent:** The overall term that includes the OPR and the BOD. It is a detailed explanation of the ideas, concepts, and criteria that are defined by the owner to be important. The design intent documents are utilized to provide a written record of these ideas, concepts and criteria.

**Design Narrative:** A written description of the proposed design solutions that satisfy the requirements of the OPR.

**Design Phase Commissioning (DPC):** All commissioning tasks executed during the design phase of the project.

**Environmental Systems:** Systems that use a combination of mechanical equipment, airflow, water flow and electrical energy to provide heating, ventilating, air conditioning, humidification, and dehumidification for the purpose of human comfort or process control of temperature and humidity.

**Executive Summary:** A section of the Commissioning report that reviews the general outcome of the project. It also includes any unresolved issues, recommendations for the resolution of unresolved issues and all deferred testing requirements.

**Functionality:** This defines a design component or construction process which will allow a system or component to operate or be constructed in a manner that will produce the required outcome of the OPR.

**Functional Test Procedure (FTP):** A written protocol that defines methods, steps, personnel, and acceptance criteria for tests conducted on components, equipment, assemblies, systems, and interfaces among systems.

**Industry Accepted Best Practice:** A design component or construction process that has achieved industry consensus for quality performance and functionality. Refer to the current edition of the NEBB Design Phase Commissioning Handbook for examples.

**Installation Verification:** Observations or inspections that confirm the system or component has been installed in accordance with the contract documents and to industry accepted best practices.

**Integrated System Testing:** Integrated Systems Testing procedures entail testing of multiple integrated systems performance to verify proper functional interface between systems. Typical Integrated Systems Testing includes verifying that building systems respond properly to loss of utility, transfer to emergency power sources, re-transfer from emergency power source to normal utility source; interface between HVAC controls and Fire Alarm systems for equipment shutdown, interface between Fire Alarm system and elevator control systems for elevator recall and shutdown; interface between Fire Alarm System and Security Access Control Systems to control access to spaces during fire alarm

conditions; and other similar tests as determined for each specific project.

Issues Log: A formal and ongoing record of problems or concerns - and their resolution - that have been raised by members of the Commissioning Team during the Commissioning Process.

**Lessons Learned Workshop:** A workshop conducted to discuss and document project successes and identify opportunities for improvements for future projects.

**Maintainability:** A design component or construction process that will allow a system or component to be effectively maintained. This includes adequate room for access to adjust and repair the equipment. Maintainability also includes components that have readily obtainable repair parts or service.

**Manual Test:** Testing using hand-held instruments, immediate control system readouts or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the 'observation').

**Owner's Project Requirements (OPR):** A written document that details the project requirements and the expectations of how the building and its systems will be used and operated. These include project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.

**Peer Review:** A formal in-depth review separate from the commissioning review processes. The level of effort and intensity is much greater than a typical commissioning facilitation or extended commissioning review. The VA usually hires an independent third-party (called the IDIQ A/E) to conduct peer reviews.

**Precision:** The ability of an instrument to produce repeatable readings of the same quantity under the same conditions. The precision of an instrument refers to its ability to produce a tightly grouped set of values around the mean value of the measured quantity.

**Pre-Design Phase Commissioning:** Commissioning tasks performed prior to the commencement of design activities that includes project programming and the development of the commissioning process for the project

**Pre-Functional Checklist (PFC):** A form used by the contractor to verify that appropriate components are onsite, correctly installed, set up, calibrated, functional and ready for functional testing.

**Pre-Functional Test (PFT):** An inspection or test that is done before functional testing. PFT's include installation verification and system and component start up tests.

**Procedure or Protocol:** A defined approach that outlines the execution of a sequence of work or operations. Procedures are used to produce repeatable and defined results.

**Range:** The upper and lower limits of an instrument's ability to measure the value of a quantity for which the instrument is calibrated.

**Resolution:** This word has two meanings in the Cx Process. The first refers to the smallest change in a measured variable that an instrument can detect. The second refers to the implementation of actions that correct a tested or observed deficiency.

**Site Observation Visit:** On-site inspections and observations made by the Commissioning Agent for the purpose of verifying component, equipment, and system installation, to observe contractor testing, equipment start-up procedures, or other purposes.

**Site Observation Reports (SO):** Reports of site inspections and observations made by the Commissioning Agent. Observation reports are intended to provide early indication of an installation issue which will need correction or analysis.

**Special System Inspections:** Inspections required by a local code authority prior to occupancy and are not normally a part of the commissioning process.

**Static Tests:** Tests or inspections that validate a specified static condition such as pressure testing. Static tests may be specification or code initiated.

**Start Up Tests:** Tests that validate the component or system is ready for automatic operation in accordance with the manufactures requirements.

**Systems Manual:** A system-focused composite document that includes all information required for the owners' operators to operate the systems.

**Test Procedure:** A written protocol that defines methods, personnel, and expectations for tests conducted on components, equipment, assemblies, systems, and interfaces among systems.

**Testing:** The use of specialized and calibrated instruments to measure parameters such as: temperature, pressure, vapor flow, air flow, fluid

flow, rotational speed, electrical characteristics, velocity, and other data to determine performance, operation, or function.

**Testing, Adjusting, and Balancing (TAB):** A systematic process or service applied to heating, ventilating and air-conditioning (HVAC) systems and other environmental systems to achieve and document air and hydronic flow rates. The standards and procedures for providing these services are referred to as "Testing, Adjusting, and Balancing" and are described in the Procedural Standards for the Testing, Adjusting and Balancing of Environmental Systems, published by NEBB or AABC.

**Thermal Scans:** Thermographic pictures taken with an Infrared Thermographic Camera. Thermographic pictures show the relative temperatures of objects and surfaces and are used to identify leaks, thermal bridging, thermal intrusion, electrical overload conditions, moisture containment, and insulation failure.

**Training Plan:** A written document that details, in outline form the expectations of the operator training. Training agendas should include instruction on how to obtain service, operate, startup, shutdown and maintain all systems and components of the project.

**Trending:** Monitoring over a period of time with the building automation system.

**Unresolved Commissioning Issue:** Any Commissioning Issue that, at the time that the Final Report or the Amended Final Report is issued that has not been either resolved by the construction team or accepted by the VA. Validation: The process by which work is verified as complete and operating correctly:

1. First party validation occurs when a firm or individual verifying the task is the same firm or individual performing the task.
2. Second party validation occurs when the firm or individual verifying the task is under the control of the firm performing the task or has other possibilities of financial conflicts of interest in the resolution (Architects, Designers, General Contractors and Third Tier Subcontractors or Vendors).
3. Third party validation occurs when the firm verifying the task is not associated with or under control of the firm performing or designing the task.

**Verification:** The process by which specific documents, components, equipment, assemblies, systems, and interfaces among systems are

confirmed to comply with the criteria described in the Owner's Project Requirements.

**Warranty Phase Commissioning:** Commissioning efforts executed after a project has been completed and accepted by the Owner. Warranty Phase Commissioning includes follow-up on verification of system performance, measurement and verification tasks and assistance in identifying warranty issues and enforcing warranty provisions of the construction contract.

**Warranty Visit:** A commissioning meeting and site review where all outstanding warranty issues and deferred testing is reviewed and discussed.

**Whole Building Commissioning:** Commissioning of building systems such as Building Envelope, HVAC, Electrical, Special Electrical (Fire Alarm, Security & Communications), Plumbing and Fire Protection as described in this specification.

**1.7 SYSTEMS TO BE COMMISSIONED**

A. Commissioning of a system or systems specified for this project is part of the construction process. Documentation and testing of these systems, as well as training of the VA's Operation and Maintenance personnel, is required in cooperation with the VA and the Commissioning Agent.

B. The following systems will be commissioned as part of this project:

| **Systems To Be Commissioned** | |
|---|---|
| **System** | **Description** |
| **Building Exterior Closure** | |
| Foundations (excluding structural) | Standard, special, slab-on-grade, vapor barriers, air barriers |
| Basements | Basement walls, crawl spaces, waterproofing, drainage |
| Superstructure | Floor construction, roof construction, sunshades, connections to adjacent structures |
| Exterior Closure | Exterior walls, exterior windows, exterior doors, louvers, grilles and sunscreens, |

| Systems To Be Commissioned | |
|---|---|
| **System** | **Description** |
| Roofing | Roof system (including parapet), roof openings (skylights, pipe chases, ducts, equipment curbs, etc.) |
| Note: | The emphasis on commissioning the above building envelope systems is on control of air flow, heat flow, noise, infrared, ultraviolet, rain penetration, moisture, durability, security, reliability, constructability, maintainability, and sustainability. |
| **Specialties** | |
| | |
| **Equipment** | |
| Parking Control Equipment | Barriers |
| Laboratory Fume Hoods | Fume Hood Certification |
| Biological Safety Cabinets | Cabinet Certification |
| | |
| **Conveying Equipment** | |
| | |
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| | |
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| | |
| **Fire Suppression** | |
| Fire Pump | Fire Pump, jockey pump, fire pump controller/ATS |
| Fire Sprinkler Systems | Wet pipe system, dry pipe system, pre-action system, special agent systems |
| **Plumbing** | |
| Domestic Water Distribution | Booster pumps, backflow preventers, water softeners, potable water storage tanks |

| Systems To Be Commissioned | |
|---|---|
| **System** | **Description** |
| Domestic Hot Water Systems | Water heaters**, heat exchangers, circulation pumps, point-of-use water heaters* |
| Sewerage Pump Systems | Sewage ejectors |
| Wastewater Pump Systems | Sump pumps |
| Sanitary Waste Interceptors | Grease interceptors, acid neutralizers |
| General Service Air Systems | Packaged compressor systems, air dryers, filtration |
| | |
| | |
| Dental Air Systems | Packaged dental air compressor units, outlet certification, cross-connect verification |
| Dental Evacuation and Vacuum Systems | Packaged Dental Evacuation units, packaged dental vacuum units, outlet certification, cross-connection verification |
| Waste Anesthesia Gas Systems | Packaged Waste Anesthesia Gas units, outlet certification, cross-connection verification |
| Medical Gas Systems (other than Medical Air Systems) | Medical gas (oxygen, nitrogen, nitrous oxide, etc.) tank/manifold systems, outlet certification, cross-connection verification |
| Chemical Waste Systems | Chemical storage tanks, neutralization systems, ventilation, process control |
| Reverse-Osmosis Systems | Packaged Reverse-Osmosis systems |
| Water De-Alkalizing Systems | Package Water De-Alkalizing systems |
| **HVAC** | |
| Noise and Vibration Control | Noise and vibration levels for critical equipment such as Air Handlers, Chillers, Cooling Towers, Boilers, Generators, etc. will be commissioned as part of the system commissioning |

| Systems To Be Commissioned | |
|---|---|
| **System** | **Description** |
| Direct Digital Control System** | Operator Interface Computer, Operator Work Station (including graphics, point mapping, trends, alarms), Network Communications Modules and Wiring, Integration Panels. [DDC Control panels will be commissioned with the systems controlled by the panel] |
| Chilled Water System** | Chillers (centrifugal, rotary screw, air-cooled), pumps (primary, secondary, variable primary), VFDs associated with chilled water system components, DDC Control Panels (including integration with Building Control System) |
| Condenser Water System** | Cooling Towers, Fluid Coolers, heat exchangers/economizers, pumps, VFDs associated with condenser water system components, DDC control panels. |
| Steam/Heating Hot Water System** | Boilers, boiler feed water system, economizers/heat recovery equipment, condensate recovery, water treatment, boiler fuel system, controls, interface with facility DDC system. |
| HVAC Air Handling Systems** | Air handling Units, packaged rooftop AHU, Outdoor Air conditioning units, humidifiers, DDC control panels |
| HVAC Ventilation/Exhaust Systems | General exhaust, toilet exhaust, laboratory exhaust, isolation exhaust, room pressurization control systems |
| HVAC Energy Recovery Systems** | Heat Wheels, Heat Recovery Loops, AHU Integrated Heat Recovery |
| HVAC Terminal Unit Systems** | VAV Terminal Units, CAV terminal units, fan coil units, fin-tube radiation, unit heaters |
| Decentralized Unitary HVAC Systems* | Split-system HVAC systems, controls, interface with facility DDC |

| Systems To Be Commissioned | |
|---|---|
| **System** | **Description** |
| Unitary Heat Pump Systems** | Water-source heat pumps, controls, interface with facility DDC |
| Humidity Control Systems | Humidifiers, de-humidifiers, controls, interface with facility DDC |
| Hydronic Distribution Systems | Pumps, DDC control panels, heat exchangers, |
| Facility Fuel Systems | Boiler fuel system, generator fuel system |
| Geothermal Energy Direct Use Heating ** | Geothermal well, ground heat exchanger, geothermal pumps, heat exchanger, valves, instrumentation |
| Solar Energy Heating Systems ** | Solar collectors, heat exchangers, storage tanks, solar-boosted domestic hot water heater, pumps, valves, instrumentation |
| Facility Fuel Gas Systems | Witness Natural gas piping pressure testing, natural gas compressors and storage, propane storage |
| Smoke Evacuation System | Atrium smoke evacuation, other smoke evacuation and smoke management systems, controls, interface with other systems (fire alarm), emergency operation. |
| **Electrical** | |
| Medium-Voltage Electrical Distribution Systems | Medium-Voltage Switchgear, Medium-Voltage Switches, Underground ductbank and distribution, Pad-Mount Transformers, Medium-Voltage Load Interrupter Switches, |
| Grounding & Bonding Systems | Witness 3rd party testing, review reports |
| Electric Power Monitoring Systems | Metering, sub-metering, power monitoring systems, PLC control systems |
| Electrical System Protective Device Study | Review reports, verify field settings consistent with Study |

| Systems To Be Commissioned | |
|---|---|
| **System** | **Description** |
| Secondary Unit Substations | Medium-voltage components, transformers, low-voltage distribution, verify breaker testing results (injection current, etc) |
| Low-Voltage Distribution System | Normal power distribution system, Life-safety power distribution system, critical power distribution system, equipment power distribution system, switchboards, distribution panels, panelboards, verify breaker testing results (injection current, etc) |
| Emergency Power Generation Systems | Generators, Generator paralleling switchgear, automatic transfer switches, PLC and other control systems |
| Lighting & Lighting Control** Systems | Emergency lighting, occupancy sensors, lighting control systems, architectural dimming systems, theatrical dimming systems, exterior lighting, and controls |
| Cathodic Protection Systems | Review 3rd party testing results. |
| Lightning Protection System | Witness 3rd party testing, review reports |
| | |
| **Communications** | |
| Grounding & Bonding System | Witness 3rd party testing, review reports |
| Structured Cabling System | Witness 3rd party testing, review reports |
| Master Antenna Television System | Witness 3rd party testing, review reports |
| Public Address & Mass Notification Systems | Witness 3rd party testing, review reports |
| Intercom & Program Systems | Witness 3rd party testing, review reports |

| Systems To Be Commissioned | |
|---|---|
| **System** | **Description** |
| Nurse Call & Code Blue Systems | Witness 3rd party testing, review reports |
| Security Emergency Call Systems | Witness 3rd party testing, review reports |
| Duress Alarm Systems | Witness 3rd party testing, review reports |
| **Electronic Safety and Security** | |
| Grounding & Bonding | Witness 3rd party testing, review reports |
| Physical Access Control Systems | Witness 3rd party testing, review reports |
| Access Control Systems | Witness 3rd party testing, review reports |
| Security Access Detection Systems | Witness 3rd party testing, review reports |
| Video Surveillance System | Witness 3rd party testing, review reports |
| Electronic Personal Protection System | Witness 3rd party testing, review reports |
| Fire Detection and Alarm System | 100% device acceptance testing, battery draw-down test, verify system monitoring, verify interface with other systems. |
| **Renewable Energy Sources** | |
| Geothermal Energy Electrical Generation Systems ** | Geothermal well, DC-AC Inverters, storage batteries, turbine generator modules, switchgear, combiner boxes, instrumentation, monitoring and control systems |
| Solar Energy Electrical Power Generation Systems ** | Solar collector modules, DC-AC inverter, storage batteries, combiners, Switchgear, instrumentation, monitoring and control systems |
| Wind Energy Electrical Power Generation Systems ** | Wind Turbines, DC-AC inverter, storage batteries, combiners, switchgear, instrumentation, monitoring and control systems |
| | |

| Systems To Be Commissioned | |
|---|---|
| **System** | **Description** |
| **Site Utilities** | |
| Water Utilities | City Water Service Entrance, Backflow Prevention, Pressure Control, Booster Pumps, Irrigation Systems |
| Sanitary Sewerage Utilities | City Sanitary Connection, Waste Treatment Systems |
| Storm Drainage Utilities | City Storm Water Connection, Site Storm Water Distribution |
| Energy Distribution Utilities | Connection to Third Party Energy (Steam, High Temp Hot Water, Chilled Water) Supply Systems, Metering, Pressure Control |
| | |
| **Transportation** | |
| Active Traffic Barrier Systems | Witness 3rd party testing |
| **Integrated Systems Tests** | |
| Loss of Power Response | Loss of power to building, loss of power to campus, restoration of power to building, restoration of power to campus. |
| Fire Alarm Response | Integrated System Response to Fire Alarm Condition and Return to Normal |
| **Table Notes** | |
| ** Denotes systems that LEED requires to be commissioned to comply with the LEED Fundamental Commissioning pre-requisite. | |

**1.8 COMMISSIONING TEAM**

A. The commissioning team shall consist of, but not be limited to, representatives of Contractor, including Project Superintendent and subcontractors, installers, schedulers, suppliers, and specialists deemed appropriate by the Department of Veterans Affairs (VA) and Commissioning Agent.

B. Members Appointed by Contractor:

1. Contractor' Commissioning Manager: The designated person, company, or entity that plans, schedules, and coordinates the commissioning activities for the construction team.
2. Contractor's Commissioning Representative(s): Individual(s), each having authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated actions.

C. Members Appointed by VA:
1. Commissioning Agent: The designated person, company, or entity that plans, schedules, and coordinates the commissioning team to implement the commissioning process. The VA will engage the CxA under a separate contract.
2. User: Representatives of the facility user and operation and maintenance personnel.
3. A/E: Representative of the Architect and engineering design professionals.

**1.9 VA'S COMMISSIONING RESPONSIBILITIES**

A. Appoint an individual, company or firm to act as the Commissioning Agent.
B. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities including, but not limited to, the following:
1. Coordination meetings.
2. Training in operation and maintenance of systems, subsystems, and equipment.
3. Testing meetings.
4. Witness and assist in Systems Functional Performance Testing.
5. Demonstration of operation of systems, subsystems, and equipment.

C. Provide the Construction Documents, prepared by Architect and approved by VA, to the Commissioning Agent and for use in managing the commissioning process, developing the commissioning plan, systems manuals, and reviewing the operation and maintenance training plan.

**1.10 CONTRACTOR'S COMMISSIONING RESPONSIBILITIES**

A. The Contractor shall assign a Commissioning Manager to manage commissioning activities of the Contractor, and subcontractors.
B. The Contractor shall ensure that the commissioning responsibilities outlined in these specifications are included in all subcontracts and

that subcontractors comply with the requirements of these specifications.

C. The Contractor shall ensure that each installing subcontractor shall assign representatives with expertise and authority to act on behalf of the subcontractor and schedule them to participate in and perform commissioning team activities including, but not limited to, the following:

1. Participate in commissioning coordination meetings.
2. Conduct operation and maintenance training sessions in accordance with approved training plans.
3. Verify that Work is complete, and systems are operational according to the Contract Documents, including calibration of instrumentation and controls.
4. Evaluate commissioning issues and commissioning observations identified in the Commissioning Issues Log, field reports, test reports or other commissioning documents. In collaboration with entity responsible for system and equipment installation, recommend corrective action.
5. Review and comment on commissioning documentation.
6. Participate in meetings to coordinate Systems Functional Performance Testing.
7. Provide schedule for operation and maintenance data submittals, equipment startup, and testing to Commissioning Agent for incorporation into the commissioning plan.
8. Provide information to the Commissioning Agent for developing commissioning plan.
9. Participate in training sessions for VA's operation and maintenance personnel.
10. Provide technicians who are familiar with the construction and operation of installed systems and who shall develop specific test procedures to conduct Systems Functional Performance Testing of installed systems.

**1.11 COMMISSIONING AGENT'S RESPONSIBILITIES**

A. Organize and lead the commissioning team.

B. Prepare the commissioning plan. See Paragraph 1.11-A of this specification Section for further information.

C. Review and comment on selected submittals from the Contractor for general conformance with the Construction Documents. Review and comment on the ability to test and operate the system and/or equipment, including providing gages, controls and other components required to operate, maintain, and test the system. Review and comment on performance expectations of systems and equipment and interfaces between systems relating to the Construction Documents.

D. At the beginning of the construction phase, conduct an initial construction phase coordination meeting for the purpose of reviewing the commissioning activities and establishing tentative schedules for operation and maintenance submittals; operation and maintenance training sessions; TAB Work; Pre-Functional Checklists, Systems Functional Performance Testing; and project completion.

E. Convene commissioning team meetings for the purpose of coordination, communication, and conflict resolution; discuss status of the commissioning processes. Responsibilities include arranging for facilities, preparing agenda and attendance lists, and notifying participants. The Commissioning Agent shall prepare and distribute minutes to commissioning team members and attendees within five workdays of the commissioning meeting.

F. Observe construction and report progress, observations, and issues. Observe systems and equipment installation for adequate accessibility for maintenance and component replacement or repair, and for general conformance with the Construction Documents.

G. Prepare Project specific Pre-Functional Checklists and Systems Functional Performance Test procedures.

H. Coordinate Systems Functional Performance Testing schedule with the Contractor.

I. Witness selected systems startups.

J. Verify selected Pre-Functional Checklists completed and submitted by the Contractor.

K. Witness and document Systems Functional Performance Testing.

L. Compile test data, inspection reports, and certificates and include them in the systems manual and commissioning report.

M. Review and comment on operation and maintenance (O&M) documentation and systems manual outline for compliance with the Contract Documents.

Operation and maintenance documentation requirements are specified in Paragraph 1.25, Section 01 00 00 GENERAL REQUIREMENTS.

N. Review operation and maintenance training program developed by the Contractor. Verify training plans provide qualified instructors to conduct operation and maintenance training.
O. Prepare commissioning Field Observation Reports.
P. Prepare the Final Commissioning Report.
Q. Return to the site at 10 months into the 12-month warranty period and review with facility staff the current building operation and the condition of outstanding issues related to the original and seasonal Systems Functional Performance Testing. Also interview facility staff and identify problems or concerns they have operated the building as originally intended. Make suggestions for improvements and for recording these changes in the O&M manuals. Identify areas that may come under warranty or under the original construction contract. Assist facility staff in developing reports, documents, and requests for services to remedy outstanding problems.
R. Assemble the final commissioning documentation, including the Final Commissioning Report and Addendum to the Final Commissioning Report.

**1.12 COMMISSIONING DOCUMENTATION**

A. Commissioning Plan: A document, prepared by Commissioning Agent, that outlines the schedule, allocation of resources, and documentation requirements of the commissioning process, and shall include, but is not limited, to the following:
   1. Plan for delivery and review of submittals, systems manuals, and other documents and reports. Identification of the relationship of these documents to other functions and a detailed description of submittals that are required to support the commissioning processes. Submittal dates shall include the latest date approved submittals must be received without adversely affecting commissioning plan.
   2. Description of the organization, layout, and content of commissioning documentation (including systems manual) and a detailed description of documents to be provided along with identification of responsible parties.
   3. Identification of systems and equipment to be commissioned.
   4. Schedule of Commissioning Coordination meetings.

5. Identification of items that must be completed before the next operation can proceed.
6. Description of responsibilities of commissioning team members.
7. Description of observations to be made.
8. Description of requirements for operation and maintenance training.
9. Schedule for commissioning activities with dates coordinated with overall construction schedule.
10. Process and schedule for documenting changes on a continuous basis to appear in Project Record Documents.
11. Process and schedule for completing prestart and startup checklists for systems, subsystems, and equipment to be verified and tested.
12. Preliminary Systems Functional Performance Test procedures.

B. Systems Functional Performance Test Procedures: The Commissioning Agent will develop Systems Functional Performance Test Procedures for each system to be commissioned, including subsystems, or equipment and interfaces or interlocks with other systems. Systems Functional Performance Test Procedures will include a separate entry, with space for comments, for each item to be tested. Preliminary Systems Functional Performance Test Procedures will be provided to the VA, Architect/Engineer, and Contractor for review and comment. The Systems Performance Test Procedure will include test procedures for each mode of operation and provide space to indicate whether the mode under test responded as required. Each System Functional Performance Test procedure, regardless of system, subsystem, or equipment being tested, shall include, but not be limited to, the following:

1. Name and identification code of tested system.
2. Test number.
3. Time and date of test.
4. Indication of whether the record is for a first test or retest following correction of a problem or issue.
5. Dated signatures of the person performing test and of the witness, if applicable.
6. Individuals present for test.
7. Observations and Issues.
8. Issue number, if any, generated as the result of test.

C. Pre-Functional Checklists: The Commissioning Agent will prepare Pre-Functional Checklists. Pre-Functional Checklists shall be completed

and signed by the Contractor, verifying that systems, subsystems, equipment, and associated controls are ready for testing. The Commissioning Agent will spot check Pre-Functional Checklists to verify accuracy and readiness for testing. Inaccurate or incomplete Pre-Functional Checklists shall be returned to the Contractor for correction and resubmission.

D. Test and Inspection Reports: The Commissioning Agent will record test data, observations, and measurements on Systems Functional Performance Test Procedure. The report will also include recommendation for system acceptance or non-acceptance. Photographs, forms, and other means appropriate for the application shall be included with data. Commissioning Agent Will compile test and inspection reports and test and inspection certificates and include them in systems manual and commissioning report.

E. Corrective Action Documents: The Commissioning Agent will document corrective action taken for systems and equipment that fail tests. The documentation will include any required modifications to systems and equipment and/or revisions to test procedures, if any. The Commissioning Agent will witness and document any retesting of systems and/or equipment requiring corrective action and document retest results.

F. Commissioning Issues Log: The Commissioning Agent will prepare and maintain Commissioning Issues Log that describes Commissioning Issues and Commissioning Observations that are identified during the Commissioning process. These observations and issues include, but are not limited to, those that are at variance with the Contract Documents. The Commissioning Issues Log will identify and track issues as they are encountered, the party responsible for resolution, progress toward resolution, and document how the issue was resolved. The Master Commissioning Issues Log will also track the status of unresolved issues.

1. Creating a Commissioning Issues Log Entry:
   a. Identify the issue with unique numeric or alphanumeric identifier by which the issue may be tracked.
   b. Assign a descriptive title for the issue.
   c. Identify date and time of the issue.

d. Identify test number of test being performed at the time of the observation, if applicable, for cross reference.
e. Identify system, subsystem, and equipment to which the issue applies.
f. Identify location of system, subsystem, and equipment.
g. Include information that may be helpful in diagnosing or evaluating the issue.
h. Note recommended corrective action.
i. Identify commissioning team member responsible for corrective action.
j. Identify expected date of correction.
k. Identify person that identified the issue.

2. Documenting Issue Resolution:
a. Log date correction is completed, or the issue is resolved.
b. Describe corrective action or resolution taken. Include description of diagnostic steps taken to determine root cause of the issue, if any.
c. Identify changes to the Contract Documents that may require action.
d. State that correction was completed, and system, subsystem, and equipment are ready for retest, if applicable.
e. Identify person(s) who corrected or resolved the issue.
f. Identify person(s) verifying the issue resolution.

G. Final Commissioning Report: The Commissioning Agent will document results of the commissioning process, including unresolved issues, and performance of systems, subsystems, and equipment. The Commissioning Report will indicate whether systems, subsystems, and equipment have been properly installed and are performing according to the Contract Documents. This report will be used by the Department of Veterans Affairs when determining that systems will be accepted. This report will be used to evaluate systems, subsystems, and equipment and will serve as a future reference document during VA occupancy and operation. It shall describe components and performance that exceed requirements of the Contract Documents and those that do not meet requirements of the Contract Documents. The commissioning report will include, but is not limited to, the following:

1. Lists and explanations of substitutions; compromises; variances with the Contract Documents; record of conditions; and, if appropriate, recommendations for resolution. Design Narrative documentation maintained by the Commissioning Agent.
2. Commissioning plan.
3. Pre-Functional Checklists completed by the Contractor, with annotation of the Commissioning Agent review and spot check.
4. Systems Functional Performance Test Procedures, with annotation of test results and test completion.
5, Commissioning Issues Log.
6. Listing of deferred and off-season test(s) not performed, including the schedule for their completion.

H. Addendum to Final Commissioning Report: The Commissioning Agent will prepare an Addendum to the Final Commissioning Report near the end of the Warranty Period. The Addendum will indicate whether systems, subsystems, and equipment are complete and continue to perform according to the Contract Documents. The Addendum to the Final Commissioning Report shall include, but is not limited to, the following:

1. Documentation of deferred and off-season test(s) results.
2. Completed Systems Functional Performance Test Procedures for off season test(s).
3. Documentation that unresolved system performance issues have been resolved.
4. Updated Commissioning Issues Log, including status of unresolved issues.
5. Identification of potential Warranty Claims to be corrected by the Contractor.

I. Systems Manual: The Commissioning Agent will gather required information and compile the Systems Manual. The Systems Manual will include, but is not limited to, the following:

1. Design Narrative, including system narratives, schematics, single-line diagrams, flow diagrams, equipment schedules, and changes made throughout the Project.
2. Reference to Final Commissioning Plan.
3. Reference to Final Commissioning Report.

4. Approved Operation and Maintenance Data as submitted by the Contractor.

**1.13 SUBMITTALS**

A. Preliminary Commissioning Plan Submittal: The Commissioning Agent has prepared a Preliminary Commissioning Plan based on the final Construction Documents. The Preliminary Commissioning Plan is included as an Appendix to this specification section. The Preliminary Commissioning Plan is provided for information only. It contains preliminary information about the following commissioning activities:

1. The Commissioning Team: A list of commissioning team members by organization.
2. Systems to be commissioned. A detailed list of systems to be commissioned for the project. This list also provides preliminary information on systems/equipment submittals to be reviewed by the Commissioning Agent; preliminary information on Pre-Functional Checklists that are to be completed; preliminary information on Systems Performance Testing, including information on testing sample size (where authorized by the VA).
3. Commissioning Team Roles and Responsibilities: Preliminary roles and responsibilities for each Commissioning Team member.
4. Commissioning Documents: A preliminary list of commissioning-related documents, include identification of the parties responsible for preparation, review, approval, and action on each document.
5. Commissioning Activities Schedule: Identification of Commissioning Activities, including Systems Functional Testing, the expected duration and predecessors for the activity.
6. Pre-Functional Checklists: Preliminary Pre-Functional Checklists for equipment, components, subsystems, and systems to be commissioned. These Preliminary Pre-Functional Checklists provide guidance on the level of detailed information the Contractor shall include on the final submission.
7. Systems Functional Performance Test Procedures: Preliminary step-by-step System Functional Performance Test Procedures to be used during Systems Functional Performance Testing. These Preliminary Systems Functional Performance procedures provide information on the level of testing rigor, and the level of Contractor support required during performance of system's testing.

B. Final Commissioning Plan Submittal: Based on the Final Construction Documents and the Contractor's project team, the Commissioning Agent will prepare the Final Commissioning Plan as described in this section. The Commissioning Agent will submit three hard copies and three sets of electronic files of Final Commissioning Plan. The Contractor shall review the Commissioning Plan and provide any comments to the VA. The Commissioning Agent will incorporate review comments into the Final Commissioning Plan as directed by the VA.

C. Systems Functional Performance Test Procedure: The Commissioning Agent will submit preliminary Systems Functional Performance Test Procedures to the Contractor, and the VA for review and comment. The Contractor shall return review comments to the VA and the Commissioning Agent. The VA will also return review comments to the Commissioning Agent. The Commissioning Agent will incorporate review comments into the Final Systems Functional Test Procedures to be used in Systems Functional Performance Testing.

D. Pre-Functional Checklists: The Commissioning Agent will submit Pre-Functional Checklists to be completed by the Contractor.

E. Test and Inspection Reports: The Commissioning Agent will submit test and inspection reports to the VA with copies to the Contractor and the Architect/Engineer.

F. Corrective Action Documents: The Commissioning Agent will submit corrective action documents to the VA Resident Engineer with copies to the Contractor and Architect.

G. Preliminary Commissioning Report Submittal: The Commissioning Agent will submit three electronic copies of the preliminary commissioning report. One electronic copy, with review comments, will be returned to the Commissioning Agent for preparation of the final submittal.

H. Final Commissioning Report Submittal: The Commissioning Agent will submit four sets of electronically formatted information of the final commissioning report to the VA. The final submittal will incorporate comments as directed by the VA.

I. Data for Commissioning:

1. The Commissioning Agent will request in writing from the Contractor specific information needed about each piece of commissioned equipment or system to fulfill requirements of the Commissioning Plan.

2. The Commissioning Agent may request further documentation as is necessary for the commissioning process or to support other VA data collection requirements, including Construction Operations Building Information Exchange (COBIE), Building Information Modeling (BIM), etc.

**1.14 COMMISSIONING PROCESS**

A. The Commissioning Agent will be responsible for the overall management of the commissioning process as well as coordinating scheduling of commissioning tasks with the VA and the Contractor. As directed by the VA, the Contractor shall incorporate Commissioning tasks, including, but not limited to, Systems Functional Performance Testing (including predecessors) with the Master Construction Schedule.

B. Within 30 days of contract award, the Contractor shall designate a specific individual as the Commissioning Manager (CxM) to manage and lead the commissioning effort on behalf of the Contractor. The Commissioning Manager shall be the single point of contact and communications for all commissioning related services by the Contractor.

C. Within 30 days of contract award, the Contractor shall ensure that each subcontractor designates specific individuals as Commissioning Representatives (CXR) to be responsible for commissioning related tasks. The Contractor shall ensure the designated Commissioning Representatives participate in the commissioning process as team members providing commissioning testing services, equipment operation, adjustments, and corrections if necessary. The Contractor shall ensure that all Commissioning Representatives shall have sufficient authority to direct their respective staff to provide the services required, and to speak on behalf of their organizations in all commissioning related contractual matters.

**1.15 QUALITY ASSURANCE**

A. Instructor Qualifications: Factory authorized service representatives shall be experienced in training, operation, and maintenance procedures for installed systems, subsystems, and equipment.

B. Test Equipment Calibration: The Contractor shall comply with test equipment manufacturer's calibration procedures and intervals. Recalibrate test instruments immediately whenever instruments have been repaired following damage or dropping. Affix calibration tags to test

instruments. Instruments shall have been calibrated within six months prior to use.

**1.16 COORDINATION**

A. Management: The Commissioning Agent will coordinate the commissioning activities with the VA and Contractor. The Commissioning Agent will submit commissioning documents and information to the VA. All commissioning team members shall work together to fulfill their contracted responsibilities and meet the objectives of the contract documents.

B. Scheduling: The Contractor shall work with the Commissioning Agent and the VA to incorporate the commissioning activities into the construction schedule. The Commissioning Agent will provide sufficient information (including, but not limited to, tasks, durations and predecessors) on commissioning activities to allow the Contractor and the VA to schedule commissioning activities. All parties shall address scheduling issues and make necessary notifications in a timely manner in order to expedite the project and the commissioning process. The Contractor shall update the Master Construction as directed by the VA.

C. Initial Schedule of Commissioning Events: The Commissioning Agent will provide the initial schedule of primary commissioning events in the Commissioning Plan and at the commissioning coordination meetings. The Commissioning Plan will provide a format for this schedule. As construction progresses, more detailed schedules will be developed by the Contractor with information from the Commissioning Agent.

D. Commissioning Coordinating Meetings: The Commissioning Agent will conduct periodic Commissioning Coordination Meetings of the commissioning team to review status of commissioning activities, to discuss scheduling conflicts, and to discuss upcoming commissioning process activities.

E. Pretesting Meetings: The Commissioning Agent will conduct pretest meetings of the commissioning team to review startup reports, Pre-Functional Checklist results, Systems Functional Performance Testing procedures, testing personnel and instrumentation requirements.

F. Systems Functional Performance Testing Coordination: The Contractor shall coordinate testing activities to accommodate required quality assurance and control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing

and inspecting. The Contractor shall coordinate the schedule times for tests, inspections, obtaining samples, and similar activities.

**PART 2 - PRODUCTS**

**2.1 TEST EQUIPMENT**

A. The Contractor shall provide all standard and specialized testing equipment required to perform Systems Functional Performance Testing. Test equipment required for Systems Functional Performance Testing will be identified in the detailed System Functional Performance Test Procedure prepared by the Commissioning Agent.

B. Data logging equipment and software required to test equipment shall be provided by the Contractor.

C. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the Specifications. If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers shall have a certified calibration within the past year to an accuracy of 0.5 °C (1.0 °F) and a resolution of + or - 0.1 °C (0.2 °F). Pressure sensors shall have an accuracy of + or - 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year. All equipment shall be calibrated according to the manufacturer's recommended intervals and following any repairs to the equipment. Calibration tags shall be affixed or certificates readily available.

**PART 3 – EXECUTION**

**3.1 COMMISSIONING PROCESS ROLES AND RESPONSIBILITIES**

A. The following table outlines the roles and responsibilities for the Commissioning Team members during the Construction Phase:

| **Construction Phase** | | CxA = Commissioning Agent<br>RE = Resident Engineer<br>A/E = Design Arch/Engineer<br>PC = Prime Contractor<br>O&M = Gov't Facility O&M | | | | | L = Lead<br>P = Participate<br>A = Approve<br>R = Review<br>O = Optional |
|---|---|---|---|---|---|---|---|
| Commissioning Roles & Responsibilities | | | | | | | |
| Category | Task Description | CxA | RE | A/E | PC | O&M | Notes |
| Meetings | Construction Commissioning Kick Off meeting | L | A | P | P | O | |
| | Commissioning Meetings | L | A | P | P | O | |
| | Project Progress Meetings | P | A | P | L | O | |
| | Controls Meeting | L | A | P | P | O | |
| | | | | | | | |
| Coordination | Coordinate with [OGC's, AHJ, Vendors, etc.] to ensure that Cx interacts properly with other systems as needed to support the OPR and BOD. | L | A | P | P | N/A | |
| | | | | | | | |
| Cx Plan & Spec | Final Commissioning Plan | L | A | R | R | O | |
| | | | | | | | |
| Schedules | Duration Schedule for Commissioning Activities | L | A | R | R | N/A | |
| | | | | | | | |

| **Construction Phase** | | CxA = Commissioning Agent<br>RE = Resident Engineer<br>A/E = Design Arch/Engineer<br>PC = Prime Contractor<br>O&M = Gov't Facility O&M | | | | | L = Lead<br>P = Participate<br>A = Approve<br>R = Review<br>O = Optional |
|---|---|---|---|---|---|---|---|
| Commissioning Roles & Responsibilities | | | | | | | |
| Category | Task Description | CxA | RE | A/E | PC | O&M | Notes |
| OPR and BOD | Maintain OPR on behalf of Owner | L | A | R | R | O | |
| | Maintain BOD/DID on behalf of Owner | L | A | R | R | O | |
| | | | | | | | |
| Document Reviews | TAB Plan Review | L | A | R | R | O | |
| | Submittal and Shop Drawing Review | R | A | R | L | O | |
| | Review Contractor Equipment Startup Checklists | L | A | R | R | N/A | |
| | Review Change Orders, ASI, and RFI | L | A | R | R | N/A | |
| | | | | | | | |
| | | | | | | | |
| Site Observations | Witness Factory Testing | P | A | P | L | O | |
| | Construction Observation Site Visits | L | A | R | R | O | |
| | | | | | | | |
| | | | | | | | |
| Functional Test Protocols | Final Pre-Functional Checklists | L | A | R | R | O | |
| | Final Functional Performance Test Protocols | L | A | R | R | O | |
| | | | | | | | |
| Technical Activities | Issues Resolution Meetings | P | A | P | L | O | |
| | | | | | | | |

| **Construction Phase** | | CxA = Commissioning Agent<br>RE = Resident Engineer<br>A/E = Design Arch/Engineer<br>PC = Prime Contractor<br>O&M = Gov't Facility O&M | | | | | L = Lead<br>P = Participate<br>A = Approve<br>R = Review<br>O = Optional |
|---|---|---|---|---|---|---|---|
| Commissioning Roles & Responsibilities | | | | | | | |
| Category | Task Description | CxA | RE | A/E | PC | O&M | Notes |
| Reports and Logs | Status Reports | L | A | R | R | O | |
| | Maintain Commissioning Issues Log | L | A | R | R | O | |
| | | | | | | | |

B. The following table outlines the roles and responsibilities for the Commissioning Team members during the Acceptance Phase:

| **Acceptance Phase** | | CxA = Commissioning Agent<br>RE = Resident Engineer<br>A/E = Design Arch/Engineer<br>PC = Prime Contractor<br>O&M = Gov't Facility O&M | | | | | L = Lead<br>P = Participate<br>A = Approve<br>R = Review<br>O = Optional |
|---|---|---|---|---|---|---|---|
| Commissioning Roles & Responsibilities | | | | | | | |
| Category | Task Description | CxA | RE | A/E | PC | O&M | Notes |
| Meetings | Commissioning Meetings | L | A | P | P | O | |
| | Project Progress Meetings | P | A | P | L | O | |
| | Pre-Test Coordination Meeting | L | A | P | P | O | |
| | Lessons Learned and Commissioning Report Review Meeting | L | A | P | P | O | |
| | | | | | | | |

| **Acceptance Phase** | | CxA = Commissioning Agent<br>RE = Resident Engineer<br>A/E = Design Arch/Engineer<br>PC = Prime Contractor<br>O&M = Gov't Facility O&M | | | | | L = Lead<br>P = Participate<br>A = Approve<br>R = Review<br>O = Optional |
|---|---|---|---|---|---|---|---|
| Commissioning Roles & Responsibilities | | | | | | | |
| Category | Task Description | CxA | RE | A/E | PC | O&M | Notes |
| Coordination | Coordinate with [OGC's, AHJ, Vendors, etc.] to ensure that Cx interacts properly with other systems as needed to support OPR and BOD | L | P | P | P | O | |
| | | | | | | | |
| Cx Plan & Spec | Maintain/Update Commissioning Plan | L | A | R | R | O | |
| | | | | | | | |
| Schedules | Prepare Functional Test Schedule | L | A | R | R | O | |
| | | | | | | | |
| OPR and BOD | Maintain OPR on behalf of Owner | L | A | R | R | O | |
| | Maintain BOD/DID on behalf of Owner | L | A | R | R | O | |
| | | | | | | | |
| Document Reviews | Review Completed Pre-Functional Checklists | L | A | R | R | O | |
| | Pre-Functional Checklist Verification | L | A | R | R | O | |
| | Review Operations & Maintenance Manuals | L | A | R | R | R | |
| | Training Plan Review | L | A | R | R | R | |
| | Warranty Review | L | A | R | R | O | |
| | Review TAB Report | L | A | R | R | O | |
| | | | | | | | |
| Site Observations | Construction Observation Site Visits | L | A | R | R | O | |
| | Witness Selected Equipment Startup | L | A | R | R | O | |
| | | | | | | | |

| **Acceptance Phase** | | CxA = Commissioning Agent<br>RE = Resident Engineer<br>A/E = Design Arch/Engineer<br>PC = Prime Contractor<br>O&M = Gov't Facility O&M | | | | | L = Lead<br>P = Participate<br>A = Approve<br>R = Review<br>O = Optional |
|---|---|---|---|---|---|---|---|
| Commissioning Roles & Responsibilities | | | | | | | |
| Category | Task Description | CxA | RE | A/E | PC | O&M | Notes |
| Functional Test Protocols | TAB Verification | L | A | R | R | O | |
| | Systems Functional Performance Testing | L | A | P | P | P | |
| | Retesting | L | A | P | P | P | |
| | | | | | | | |
| Technical Activities | Issues Resolution Meetings | P | A | P | L | O | |
| | Systems Training | L | S | R | P | P | |
| | | | | | | | |
| Reports and Logs | Status Reports | L | A | R | R | O | |
| | Maintain Commissioning Issues Log | L | A | R | R | O | |
| | Final Commissioning Report | L | A | R | R | R | |
| | Prepare Systems Manuals | L | A | R | R | R | |
| | | | | | | | |

C. The following table outlines the roles and responsibilities for the Commissioning Team members during the Warranty Phase:

| Warranty Phase | | CxA = Commissioning Agent | | | | | L = Lead |
|---|---|---|---|---|---|---|---|
| Commissioning Roles & Responsibilities | | RE = Resident Engineer<br>A/E = Design Arch/Engineer<br>PC = Prime Contractor<br>O&M = Gov't Facility O&M | | | | | P = Participate<br>A = Approve<br>R = Review<br>O = Optional |
| Category | Task Description | CxA | RE | A/E | PC | O&M | Notes |
| Meetings | Post-Occupancy User Review Meeting | L | A | O | P | P | |
| | | | | | | | |
| Site Observations | Periodic Site Visits | L | A | O | O | P | |
| Functional Test Protocols | Deferred and/or seasonal Testing | L | A | O | P | P | |
| | | | | | | | |
| Technical Activities | Issues Resolution Meetings | L | S | O | O | P | |
| | Post-Occupancy Warranty Checkup and review of Significant Outstanding Issues | L | A | | R | P | |
| Reports and Logs | Final Commissioning Report Amendment | L | A | | R | R | |
| | Status Reports | L | A | | R | R | |
| | | | | | | | |

**3.2 STARTUP, INITIAL CHECKOUT, AND PRE-FUNCTIONAL CHECKLISTS**

A. The following procedures shall apply to all equipment and systems to be commissioned, according to Part 1, Systems to Be Commissioned.

1. Pre-Functional Checklists are important to ensure that the equipment and systems are hooked up and operational. These ensure that Systems Functional Performance Testing may proceed without unnecessary delays. Each system to be commissioned shall have a full Pre-Functional Checklist completed by the Contractor prior to Systems Functional Performance Testing. No sampling strategies are used.
   a. The Pre-Functional Checklist will identify the trades responsible for completing the checklist. The Contractor shall ensure the appropriate trades complete the checklists.
   b. The Commissioning Agent will review completed Pre-Functional Checklists and field-verify the accuracy of the completed checklist using sampling techniques.
2. Startup and Initial Checkout Plan: The Contractor shall develop detailed startup plans for all equipment. The primary role of the Contractor in this process is to ensure that there is written documentation that each of the manufacturer recommended procedures have been completed. Parties responsible for startup shall be identified in the Startup Plan and in the checklist forms.
   a. The Contractor shall develop the full startup plan by combining (or adding to) the checklists with the manufacturer's detailed startup and checkout procedures from the O&M manual data and the field checkout sheets normally used by the Contractor. The plan shall include checklists and procedures with specific boxes or lines for recording and documenting the checking and inspections of each procedure and a summary statement with a signature block at the end of the plan.
   b. The full startup plan shall at a minimum consist of the following items:
      1) The Pre-Functional Checklists.
      2) The manufacturer's standard written startup procedures copied from the installation manuals with check boxes by each procedure and a signature block added by hand at the end.
      3) The manufacturer's normally used field checkout sheets.

c. The Commissioning Agent will submit the full startup plan to the VA and Contractor for review. Final approval will be by the VA.
d. The Contractor shall review and evaluate the procedures and the format for documenting them, noting any procedures that need to be revised or added.

3. Sensor and Actuator Calibration
   a. All field installed temperature, relative humidity, CO2 and pressure sensors and gages, and all actuators (dampers and valves) on all equipment shall be calibrated using the methods described in Division 21, Division 22, Division 23, Division 26, Division 27, and Division 28 specifications.
   b. All procedures used shall be fully documented on the Pre-Functional Checklists or other suitable forms, clearly referencing the procedures followed and written documentation of initial, intermediate, and final results.
4. Execution of Equipment Startup
   a. Four weeks prior to equipment startup, the Contractor shall schedule startup and checkout with the VA and Commissioning Agent. The performance of the startup and checkout shall be directed and executed by the Contractor.
   b. The Commissioning Agent will observe the startup procedures for selected pieces of primary equipment.
   c. The Contractor shall execute startup and provide the VA and Commissioning Agent with a signed and dated copy of the completed startup checklists, and contractor tests.
   d. Only individuals that have direct knowledge and witnessed that a line-item task on the Startup Checklist was actually performed shall initial or check that item off. It is not acceptable for witnessing supervisors to fill out these forms.

**3.3 DEFICIENCIES, NONCONFORMANCE, AND APPROVAL IN CHECKLISTS AND STARTUP**

A. The Contractor shall clearly list any outstanding items of the initial startup and Pre-Functional Checklist procedures that were not completed successfully, at the bottom of the procedures form or on an attached sheet. The procedures form and any outstanding deficiencies shall be provided to the VA and the Commissioning Agent within two days of completion.

B. The Commissioning Agent will review the report and submit comments to the VA. The Commissioning Agent will work with the Contractor to correct and verify deficiencies or uncompleted items. The Commissioning Agent will involve the VA and others as necessary. The Contractor shall correct all areas that are noncompliant or incomplete in the checklists in a timely manner and shall notify the VA and Commissioning Agent as soon as outstanding items have been corrected. The Contractor shall submit an updated startup report and a Statement of Correction on the original noncompliance report. When satisfactorily completed, the Commissioning Agent will recommend approval of the checklists and startup of each system to the VA.

C. The Contractor shall be responsible for resolution of deficiencies as directed the VA.

**3.5 DDC SYSTEM TRENDING FOR COMMISSIONING**

A. Trending is a method of testing as a standalone method or to augment manual testing. The Contractor shall trend any and all points of the system or systems at intervals specified below.

B. Alarms are a means to notify the system operator that abnormal conditions are present in the system. Alarms shall be structured into three tiers - Critical, Priority, and Maintenance.

1. Critical alarms are intended to be alarms that require the immediate attention of and action by the Operator. These alarms shall be displayed on the Operator Workstation in a popup style window that is graphically linked to the associated unit's graphical display. The popup style window shall be displayed on top of any active window within the screen, including non DDC system software.
2. Priority level alarms are to be printed to a printer which is connected to the Operator’s Workstation located within the engineer’s office. Additionally, Priority level alarms shall be able to be monitored and viewed through an active alarm application. Priority level alarms are alarms which shall require reaction from the operator or maintenance personnel within a normal work shift, and not immediate action.
3. Maintenance alarms are intended to be minor issues which would require examination by maintenance personnel within the following shift. These alarms shall be generated in a scheduled report automatically by the DDC system at the start of each shift. The

generated maintenance report will be printed to a printer located within the engineer's office.

C. The Contractor shall provide a wireless internet network in the building for use during controls programming, checkout, and commissioning. This network will allow project team members to more effectively program, view, manipulate and test control devices while being in the same room as the controlled device.

D. The Contractor shall provide graphical trending through the DDC control system of systems being commissioned. Trending requirements are indicated below and included with the Systems Functional Performance Test Procedures. Trending shall occur before, during and after Systems Functional Performance Testing. The Contractor shall be responsible for producing graphical representations of the trended DDC points that show each system operating properly during steady state conditions as well as during the System Functional Testing. These graphical reports shall be submitted to the Resident Engineer and Commissioning Agent for review and analysis before, during dynamic operation, and after Systems Functional Performance Testing. The Contractor shall provide, but not limited to, the following trend requirements and trend submissions:

1. Pre-testing, Testing, and Post-testing - Trend reports of trend logs and graphical trend plots are required as defined by the Commissioning Agent. The trend log points, sampling rate, graphical plot configuration, and duration will be dictated by the Commissioning Agent. At any time during the Commissioning Process the Commissioning Agent may recommend changes to aspects of trending as deemed necessary for proper system analysis. The Contractor shall implement any changes as directed by the Resident Engineer. Any pre-test trend analysis comments generated by the Commissioning Team should be addressed and resolved by the Contractor, as directed by the Resident Engineer, prior to the execution of Systems Functional Performance Testing.
2. Dynamic plotting - The Contractor shall also provide dynamic plotting during Systems Functional Performance testing at frequent intervals for points determined by the Systems Functional Performance Test Procedure. The graphical plots will be formatted and plotted at durations listed in the Systems Functional Performance Test Procedure.

3. Graphical plotting - The graphical plots shall be provided with a dual y-axis allowing 15 or more trend points (series) plotted simultaneously on the graph with each series in distinct color. The plots will further require title, axis naming, legend etc. all described by the Systems Functional Performance Test Procedure. If this cannot be sufficiently accomplished directly in the Direct Digital Control System, then it is the responsibility of the Contractor to plot these trend logs in Microsoft Excel.
4. The following tables indicate the points to be trended and alarmed by system. The Operational Trend Duration column indicates the trend duration for normal operations. The Testing Trend Duration column indicates the trend duration prior to Systems Functional Performance Testing and again after Systems Functional Performance Testing. The Type column indicates point type: AI = Analog Input, AO = Analog Output, DI = Digital Input, DO = Digital Output, Calc = Calculated Point. In the Trend Interval Column, COV = Change of Value. The Alarm Type indicates the alarm priority; C = Critical, P = Priority, and M = Maintenance. The Alarm Range column indicates when the point is considered in the alarm state. The Alarm Delay column indicates the length of time the point must remain in an alarm state before the alarm is recorded in the DDC. The intent is to allow minor, short-duration events to be corrected by the DDC system prior to recording an alarm.

| **Dual-Path Air Handling Unit Trending and Alarms** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Point** | **Type** | **Trend Interval** | **Operational Trend Duration** | **Testing Trend Duration** | **Alarm Type** | **Alarm Range** | **Alarm Delay** |
| OA Temperature | AI | 15 Min | 24 hours | 3 days | N/A | | |
| RA Temperature | AI | 15 Min | 24 hours | 3 days | N/A | | |
| RA Humidity | AI | 15 Min | 24 hours | 3 days | P | >60% RH | 10 min |
| Mixed Air Temp | AI | None | None | None | N/A | | |
| SA Temp | AI | 15 Min | 24 hours | 3 days | C | ±5°F from SP | 10 min |
| Supply Fan Speed | AI | 15 Min | 24 hours | 3 days | N/A | | |

| Dual-Path Air Handling Unit Trending and Alarms | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Point** | **Type** | **Trend Interval** | **Operational Trend Duration** | **Testing Trend Duration** | **Alarm Type** | **Alarm Range** | **Alarm Delay** |
| Return Fan Speed | AI | 15 Min | 24 hours | 3 days | N/A | | |
| RA Pre-Filter Status | AI | None | None | None | N/A | | |
| OA Pre-Filter Status | AI | None | None | None | N/A | | |
| After Filter Status | AI | None | None | None | N/A | | |
| SA Flow | AI | 15 Min | 24 hours | 3 days | C | ±10% from SP | 10 min |
| OA Supply Temp | AI | 15 Min | 24 hours | 3 days | P | ±5°F from SP | 10 min |
| RA Supply Temp | AI | 15 Min | 24 hours | 3 days | N/A | | |
| RA CHW Valve Position | AI | 15 Min | 24 hours | 3 days | N/A | | |
| OA CHW Valve Position | AI | 15 Min | 24 hours | 3 days | N/A | | |
| OA HW Valve Position | AI | 15 Min | 24 hours | 3 days | N/A | | |
| OA Flow | AI | 15 Min | 24 hours | 3 days | P | ±10% from SP | 5 min |
| RA Flow | AI | 15 Min | 24 hours | 3 days | P | ±10% from SP | 5 min |
| Initial UVC Intensity (%) | AI | None | None | None | N/A | | |
| Duct Pressure | AI | 15 Min | 24 hours | 3 days | C | ±25% from SP | 6 min |
| CO2 Level | AI | 15 Min | 24 hours | 3 days | P | ±10% from SP | 10 min |
| | | | | | | | |
| Supply Fan Status | DI | COV | 24 hours | 3 days | C | Status <> Command | 10 min |
| Return Fan Status | DI | COV | 24 hours | 3 days | C | Status <> Command | 10 Min |
| High Static Status | DI | COV | 24 hours | 3 days | P | True | 1 min |
| Fire Alarm Status | DI | COV | 24 hours | 3 days | C | True | 5 min |
| Freeze Stat Level 1 | DI | COV | 24 hours | 3 days | C | True | 10 min |
| Freeze Stat Level 2 | DI | COV | 24 hours | 3 days | C | True | 5 min |
| Freeze Stat Level 3 | DI | COV | 24 hours | 3 days | P | True | 1 min |

| Dual-Path Air Handling Unit Trending and Alarms | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Point** | **Type** | **Trend Interval** | **Operational Trend Duration** | **Testing Trend Duration** | **Alarm Type** | **Alarm Range** | **Alarm Delay** |
| Fire/Smoke Damper Status | DI | COV | 24 hours | 3 days | P | Closed | 1 min |
| Emergency AHU Shutdown | DI | COV | 24 hours | 3 days | P | True | 1 min |
| Exhaust Fan #1 Status | DI | COV | 24 hours | 3 days | C | Status <> Command | 10 min |
| Exhaust Fan #2 Status | DI | COV | 24 hours | 3 days | C | Status <> Command | 10 min |
| Exhaust Fan #3 Status | DI | COV | 24 hours | 3 days | C | Status <> Command | 10 min |
| OA Alarm | DI | COV | 24 hours | 3 days | C | True | 10 min |
| High Static Alarm | DI | COV | 24 hours | 3 days | C | True | 10 min |
| UVC Emitter Alarm | DI | COV | 24 hours | 3 days | P | True | 10 min |
| CO2 Alarm | DI | COV | 24 hours | 3 days | P | True | 10 min |
| Power Failure | DI | COV | 24 hours | 3 days | P | True | 1 min |
| | | | | | | | |
| Supply Fan Speed | AO | 15 Min | 24 hours | 3 days | N/A | | |
| Return Fan Speed | AO | 15 Min | 24 hours | 3 days | N/A | | |
| RA CHW Valve Position | AO | 15 Min | 24 hours | 3 days | N/A | | |
| OA CHW Valve Position | AO | 15 Min | 24 hours | 3 days | N/A | | |
| OA HW Valve Position | AO | 15 Min | 24 hours | 3 days | N/A | | |
| | | | | | | | |
| Supply Fan S/S | DO | COV | 24 hours | 3 days | N/A | | |
| Return Fan S/S | DO | COV | 24 hours | 3 days | N/A | | |
| Fire/Smoke Dampers | DO | COV | 24 hours | 3 days | N/A | | |
| Exhaust Fan S/S | DO | COV | 24 hours | 3 days | N/A | | |
| Exhaust Fan S/S | DO | COV | 24 hours | 3 days | N/A | | |
| Exhaust Fan S/S | DO | COV | 24 hours | 3 days | N/A | | |

| Dual-Path Air Handling Unit Trending and Alarms | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Point** | **Type** | **Trend Interval** | **Operational Trend Duration** | **Testing Trend Duration** | **Alarm Type** | **Alarm Range** | **Alarm Delay** |
| | | | | | | | |
| AHU Energy | Calc | 1 Hour | 30 day | N/A | N/A | | |
| | | | | | | | |

| Terminal Unit (VAV, CAV, etc.) Trending and Alarms | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Point** | **Type** | **Trend Interval** | **Operational Trend Duration** | **Testing Trend Duration** | **Alarm Type** | **Alarm Range** | **Alarm Delay** |
| Space Temperature | AI | 15 Min | 12 hours | 3 days | P | ±5°F from SP | 10 min |
| Air Flow | AI | 15 Min | 12 hours | 3 days | P | ±5°F from SP | 10 min |
| SA Temperature | AI | 15 Min | 12 hours | 3 days | P | ±5°F from SP | 10 min |
| Local Setpoint | AI | 15 Min | 12 hours | 3 days | M | ±10°F from SP | 60 min |
| Space Humidity | AI | 15 Min | 12 hours | 3 days | P | > 60% RH | 5 min |
| | | | | | | | |
| Unoccupied Override | DI | COV | 12 hours | 3 days | M | N/A | 12 Hours |
| Refrigerator Alarm | DI | COV | 12 hours | 3 days | C | N/A | 10 min |
| | | | | | | | |
| Damper Position | AO | 15 Minutes | 12 hours | 3 days | N/A | | |
| Heating coil Valve Position | AO | 15 Minutes | 12 hours | 3 days | N/A | | |

| 4-Pipe Fan Coil Trending and Alarms | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Point** | **Type** | **Trend Interval** | **Operational Trend Duration** | **Testing Trend Duration** | **Alarm Type** | **Alarm Range** | **Alarm Delay** |
| Space Temperature | AI | 15 Minutes | 12 hours | 3 days | P | ±5°F from SP | 10 min |
| SA Temperature | AI | 15 Minutes | 12 hours | 3 days | P | ±5°F from SP | 10 min |

| 4-Pipe Fan Coil Trending and Alarms | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Point** | **Type** | **Trend Interval** | **Operational Trend Duration** | **Testing Trend Duration** | **Alarm Type** | **Alarm Range** | **Alarm Delay** |
| Pre-Filter Status | AI | None | None | None | M | > SP | 1 hour |
| | | | | | | | |
| Water Sensor | DI | COV | 12 hours | 3 days | M | N/A | 30 Min |
| | | | | | | | |
| Cooling Coil Valve Position | AO | 15 Minutes | 12 hours | 3 days | N/A | | |
| Heating coil Valve Position | AO | 15 Minutes | 12 hours | 3 days | N/A | | |
| Fan Coil ON/OFF | DO | COV | 12 hours | 3 days | M | Status <> Command | 30 min |

| 2-Pipe Fan Coil Unit Trending and Alarms | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Point** | **Type** | **Trend Interval** | **Operational Trend Duration** | **Testing Trend Duration** | **Alarm Type** | **Alarm Range** | **Alarm Delay** |
| Space Temperature | AI | 15 Minutes | 12 hours | 3 days | P | ±5°F from SP | 10 min |
| SA Temperature | AI | 15 Minutes | 12 hours | 3 days | P | ±5°F from SP | 10 min |
| Pre-Filter Status | AI | None | None | None | M | > SP | 1 hour |
| | | | | | | | |
| Water Sensor | DI | COV | 12 hours | 3 days | M | N/A | 30 Min |
| | | | | | | | |
| Cooling Coil Valve Position | AO | 15 Minutes | 12 hours | 3 days | N/A | | |
| Fan Coil ON/OFF | DO | COV | 12 hours | 3 days | M | Status <> Command | 30 min |

| Unit Heater Trending and Alarms | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Point** | **Type** | **Trend Interval** | **Operational Trend Duration** | **Testing Trend Duration** | **Alarm Type** | **Alarm Range** | **Alarm Delay** |
| Space Temperature | AI | 15 Minutes | 12 hours | 3 days | P | ±5°F from SP | 10 min |
| | | | | | | | |
| Heating Valve Position | AO | 15 Minutes | 12 hours | 3 days | N/A | | |
| | | | | | | | |
| Unit Heater ON/OFF | DO | COV | 12 hours | 3 days | M | Status <> Command | 30 min |

| Steam and Condensate Pumps Trending and Alarms | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Point** | **Type** | **Trend Interval** | **Operational Trend Duration** | **Testing Trend Duration** | **Alarm Type** | **Alarm Range** | **Alarm Delay** |
| Steam Flow (LB/HR) | AI | 15 Minutes | 12 hours | 3 days | N/A | | |
| Condensate Pump Run Hours | AI | 15 Minutes | 12 hours | 3 days | N/A | | |
| Water Meter (GPM) | AI | 15 Minutes | 12 hours | 3 days | N/A | | |
| Electric Meter (KW/H) | AI | 15 Minutes | 12 hours | 3 days | N/A | | |
| Irrigation Meter (GPM) | AI | 15 Minutes | 12 hours | 3 days | N/A | | |
| Chilled Water Flow (TONS) | AI | 15 Minutes | 12 hours | 3 days | N/A | | |
| Condensate Flow (GPM) | AI | 15 Minutes | 12 hours | 3 days | N/A | | |
| | | | | | | | |
| High Water Level Alarm | DI | COV | 12 hours | 3 days | C | True | 5 Min |
| | | | | | | | |
| Condensate Pump Start/Stop | DO | COV | 12 hours | 3 days | P | Status <> Command | 10 min |

| Domestic Hot Water Trending and Alarms |
|---|

| Point | Type | Trend Interval | Operational Trend Duration | Testing Trend Duration | Alarm Type | Alarm Range | Alarm Delay |
|---|---|---|---|---|---|---|---|
| Domestic HW Setpoint WH-1 | AI | 15 Minute | 12 Hours | 3 days | N/A | | |
| Domestic HW Setpoint WH-2 | AI | 15 Minute | 12 Hours | 3 days | N/A | | |
| Domestic HW Temperature | AI | 15 Minute | 12 Hours | 3 days | C | > 135 oF | 10 Min |
| Domestic HW Temperature | AI | 15 Minute | 12 Hours | 3 days | P | ±5°F from SP | 10 Min |
| | | | | | | | |
| Dom. Circ. Pump #1 Status | DI | COV | 12 Hours | 3 days | M | Status <> Command | 30 min |
| Dom. Circ. Pump #2 Status | DI | COV | 12 Hours | 3 days | M | Status <> Command | 30 min |
| | | | | | | | |
| Dom. Circ. Pump #1 Start/Stop | DO | COV | 12 Hours | 3 days | N/A | | |
| Dom. Circ. Pump #2 Start/Stop | DO | COV | 12 Hours | 3 days | N/A | | |
| Domestic HW Start/Stop | DO | COV | 12 Hours | 3 days | N/A | | |

| **Hydronic Hot Water Trending and Alarms** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Point** | **Type** | **Trend Interval** | **Operational Trend Duration** | **Testing Trend Duration** | **Alarm Type** | **Alarm Range** | **Alarm Delay** |
| System HWS Temperature | AI | 15 min | 12 hours | 3 days | C | ±5°F from SP | 10 Min |
| System HWR Temperature | AI | 15 min | 12 hours | 3 days | M | ±15°F from SP | 300 Min |
| HX-1 Entering Temperature | AI | 15 min | 12 hours | 3 days | P | ±5°F from SP | 10 Min |
| HX-2 Entering Temperature | AI | 15 min | 12 hours | 3 days | P | ±5°F from SP | 10 Min |
| HX-2 Leaving Temperature | AI | 15 min | 12 hours | 3 days | P | ±5°F from SP | 10 Min |
| | | | | | | | |
| System Flow (GPM) | AI | 15 min | 12 hours | 3 days | N/A | | |
| System Differential Pressure | AI | 15 min | 12 hours | 3 days | P | ±10% from SP | 8 Min |

| Hydronic Hot Water Trending and Alarms | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Point** | **Type** | **Trend Interval** | **Operational Trend Duration** | **Testing Trend Duration** | **Alarm Type** | **Alarm Range** | **Alarm Delay** |
| | | | | 3 days | | | |
| HW Pump 1 Status | DI | COV | 12 Hours | 3 days | C | Status <> Command | 30 min |
| HW Pump 2 Status | DI | COV | 12 Hours | 3 days | C | Status <> Command | 30 min |
| | | | | | | | |
| HW Pump 1 VFD Speed | AO | 15 Min | 12 Hours | 3 days | N/A | | |
| HW Pump 2 VFD Speed | AO | 15 Min | 12 Hours | 3 days | N/A | | |
| Steam Station #1 1/3 Control Valve Position | AO | 15 Min | 12 Hours | 3 days | N/A | | |
| Steam Station #1 2/3 Control Valve Position | AO | 15 Min | 12 Hours | 3 days | N/A | | |
| Steam Station #2 1/3 Control Valve Position | AO | 15 Min | 12 Hours | 3 days | N/A | | |
| Steam Station #2 2/3 Control Valve Position | AO | 15 Min | 12 Hours | 3 days | N/A | | |
| Steam Station Bypass Valve Position | AO | 15 Min | 12 Hours | 3 days | N/A | | |
| | | | | | | | |
| HW Pump 1 Start/Stop | DO | COV | 12 Hours | 3 days | N/A | | |
| HW Pump 2 Start/Stop | DO | COV | 12 Hours | 3 days | N/A | | |
| HWR #1 Valve | DO | COV | 12 Hours | 3 days | N/A | | |
| HWR #2 Valve | DO | COV | 12 Hours | 3 days | N/A | | |

| Chilled Water System Trending and Alarms | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Point** | **Type** | **Trend Interval** | **Operational Trend Duration** | **Testing Trend Duration** | **Alarm Type** | **Alarm Range** | **Alarm Delay** |

| Chilled Water System Trending and Alarms | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Point** | **Type** | **Trend Interval** | **Operational Trend Duration** | **Testing Trend Duration** | **Alarm Type** | **Alarm Range** | **Alarm Delay** |
| Chiller 1 Entering Temperature | AI | 15 Minutes | 12 Hours | 3 days | N/A | | |
| Chiller 1 Leaving Temperature | AI | 15 Minutes | 12 Hours | 3 days | P | ±5°F from SP | 10 Min |
| Chiller 1 Flow | AI | 15 Minutes | 12 Hours | 3 days | N/A | | |
| Chiller 1 Percent Load | AI | 15 Minutes | 12 Hours | 3 days | N/A | | |
| Chiller 1 KW Consumption | AI | 15 Minutes | 12 Hours | 3 days | N/A | | |
| Chiller 1 Tonnage | AI | 15 Minutes | 12 Hours | 3 days | N/A | | |
| Chiller 2 Entering Temperature | AI | 15 Minutes | 12 Hours | 3 days | N/A | | |
| Chiller 2 Leaving Temperature | AI | 15 Minutes | 12 Hours | 3 days | P | ±5°F from SP | 10 Min |
| Chiller 2 Flow | AI | 15 Minutes | 12 Hours | 3 days | N/A | | |
| Chiller 2 Percent Load | AI | 15 Minutes | 12 Hours | 3 days | N/A | | |
| Chiller 2 KW Consumption | AI | 15 Minutes | 12 Hours | 3 days | N/A | | |
| Chiller 2 Tonnage | AI | 15 Minutes | 12 Hours | 3 days | N/A | | |
| Primary Loop Decoupler Flow | AI | 15 Minutes | 12 Hours | 3 days | N/A | | |
| Primary Loop Flow | AI | 15 Minutes | 12 Hours | 3 days | N/A | | |
| Primary Loop Supply Temperature | AI | 15 Minutes | 12 Hours | 3 days | N/A | | |
| Secondary Loop Differential Pressure | AI | 15 Minutes | 12 Hours | 3 days | P | ±5% from SP | 10 Min |
| Secondary Loop Flow | AI | 15 Minutes | 12 Hours | 3 days | N/A | | |
| Secondary Loop Supply Temperature | AI | 15 Minutes | 12 Hours | 3 days | N/A | | |
| Secondary Loop Return Temperature | AI | 15 Minutes | 12 Hours | 3 days | N/A | | |

| Chilled Water System Trending and Alarms | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Point** | **Type** | **Trend Interval** | **Operational Trend Duration** | **Testing Trend Duration** | **Alarm Type** | **Alarm Range** | **Alarm Delay** |
| Secondary Loop Tonnage | AI | 15 Minutes | 12 Hours | 3 days | N/A | | |
| | | | | | | | |
| Primary Loop Pump 1 Status | DI | COV | 12 Hours | 3 days | C | Status <> Command | 30 min |
| Primary Loop Pump 2 Status | DI | COV | 12 Hours | 3 days | C | Status <> Command | 30 min |
| Secondary Loop Pump 1 Status | DI | COV | 12 Hours | 3 days | C | Status <> Command | 30 min |
| Secondary Loop Pump 2 Status | DI | COV | 12 Hours | 3 days | C | Status <> Command | 30 min |
| Chiller 1 Status | DI | COV | 12 Hours | 3 days | C | Status <> Command | 30 min |
| Chiller 1 Evaporator Iso-Valve | DI | COV | 12 Hours | 3 days | N/A | | |
| Chiller 1 Evaporator Flow Switch | DI | COV | 12 Hours | 3 days | N/A | | |
| Chiller 1 Unit Alarm | DI | COV | 12 Hours | 3 days | C | True | 10 Min |
| Chiller 2 Status | DI | COV | 12 Hours | 3 days | C | Status <> Command | 30 min |
| Chiller 2 Evaporator Iso-Valve | DI | COV | 12 Hours | 3 days | N/A | | |
| Chiller 2 Evaporator Flow Switch | DI | COV | 12 Hours | 3 days | N/A | | |
| Chiller 2 Unit Alarm | DI | COV | 12 Hours | 3 days | C | True | 10 Min |
| Refrigerant Detector | DI | COV | 12 Hours | 3 days | C | True | 10 Min |
| Refrigerant Exhaust Fan Status | DI | COV | 12 Hours | 3 days | M | Status <> Command | 30 min |
| Emergency Shutdown | DI | COV | 12 Hours | 3 days | P | True | 1 Min |
| | | | | | | | |

| Chilled Water System Trending and Alarms | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Point** | **Type** | **Trend Interval** | **Operational Trend Duration** | **Testing Trend Duration** | **Alarm Type** | **Alarm Range** | **Alarm Delay** |
| Primary Loop Pump 1 VFD Speed | AO | 15 Minutes | 12 Hours | 3 days | N/A | | |
| Primary Loop Pump 2 VFD Speed | AO | 15 Minutes | 12 Hours | 3 days | N/A | | |
| Secondary Loop Pump 1 VFD Speed | AO | 15 Minutes | 12 Hours | 3 days | N/A | | |
| Secondary Loop Pump 2 VFD Speed | AO | 15 Minutes | 12 Hours | 3 days | N/A | | |
| | | | | | | | |
| Primary Pump 1 Start / Stop | DO | COV | 12 Hours | 3 days | N/A | | |
| Primary Pump 2 Start / Stop | DO | COV | 12 Hours | 3 days | N/A | | |
| Secondary Pump 1 Start / Stop | DO | COV | 12 Hours | 3 days | N/A | | |
| Secondary Pump 2 Start / Stop | DO | COV | 12 Hours | 3 days | N/A | | |
| Chiller 1 Enable | DO | COV | 12 Hours | 3 days | N/A | | |
| Chiller 1 Iso-Valve Command | DO | COV | 12 Hours | 3 days | N/A | | |
| Chiller 2 Enable | DO | COV | 12 Hours | 3 days | N/A | | |
| Chiller 2 Iso-Valve Command | DO | COV | 12 Hours | 3 days | N/A | | |
| Refrigerant Exhaust Fan Start / Stop | DO | COV | 12 Hours | 3 days | N/A | | |

| Condenser Water System Trending and Alarms | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Point** | **Type** | **Trend Interval** | **Operational Trend Duration** | **Testing Trend Duration** | **Alarm Type** | **Alarm Range** | **Alarm Delay** |

| Condenser Water System Trending and Alarms | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Point** | **Type** | **Trend Interval** | **Operational Trend Duration** | **Testing Trend Duration** | **Alarm Type** | **Alarm Range** | **Alarm Delay** |
| Chiller 1 Condenser Entering Temp | AI | 15 Minutes | 12 Hours | 3 days | N/A | | |
| Chiller 1 Condenser Leaving Temp | AI | 15 Minutes | 12 Hours | 3 days | N/A | | |
| Chiller 2 Condenser Entering Temp | AI | 15 Minutes | 12 Hours | 3 days | N/A | | |
| Chiller 2 Condenser Leaving Temp | AI | 15 Minutes | 12 Hours | 3 days | N/A | | |
| Cooling Tower 1 Supply Temp | AI | 15 Minutes | 12 Hours | 3 days | N/A | | |
| Cooling Tower 1 Return Temp | AI | 15 Minutes | 12 Hours | 3 days | N/A | | |
| Cooling Tower 1 Basin Temp | AI | 15 Minutes | 12 Hours | 3 days | P | < 45 oF | 10 Min |
| Cooling Tower 2 Supply Temp | AI | 15 Minutes | 12 Hours | 3 days | N/A | | |
| Cooling Tower 2 Return Temp | AI | 15 Minutes | 12 Hours | 3 days | N/A | | |
| Cooling Tower 2 Basin Temp | AI | 15 Minutes | 12 Hours | 3 days | P | < 45 oF | 10 Min |
| Condenser Water Supply Temp | AI | 15 Minutes | 12 Hours | 3 days | N/A | | |
| Condenser Water Return Temp | AI | 15 Minutes | 12 Hours | 3 days | N/A | | |
| Outdoor Air Wet Bulb | AI | 15 Minutes | 12 Hours | 3 days | N/A | | |
| | | | | | | | |
| Cooling Tower 1 Fan Status | DI | COV | 12 Hours | 3 days | P | Status <> Command | 1 min |
| Cooling Tower 1 Basin Heat | DI | COV | 12 Hours | 3 days | N/A | | |
| Cooling Tower 1 Heat Trace | DI | COV | 12 Hours | 3 days | N/A | | |
| Cooling Tower 2 Fan Status | DI | COV | 12 Hours | 3 days | P | Status <> Command | 1 min |
| Cooling Tower 2 Basin Heat | DI | COV | 12 Hours | 3 days | N/A | | |
| Cooling Tower 2 Heat Trace | DI | COV | 12 Hours | 3 days | N/A | | |

| Condenser Water System Trending and Alarms | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Point** | **Type** | **Trend Interval** | **Operational Trend Duration** | **Testing Trend Duration** | **Alarm Type** | **Alarm Range** | **Alarm Delay** |
| Chiller 1 Isolation Valve | DI | COV | 12 Hours | 3 days | P | Status <> Command | 1 min |
| Chiller 2 Isolation Valve | DI | COV | 12 Hours | 3 days | P | Status <> Command | 1 min |
| Condenser Water Pump 1 Status | DI | COV | 12 Hours | 3 days | P | Status <> Command | 1 min |
| Condenser Water Pump 2 Status | DI | COV | 12 Hours | 3 days | P | Status <> Command | 1 min |
| | | | | | | | |
| Chiller 1 Condenser Bypass Valve | AO | 15 Minutes | 12 Hours | 3 days | N/A | | |
| Chiller 2 Condenser By-Pass Valve | AO | 15 Minutes | 12 Hours | 3 days | N/A | | |
| Cooling Tower 1 Bypass Valve | AO | 15 Minutes | 12 Hours | 3 days | N/A | | |
| Cooling Tower 1 Fan Speed | AO | 15 Minutes | 12 Hours | 3 days | N/A | | |
| Cooling Tower 2 Bypass Valve | AO | 15 Minutes | 12 Hours | 3 days | N/A | | |
| Cooling Tower 2 Fan Speed | AO | 15 Minutes | 12 Hours | 3 days | N/A | | |
| | | | | | | | |
| Cooling Tower 1 Fan Start / Stop | DO | COV | 12 Hours | 3 days | N/A | | |
| Cooling Tower 2 Fan Start / Stop | DO | COV | 12 Hours | 3 days | N/A | | |
| Condenser Water Pump 1 Start / Stop | DO | COV | 12 Hours | 3 days | N/A | | |
| Condenser Water Pump 2 Start / Stop | DO | COV | 12 Hours | 3 days | N/A | | |

| Steam Boiler System Trending and Alarms |
|---|

| Point | Type | Trend Interval | Operational Trend Duration | Testing Trend Duration | Alarm Type | Alarm Range | Alarm Delay |
|---|---|---|---|---|---|---|---|
| Boiler 1 Steam Pressure | AI | 15 Minutes | 12 Hours | 3 days | P | ±5% from SP | 10 Min |
| Boiler 1 Steam Temperature | AI | 15 Minutes | 12 Hours | 3 days | N/A | | |
| Boiler 1 Fire Signal | AI | 15 Minutes | 12 Hours | 3 days | N/A | | |
| Boiler 2 Steam Pressure | AI | 15 Minutes | 12 Hours | 3 days | P | ±5% from SP | 10 Min |
| Boiler 2 Steam Temperature | AI | 15 Minutes | 12 Hours | 3 days | N/A | | |
| Boiler 2 Fire Signal | AI | 15 Minutes | 12 Hours | 3 days | N/A | | |
| System Steam Pressure | AI | 15 Minutes | 12 Hours | 3 days | P | ±5% from SP | 10 Min |
| | | | | | | | |
| Boiler 1 Enable | DI | COV | 12 Hours | 3 days | N/A | | |
| Boiler 1 Status | DI | COV | 12 Hours | 3 days | P | Status <> Command | 10 min |
| Boiler 1 Alarm | DI | COV | 12 Hours | 3 days | C | True | 1 Min |
| Boiler 1 on Fuel Oil | DI | COV | 12 Hours | 3 days | N/A | | |
| Boiler 1 Low Water Alarm | DI | COV | 12 Hours | 3 days | C | True | 5 Min |
| Boiler 1 High Water Alarm | DI | COV | 12 Hours | 3 days | C | True | 5 Min |
| Boiler 1 Feed Pump | DI | COV | 12 Hours | 3 days | N/A | | |
| Boiler 2 Enable | DI | COV | 12 Hours | 3 days | N/A | | |
| Boiler 2 Status | DI | COV | 12 Hours | 3 days | P | Status <> Command | 10 min |
| Boiler 2 Alarm | DI | COV | 12 Hours | 3 days | C | True | 1 Min |
| Boiler 2 on Fuel Oil | DI | COV | 12 Hours | 3 days | N/A | | |
| Boiler 2 Low Water Alarm | DI | COV | 12 Hours | 3 days | C | True | 5 Min |
| Boiler 2 High Water Alarm | DI | COV | 12 Hours | 3 days | C | True | 5 Min |
| Boiler 2 Feed Pump | DI | COV | 12 Hours | 3 days | N/A | | |

| Steam Boiler System Trending and Alarms | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Point** | **Type** | **Trend Interval** | **Operational Trend Duration** | **Testing Trend Duration** | **Alarm Type** | **Alarm Range** | **Alarm Delay** |
| Combustion Damper Status | DI | COV | 12 Hours | 3 days | P | Status <> Command | 5 min |
| Condensate Recovery Pump Status | DI | COV | 12 Hours | 3 days | P | Status <> Command | 5 min |
| | | | | | | | |
| Boiler 1 Feed Pump Start / Stop | DO | COV | 12 Hours | 3 days | N/A | | |
| Boiler 2 Start / Stop | DO | COV | 12 Hours | 3 days | N/A | | |
| Combustion Damper Command | DO | COV | 12 Hours | 3 days | N/A | | |
| Condensate Recovery Pump Start / Stop | DO | COV | 12 Hours | 3 days | N/A | | |

| Hot Water Boiler System Trending and Alarms | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Point** | **Type** | **Trend Interval** | **Operational Trend Duration** | **Testing Trend Duration** | **Alarm Type** | **Alarm Range** | **Alarm Delay** |
| Outside Air Temperature | AI | 15 Minutes | 12 Hours | 3 days | N/A | | |
| Boiler 1 Fire Signal | AI | 15 Minutes | 12 Hours | 3 days | N/A | | |
| Boiler 1 Entering Water Temperature | AI | 15 Minutes | 12 Hours | 3 days | N/A | | |
| Boiler 1 Leaving Water Temperature | AI | 15 Minutes | 12 Hours | 3 days | N/A | | |
| Boiler 2 Fire Signal | AI | 15 Minutes | 12 Hours | 3 days | N/A | | |

| Hot Water Boiler System Trending and Alarms | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Point** | **Type** | **Trend Interval** | **Operational Trend Duration** | **Testing Trend Duration** | **Alarm Type** | **Alarm Range** | **Alarm Delay** |
| Boiler 2 Entering Water Temperature | AI | 15 Minutes | 12 Hours | 3 days | N/A | | |
| Boiler 2 Leaving Water Temperature | AI | 15 Minutes | 12 Hours | 3 days | N/A | | |
| Hot Water Supply Temperature | AI | 15 Minutes | 12 Hours | 3 days | P | ±5 oF from SP | 10 Min |
| Hot Water Return Temperature | AI | 15 Minutes | 12 Hours | 3 days | N/A | | |
| Secondary Loop Differential Pressure | AI | 15 Minutes | 12 Hours | 3 days | C | ±5% from SP | 10 Min |
| Lead Boiler | AI | 15 Minutes | 12 Hours | 3 days | N/A | | |
| | | | | | | | |
| Boiler 1 Enable | DI | COV | 12 Hours | 3 days | N/A | | |
| Boiler 1 Status | DI | COV | 12 Hours | 3 days | P | Status <> Command | 10 min |
| Boiler 1 Isolation Valve | DI | COV | 12 Hours | 3 days | N/A | | |
| Boiler 1 on Fuel Oil | DI | COV | 12 Hours | 3 days | N/A | | |
| Boiler 1 Alarm | DI | COV | 12 Hours | 3 days | C | True | 1 Min |
| Boiler 2 Enable | DI | COV | 12 Hours | 3 days | N/A | | |
| Boiler 2 Status | DI | COV | 12 Hours | 3 days | P | Status <> Command | 10 min |
| Boiler 2 Isolation Valve | DI | COV | 12 Hours | 3 days | N/A | | |
| Boiler 2 on Fuel Oil | DI | COV | 12 Hours | 3 days | N/A | | |
| Boiler 2 Alarm | DI | COV | 12 Hours | 3 days | C | True | 1 Min |
| Combustion Dampers Open | DI | COV | 12 Hours | 3 days | P | Status <> Command | 10 min |

| Hot Water Boiler System Trending and Alarms | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Point** | **Type** | **Trend Interval** | **Operational Trend Duration** | **Testing Trend Duration** | **Alarm Type** | **Alarm Range** | **Alarm Delay** |
| Primary Pump 1 Status | DI | COV | 12 Hours | 3 days | P | Status <> Command | 10 min |
| Primary Pump 2 Status | DI | COV | 12 Hours | 3 days | P | Status <> Command | 10 min |
| Secondary Pump 1 Status | DI | COV | 12 Hours | 3 days | P | Status <> Command | 10 min |
| Secondary Pump 2 Status | DI | COV | 12 Hours | 3 days | P | Status <> Command | 10 min |
| | | | | | | | |
| Primary Pump 1 VFD Speed | AO | COV | 12 Hours | 3 days | N/A | | |
| Primary Pump 2 VFD Speed | AO | COV | 12 Hours | 3 days | N/A | | |
| Secondary Pump 1 VFD Speed | AO | COV | 12 Hours | 3 days | N/A | | |
| Secondary Pump 2 VFD Speed | AO | COV | 12 Hours | 3 days | N/A | | |
| | | | | | | | |
| Hot Water System Enable | DO | COV | 12 Hours | 3 days | N/A | | |
| Combustion Dampers Command | DO | COV | 12 Hours | 3 days | N/A | | |
| Primary Pump 1 Start / Stop | DO | COV | 12 Hours | 3 days | N/A | | |
| Primary Pump 2 Start / Stop | DO | COV | 12 Hours | 3 days | N/A | | |
| Secondary Pump 1 Start / Stop | DO | COV | 12 Hours | 3 days | N/A | | |
| Secondary Pump 2 Start / Stop | DO | COV | 12 Hours | 3 days | N/A | | |

E. The Contractor shall provide the following information prior to Systems Functional Performance Testing. Any documentation that is modified

after submission shall be recorded and resubmitted to the Resident Engineer and Commissioning Agent.

1. Point-to-Point checkout documentation.
2. Sensor field calibration documentation including system name, sensor/point name, measured value, DDC value, and Correction Factor.
3. A sensor calibration table listing the referencing the location of procedures to following in the O&M manuals, and the frequency at which calibration should be performed for all sensors, separated by system, subsystem, and type. The calibration requirements shall be submitted both in the O&M manuals and separately in a standalone document containing all sensors for inclusion in the commissioning documentation. The following table is a sample that can be used as a template for submission.

| **SYSTEM** | | |
|---|---|---|
| **Sensor** | **Calibration Frequency** | **O&M Calibration Procedure Reference** |
| Discharge air temperature | Once a year | Volume I Section D.3.aa |
| Discharge static pressure | Every 6 months | Volume II Section A.1.c |

4. Loop tuning documentation and constants for each loop of the building systems. The documentation shall be submitted in outline or table separated by system, control type (e.g., heating valve temperature control); proportional, integral and derivative constants, interval (and bias if used) for each loop. The following table is a sample that can be used as a template for submission.

| **AIR HANDLING UNIT AHU-1** | | | | |
|---|---|---|---|---|
| Control Reference | Proportional Constant | Integral Constant | Derivative Constant | Interval |
| Heating Valve Output | 1000 | 20 | 10 | 2 sec. |

**3.6 SYSTEMS FUNCTIONAL PERFORMANCE TESTING**

A. This paragraph applies to Systems Functional Performance Testing of systems for all referenced specification Divisions.

B. Objectives and Scope: The objective of Systems Functional Performance Testing is to demonstrate that each system is operating according to the Contract Documents. Systems Functional Performance Testing facilitates bringing the systems from a state of substantial completion to full dynamic operation. Additionally, during the testing process, areas of noncompliant performance are identified and corrected, thereby improving the operation, and functioning of the systems. In general, each system shall be operated through all modes of operation (seasonal, occupied, unoccupied, warm-up, cool-down, part- and full-load, fire alarm and emergency power) where there is a specified system response. The Contractor shall verify each sequence in the sequences of operation. Proper responses to such modes and conditions as power failure, freeze condition, low oil pressure, no flow, equipment failure, etc. shall also be tested.

C. Development of Systems Functional Performance Test Procedures: Before Systems Functional Performance Test procedures are written, the Contractor shall submit all requested documentation and a current list of change orders affecting equipment or systems, including an updated points list, program code, control sequences and parameters. Using the testing parameters and requirements found in the Contract Documents and approved submittals and shop drawings, the Commissioning Agent will develop specific Systems Functional Test Procedures to verify and document proper operation of each piece of equipment and system to be commissioned. The Contractor shall assist the Commissioning Agent in developing the Systems Functional Performance Test procedures as requested by the Commissioning Agent i.e., by answering questions about equipment, operation, sequences, etc. Prior to execution, the Commissioning Agent will provide a copy of the Systems Functional Performance Test procedures to the VA, the Architect/Engineer, and the Contractor, who shall review the tests for feasibility, safety, equipment, and warranty protection.

D. Purpose of Test Procedures: The purpose of each specific Systems Functional Performance Test is to verify and document compliance with the stated criteria of acceptance given on the test form. Representative test formats and examples are found in the Commissioning Plan for this project. (The Commissioning Plan is issued as a separate document and is available for review.) The test procedure forms

developed by the Commissioning Agent will include, but not be limited to, the following information:

1. System and equipment or component name(s)
2. Equipment location and ID number
3. Unique test ID number, and reference to unique Pre-Functional Checklists and startup documentation, and ID numbers for the piece of equipment
4. Date
5. Project name
6. Participating parties
7. A copy of the specification section describing the test requirements
8. A copy of the specific sequence of operations or other specified parameters being verified
9. Formulas used in any calculations
10. Required pretest field measurements
11. Instructions for setting up the test.
12. Special cautions, alarm limits, etc.
13. Specific step-by-step procedures to execute the test, in a clear, sequential, and repeatable format
14. Acceptance criteria of proper performance with a Yes / No check box to allow for clearly marking whether proper performance of each part of the test was achieved.
15. A section for comments.
16. Signatures and date block for the Commissioning Agent. A place for the Contractor to initial to signify attendance at the test.

E. Test Methods: Systems Functional Performance Testing shall be achieved by manual testing (i.e., persons manipulate the equipment and observe performance) and/or by monitoring the performance and analyzing the results using the control system's trend log capabilities or by standalone data loggers. The Contractor and Commissioning Agent shall determine which method is most appropriate for tests that do not have a method specified.

1. Simulated Conditions: Simulating conditions (not by an overwritten value) shall be allowed, although timing the testing to experience actual conditions is encouraged wherever practical.
2. Overwritten Values: Overwriting sensor values to simulate a condition, such as overwriting the outside air temperature reading

in a control system to be something other than it really is, shall be allowed, but shall be used with caution and avoided when possible. Such testing methods often can only test a part of a system, as the interactions and responses of other systems will be erroneous or not applicable. Simulating a condition is preferable. e.g., for the above case, by heating the outside air sensor with a hair blower rather than overwriting the value or by altering the appropriate setpoint to see the desired response. Before simulating conditions or overwriting values, sensors, transducers, and devices shall have been calibrated.

3. Simulated Signals: Using a signal generator which creates a simulated signal to test and calibrate transducers and DDC constants is generally recommended overusing the sensor to act as the signal generator via simulated conditions or overwritten values.
4. Altering Setpoints: Rather than overwriting sensor values, and when simulating conditions is difficult, altering setpoints to test a sequence is acceptable. For example, to see the Air Conditioning compressor lockout initiate at an outside air temperature below 12 C (54 F), when the outside air temperature is above 12 C (54 F), temporarily change the lockout setpoint to be 2 C (4 F) above the current outside air temperature.
5. Indirect Indicators: Relying on indirect indicators for responses or performance shall be allowed only after visually and directly verifying and documenting, over the range of the tested parameters, that the indirect readings through the control system represent actual conditions and responses. Much of this verification shall be completed during systems startup and initial checkout.

F. Setup: Each function and test shall be performed under conditions that simulate actual conditions as closely as is practically possible. The Contractor shall provide all necessary materials, system modifications, etc. to produce the necessary flows, pressures, temperatures, etc. necessary to execute the test according to the specified conditions. At completion of the test, the Contractor shall return all affected building equipment and systems, due to these temporary modifications, to their pretest condition.

G. Sampling: No sampling is allowed in completing Pre-Functional Checklists. Sampling is allowed for Systems Functional Performance

Test Procedures execution. The Commissioning Agent will determine the sampling rate. If at any point, frequent failures are occurring and testing is becoming more troubleshooting than verification, the Commissioning Agent may stop the testing and require the Contractor to perform and document a checkout of the remaining units, prior to continuing with Systems Functional Performance Testing of the remaining units.

H. Cost of Retesting: The cost associated with expanded sample System Functional Performance Tests shall be solely the responsibility of the Contractor. Any required retesting by the Contractor shall not be considered a justified reason for a claim of delay or for a time extension by the Contractor.

I. Coordination and Scheduling: The Contractor shall provide a minimum of 7 days' notice to the Commissioning Agent and the VA regarding the completion schedule for the Pre-Functional Checklists and startup of all equipment and systems. The Commissioning Agent will schedule Systems Functional Performance Tests with the Contractor and VA. The Commissioning Agent will witness and document the Systems Functional Performance Testing of systems. The Contractor shall execute the tests in accordance with the Systems Functional Performance Test Procedure.

J. Testing Prerequisites: In general, Systems Functional Performance Testing will be conducted only after Pre-Functional Checklists have been satisfactorily completed. The control system shall be sufficiently tested and approved by the Commissioning Agent and the VA before it is used to verify performance of other components or systems. The air balancing and water balancing shall be completed before Systems Functional Performance Testing of air-related or water-related equipment or systems are scheduled. Systems Functional Performance Testing will proceed from components to subsystems to systems. When the proper performance of all interacting individual systems has been achieved, the interface or coordinated responses between systems will be checked.

K. Problem Solving: The Commissioning Agent will recommend solutions to problems found, however the burden of responsibility to solve, correct and retest problems is with the Contractor.

**3.7 DOCUMENTATION, NONCONFORMANCE AND APPROVAL OF TESTS**

A. Documentation: The Commissioning Agent will witness and document the results of all Systems Functional Performance Tests using the specific procedural forms developed by the Commissioning Agent for that purpose. Prior to testing, the Commissioning Agent will provide these forms to the VA and the Contractor for review and approval. The Contractor shall include the filled-out forms with the O&M manual data.

B. Nonconformance: The Commissioning Agent will record the results of the Systems Functional Performance Tests on the procedure or test form. All items of nonconformance issues will be noted and reported to the VA on Commissioning Field Reports and/or the Commissioning Master Issues Log.

1. Corrections of minor items of noncompliance identified may be made during the tests. In such cases, the item of noncompliance and resolution shall be documented on the Systems Functional Test Procedure.
2. Every effort shall be made to expedite the systems functional Performance Testing process and minimize unnecessary delays, while not compromising the integrity of the procedures. However, the Commissioning Agent shall not be pressured into overlooking noncompliant work or loosening acceptance criteria to satisfy scheduling or cost issues, unless there is an overriding reason to do so by direction from the VA.
3. As the Systems Functional Performance Tests progresses and an item of noncompliance is identified, the Commissioning Agent shall discuss the issue with the Contractor and the VA.
4. When there is no dispute on an item of noncompliance, and the Contractor accepts responsibility to correct it:
   a. The Commissioning Agent will document the item of noncompliance and the Contractor's response and/or intentions. The Systems Functional Performance Test then continues or proceeds to another test or sequence. After the day's work is complete, the Commissioning Agent will submit a Commissioning Field Report to the VA. The Commissioning Agent will also note items of noncompliance and the Contractor’s response in the Master Commissioning Issues Log. The Contractor shall correct the item of noncompliance and report completion to the VA and the Commissioning Agent.

b. The need for retesting will be determined by the Commissioning Agent. If retesting is required, the Commissioning Agent and the Contractor shall reschedule the test and the test shall be repeated.

5. If there is a dispute about item of noncompliance, regarding whether it is an item of noncompliance, or who is responsible:
   a. The item of noncompliance shall be documented on the test form with the Contractor's response. The item of noncompliance with the Contractor’s response shall also be reported on a Commissioning Field Report and on the Master Commissioning Issues Log.
   b. Resolutions shall be made at the lowest management level possible. Other parties are brought into the discussions as needed. Final interpretive and acceptance authority is with the Department of Veterans Affairs.
   c. The Commissioning Agent will document the resolution process.
   d. Once the interpretation and resolution have been decided, the Contractor shall correct the item of noncompliance, report it to the Commissioning Agent. The requirement for retesting will be determined by the Commissioning Agent. If retesting is required, the Commissioning Agent and the Contractor shall reschedule the test. Retesting shall be repeated until satisfactory performance is achieved.

C. Cost of Retesting: The cost to retest a System Functional Performance Test shall be solely the responsibility of the Contractor. Any required retesting by the Contractor shall not be considered a justified reason for a claim of delay or for a time extension by the Contractor.

D. Failure Due to Manufacturer Defect: If 10%, or three, whichever is greater, of identical pieces (size alone does not constitute a difference) of equipment fail to perform in compliance with the Contract Documents (mechanically or substantively) due to manufacturing defect, not allowing it to meet its submitted performance specifications, all identical units may be considered unacceptable by the VA. In such case, the Contractor shall provide the VA with the following:

1. Within one week of notification from the VA, the Contractor shall examine all other identical units making a record of the findings. The findings shall be provided to the VA within two weeks of the original notice.
2. Within two weeks of the original notification, the Contractor shall provide a signed and dated, written explanation of the problem, cause of failures, etc. and all proposed solutions which shall include full equipment submittals. The proposed solutions shall not significantly exceed the specification requirements of the original installation.
3. The VA shall determine whether a replacement of all identical units or a repair is acceptable.
4. Two examples of the proposed solution shall be installed by the Contractor and the VA shall be allowed to test the installations for up to one week, upon which the VA will decide whether to accept the solution.
5. Upon acceptance, the Contractor shall replace or repair all identical items, at their expense and extend the warranty accordingly, if the original equipment warranty had begun. The replacement/repair work shall proceed with reasonable speed beginning within one week from when parts can be obtained.

E. Approval: The Commissioning Agent will note each satisfactorily demonstrated function on the test form. Formal approval of the Systems Functional Performance Test shall be made later after review by the Commissioning Agent and by the VA. The Commissioning Agent will evaluate each test and report to the VA using a standard form. The VA will give final approval on each test using the same form and provide signed copies to the Commissioning Agent and the Contractor.

**3.8 DEFERRED TESTING**

A. Unforeseen Deferred Systems Functional Performance Tests: If any Systems Functional Performance Test cannot be completed due to the building structure, required occupancy condition or other conditions, execution of the Systems Functional Performance Testing may be delayed upon approval of the VA. These Systems Functional Performance Tests shall be conducted in the same manner as the seasonal tests as soon as possible. Services of the Contractor to conduct these unforeseen

Deferred Systems Functional Performance Tests shall be negotiated between the VA and the Contractor.

B. Deferred Seasonal Testing: Deferred Seasonal Systems Functional Performance Tests are those that must be deferred until weather conditions are closer to the systems design parameters. The Commissioning Agent will review systems parameters and recommend which Systems Functional Performance Tests should be deferred until weather conditions more closely match systems parameters. The Contractor shall review and comment on the proposed schedule for Deferred Seasonal Testing. The VA will review and approve the schedule for Deferred Seasonal Testing. Deferred Seasonal Systems Functional Performances Tests shall be witnessed and documented by the Commissioning Agent. Deferred Seasonal Systems Functional Performance Tests shall be executed by the Contractor in accordance with these specifications.

**3.9 OPERATION AND MAINTENANCE TRAINING REQUIREMENTS**

A. Training Preparation Conference: Before operation and maintenance training, the Commissioning Agent will convene a training preparation conference to include VA's Resident Engineer, VA’s Operations and Maintenance personnel, and the Contractor. The purpose of this conference will be to discuss and plan for Training and Demonstration of VA Operations and Maintenance personnel.

B. The Contractor shall provide training and demonstration as required by other Division 21, Division 22, Division 23, Division 26, Division 27, Division 28, and Division 31 sections. The Training and Demonstration shall include, but is not limited to, the following:

1. Review the Contract Documents.
2. Review installed systems, subsystems, and equipment.
3. Review instructor qualifications.
4. Review instructional methods and procedures.
5. Review training module outlines and contents.
6. Review course materials (including operation and maintenance manuals).
7. Review and discuss locations and other facilities required for instruction.
8. Review and finalize training schedule and verify availability of educational materials, instructors, audiovisual equipment, and facilities needed to avoid delays.

9. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

C. Training Module Submittals: The Contractor shall submit the following information to the VA and the Commissioning Agent:

1. Instruction Program: Submit two copies of outline of instructional program for demonstration and training, including a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module. At completion of training, submit two complete training manuals for VA's use.
2. Qualification Data: Submit qualifications for facilitator and/or instructor.
3. Attendance Record: For each training module, submit list of participants and length of instruction time.
4. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.
5. Demonstration and Training Recording:
   a. General: Engage a qualified commercial photographer to record demonstration and training. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice. At beginning of each training module, record each chart containing learning objective and lesson outline.
   b. Video Format: Provide high quality color DVD color on standard size DVD disks.
   c. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to show area of demonstration and training. Display continuous running time.
   d. Narration: Describe scenes on video recording by audio narration by microphone while demonstration and training is recorded. Include description of items being viewed. Describe vantage point, indicating location, direction (by compass point), and elevation or story of construction.
   e. Submit two copies within seven days of end of each training module.

6. Transcript: Prepared on 8-1/2-by-11-inch paper, punched and bound in heavy-duty, 3-ring, vinyl-covered binders. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding videotape. Include name of Project and date of videotape on each page.

D. Quality Assurance:

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

E. Training Coordination:

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

F. Instruction Program:

1. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections, and as follows:
   a. Fire protection systems, including fire alarm, fire pumps, and fire suppression systems.
   b. Intrusion detection systems.
   c. Conveying systems, including elevators, wheelchair lifts, escalators, and automated materials handling systems.
   d. Medical equipment, including medical gas equipment and piping.

e. Laboratory equipment, including laboratory air and vacuum equipment and piping.
f. Heat generation, including boilers, feedwater equipment, pumps, steam distribution piping, condensate return systems, heating hot water heat exchangers, and heating hot water distribution piping.
g. Refrigeration systems, including chillers, cooling towers, condensers, pumps, and distribution piping.
h. HVAC systems, including air handling equipment, air distribution systems, and terminal equipment and devices.
i. HVAC instrumentation and controls.
j. Electrical service and distribution, including switchgear, transformers, switchboards, panelboards, uninterruptible power supplies, and motor controls.
k. Packaged engine generators, including synchronizing switchgear/switchboards, and transfer switches.
l. Lighting equipment and controls.
m. Communication systems, including intercommunication, surveillance, nurse call systems, public address, mass evacuation, voice and data, and entertainment television equipment.
n. Site utilities including lift stations, condensate pumping and return systems, and storm water pumping systems.

G. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participants are expected to master. For each module, include instruction for the following:
1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
a. System, subsystem, and equipment descriptions.
b. Performance and design criteria if Contractor is delegated design responsibility.
c. Operating standards.
d. Regulatory requirements.
e. Equipment function.
f. Operating characteristics.
g. Limiting conditions.
H, Performance curves.

2. Documentation: Review the following items in detail:
   a. Emergency manuals.
   b. Operations manuals.
   c. Maintenance manuals.
   d. Project Record Documents.
   e. Identification systems.
   f. Warranties and bonds.
   g. Maintenance service agreements and similar continuing commitments.
3. Emergencies: Include the following, as applicable:
   a. Instructions on meaning of warnings, trouble indications, and error messages.
   b. Instructions on stopping.
   c. Shutdown instructions for each type of emergency.
   d. Operating instructions for conditions outside of normal operating limits.
   e. Sequences for electric or electronic systems.
   f. Special operating instructions and procedures.
4. Operations: Include the following, as applicable:
   a. Startup procedures.
   b. Equipment or system break-in procedures.
   c. Routine and normal operating instructions.
   d. Regulation and control procedures.
   e. Control sequences.
   f. Safety procedures.
   g. Instructions on stopping.
   h. Normal shutdown instructions.
   i. Operating procedures for emergencies.
   j. Operating procedures for system, subsystem, or equipment failure.
   k. Seasonal and weekend operating instructions.
   l. Required sequences for electric or electronic systems.
   m. Special operating instructions and procedures.
5. Adjustments: Include the following:
   a. Alignments.
   b. Checking adjustments.
   c. Noise and vibration adjustments.
   d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:
   a. Diagnostic instructions.
   b. Test and inspection procedures.
7. Maintenance: Include the following:
   a. Inspection procedures.
   b. Types of cleaning agents to be used and methods of cleaning.
   c. List of cleaning agents and methods of cleaning detrimental to product.
   d. Procedures for routine cleaning
   e. Procedures for preventive maintenance.
   f. Procedures for routine maintenance.
   g. Instruction on use of special tools.
8. Repairs: Include the following:
   a. Diagnosis instructions.
   b. Repair instructions.
   c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
   d. Instructions for identifying parts and components.
   e. Review of spare parts needed for operation and maintenance.

H. Training Execution:
1. Preparation: Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a combined training manual. Set up instructional equipment at instruction location.
2. Instruction:
   a. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Department of Veterans Affairs for number of participants, instruction times, and location.
   b. Instructor: Engage qualified instructors to instruct VA's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
      1) The Commissioning Agent will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.

2) The VA will furnish an instructor to describe VA's operational philosophy.
3) The VA will furnish the Contractor with names and positions of participants.

3. Scheduling: Provide instruction at mutually agreed times. For equipment that requires seasonal operation, provide similar instruction at start of each season. Schedule training with the VA and the Commissioning Agent with at least seven days' advance notice.
4. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of an oral, or a written, performance-based test.
5. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

I. Demonstration and Training Recording:

1. General: Engage a qualified commercial photographer to record demonstration and training. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice. At beginning of each training module, record each chart containing learning objective and lesson outline.
2. Video Format: Provide high quality color DVD color on standard size DVD disks.
3. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to show area of demonstration and training. Display continuous running time.
4. Narration: Describe scenes on videotape by audio narration by microphone while demonstration and training is recorded. Include description of items being viewed. Describe vantage point, indicating location, direction (by compass point), and elevation or story of construction.

**----- END -----**

# SECTION 02 41 00
# DEMOLITION

## PART 1 - GENERAL

### 1.1 DESCRIPTION:

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

### 1.2 RELATED WORK:

A. Safety Requirements: GENERAL CONDITIONS Article, ACCIDENT PREVENTION.

B. Disconnecting utility services prior to demolition: Section 01 00 00, GENERAL REQUIREMENTS.

C. Environmental Protection: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

D. 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. 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 Contracting Officer's Representative (COR). 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 existing structural elements are not overloaded and shall be responsible for increasing structural supports or adding / relocating 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 **be reviewed by the structural engineer of record** and have Contracting Officer's Representative (COR)'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 Contracting Officer's Representative (COR). 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. 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.

D. 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 Contracting Officer's Representative (COR). When Utility lines are encountered that are not indicated on the drawings, the Contracting Officer's Representative (COR) 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 Contracting Officer's Representative (COR). 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 09 05 16
# SUBSURFACE PREPARATION FOR FLOOR FINISHES

## PART 1 - GENERAL

### 1.1 DESCRIPTION

This section specifies subsurface preparation requirements for areas to receive the installation of applied and resinous flooring. This section includes testing concrete for moisture and pH, remedial floor coating for concrete floor slabs having unsatisfactory moisture or pH conditions, floor leveling, and repair as required.

### 1.2 RELATED WORK

A. Section 07 92 00, JOINT SEALANTS.

B. Section 09 65 16, RESILIENT SHEET FLOORING, Section 09 65 19, RESILIENT TILE FLOORING, Section 09 67 23.60, RESINOUS (Urethane and Epoxy Mortar) FLOORING, Section 09 68 00, CARPETING.

### 1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA and TEST DATA.

B. Written approval confirming product compatibility with subfloor material manufacturer and the flooring manufacturer

C. Product Data:

1. Moisture remediation system
2. Underlayment Primer
3. Cementitious Self-Leveling Underlayment
4. Cementitious Trowel-Applied Underlayment (Not suitable for resinous floor finishes)

D. Test Data:

1. Moisture test and pH results performed by a qualified independent testing agency or warranty holding manufacturer’s technical representative.

### 1.4 DELIVERY AND STORAGE

A. Deliver materials in containers with labels legible and intact and grade-seals unbroken.

B. Store material to prevent damage or contamination.

### 1.5 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in text by basic designation only.

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

| | |
|---|---|
| **D638-*10* *(2010)*** | Test Method for Tensile Properties of Plastics |
| **D4259**-*88* *(2012)* | Standard Practice for Abrading Concrete to alter the surface profile of the concrete and to remove foreign materials and weak surface laitance. |
| **C109/C109M** *-12* *(2012)* | Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens) Modified Air Cure Only |
| **D7234**-*12* *(2012)* | Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers. |
| **E96/E96M - 12** ***(2012)*** | Standard Test Methods for Water Vapor Transmission of Materials |
| **F710**-*11* *(2011)* | Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring |
| **F1869-*11*** ***(2011)*** | Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride |
| **F2170-*11*** ***(2011)*** | Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes |
| **C348-08** ***(2008)*** | Standard Test Method for Flexural Strength of Hydraulic-Cement Mortars |
| **C191-13** ***(2013)*** | Standard Test Method for Time of Setting of Hydraulic Cement by Vicat Needle |

**PART 2 - PRODUCTS**

**2.1 MOISTURE REMEDIATION COATING**

A. System Descriptions:

1. High-solids, epoxy system designed to suppress excess moisture in concrete prior to an overlayment. For use under resinous products, VCT, tile and carpet where issues caused by moisture vapor are a concern.

B. Products: Subject to compliance with applicable fire, health, environmental, and safety requirements for storage, handling, installation, and clean up.

C. System Components: Verify specific requirements as systems vary by manufacturer. Verify build up layers and installation method. Verify

compatibility with substrate. Use manufacturer's standard components, compatible with each other and as follows:

1. Liquid applied coating:
   a. Resin: epoxy.
   b. Formulation Description: Multiple component high solids.
   c. Application: Per manufacturer's written installation requirements.
   d. Thickness: minimum 10 mils

D. Material Vapor Permeance: Application shall achieve a permeance rating of less than 0.1 perm in accordance with ASTM E96/E96M.

E. Maximum RH requirement: 100% testing in accordance with ASTM F2170.

**2.2 CEMENTITIOUS SELF-LEVELING UNDERLAYMENT**

A.

| Property | Test | Value |
|---|---|---|
| Tensile Strength | ASTM D638 | 4,400 psi |
| Volatile Organic Compound Limits (V.O.C.) | SCAMD Rule 1113 | 25 grams per liter |
| Permeance | ASTM E96 | 0.1 perms |
| Tensile Modulus | ASTM D638 | $1.9X10^5$psi |
| Percent Elongation | ASTM D638 | 12% |
| Cure Rate | Per manufacture's Data | 4 hours Tack free with 24hr recoat window |
| Bond Strength | ASTM D7234 | 100% bond to concrete failure |

System Descriptions:

1. High performance self-leveling underlayment resurfacer. Single component, self-leveling, cementitious material designed for easy application as an underlayment for all types of flooring materials. It is used for substrate repair and leveling.

B. Products: Subject to compliance with applicable fire, health, environmental, and safety requirements for storage, handling, installation, and clean up. Gypsum-based products are unacceptable.

C. System Characteristics:
   1. Wearing Surface: smooth
   2. Thickness: Per architectural drawings, ranging from feathered edge to 1", per application. Applications greater than 1" require additional 3/8" aggregate to mix or as recommended by manufacturer.

D. Underlayment shall be calcium aluminate cement-based, containing Portland cement. Gypsum-based products are unacceptable.

E. Compressive Strength: Minimum 4100 psi in 28 days in accordance with ASTM C109/C109M.

F. Flexural Strength: Minimum 1000 psi in 28 days in accordance with ASTM C348

G. Dry Time: Underlayment shall receive the application of moisture insensitive tile in 6 hours, floor coverings in 16 hours, and resinous flooring in 3-7 days.

H. Primer: compatible and as recommended by manufacturer for use over intended substrate

I. System Components: Manufacturer's standard components that are compatible with each other and as follows:

1. Primer:
   a. Resin: copolymer
   b. Formulation Description: single component ready to use.
   c. Application Method: Squeegee and medium nap roller.
      All puddles shall be removed, and material shall be allowed to dry, 1-2 hours at 70F/21C.
   d. Number of Coats: (1) one.
2. Grout Resurfacing Base:
   a. Formulation Description: Single component, cementitious self-leveling high-early and high-ultimate strength grout.
   b. Application Method: colloidal mix pump, cam rake, spike roll.
      1) Thickness of Coats: Per architectural scope, 1” lifts.
      2) Number of Coats: More than one if needed.
   c. Aggregates: for applications greater than 1inch, require additional 3/8” aggregate to mix.

| Property | Test | Value |
|---|---|---|
| Compressive Strength | ASTM C109/C109M | 2,200 psi @ 24 hrs<br>3,000 psi @ 7 days |
| Initial set time<br>Final Set time | ASTM C191 | 30-45 min.<br>1 to 1.5 hours |
| Bond Strength | ASTM D7234 | 100% bond to concrete failure |

**2.3 CEMENTITIOUS TROWEL-APPLIED UNDERLAYMENT (NOT SUITABLE FOR RESINOUS FLOOR FINISHES)**

A. Underlayment shall be calcium aluminate cement-based, containing Portland cement. Gypsum-based products are unacceptable.

B. Compressive Strength: Minimum 4000 psi in 28 days

C. Trowel-applied underlayment shall not contain silica quartz (sand).

D. Dry Time: Underlayment shall receive the application of floor covering in 15-20 minutes.

**PART 3 - EXECUTION**

**3.1 ENVIRONMENTAL REQUIREMENTS**

A. Maintain ambient temperature of work areas at not less than 16 degree C (60 degrees F), without interruption, for not less than 24 hours before testing and not less than three days after testing.

B. Maintain higher temperatures for a longer period of time where required by manufacturer's recommendation.

C. Do not install materials when the temperatures of the substrate or materials are not within 60-85 degrees F/ 16-30 degrees C.

**3.2 SURFACE PREPARATION**

A. Existing concrete slabs with existing floor coverings: Not used.

B. Concrete shall meet the requirements of ASTM F710 and be sound, solid, clean, and free of all oil, grease, dirt, curing compounds, and any substance that might act as a bond-breaker before application. As required prepare slab by mechanical methods. No chemicals or solvents shall be used.

C. General: Prepare and clean substrates according to flooring manufacturer's written instructions for substrate indicated.

D. Prepare concrete substrates per ASTM D4259 as follows:

1. Dry abrasive blasting.
2. Wet abrasive blasting.
3. Vacuum-assisted abrasive blasting.
4. Centrifugal-shot abrasive blasting.
5. Comply with manufacturer's written instructions.

E. Repair damaged and deteriorated concrete according to flooring manufacturer's written recommendations.

F. Verify that concrete substrates are dry.

G. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with application only after substrates have maximum moisture-vapor-emission

rate of per flooring manufactures formal and project specific written recommendation.

H. Perform in situ probe test, ASTM F2170. Proceed with application only after substrates do not exceed a maximum potential equilibrium relative humidity per flooring manufacture’s formal and project specific written recommendation.

I. Provide a written report showing test placement and results.

J. Prepare joints in accordance with Section 07 92 00, JOINT SEALANTS and material manufacturer’s instructions

K. Alkalinity: Measure surface pH in accordance with procedures provided in ASTM F710 or as outlined by qualified testing agency or flooring manufacturer’s technical representative.

L. Tolerances: Subsurface shall meet the flatness and levelness tolerance specified on drawings or recommended by the floor finish manufacturer. Tolerance shall also not to exceed 1/4” deviation in 10’. As required, install underlayment to achieve required tolerance.

M. Other Subsurface: For all other subsurface conditions, such as wood or metal, contact the floor finish or underlayment manufacturer, as appropriate, for proper preparation practices.

**3.3 MOISTURE REMEDIATION COATING:**

A. Where results of relative humidity testing (ASTM F2170) exceed the requirements of the specified flooring manufacturer, apply remedial coating as specified to correct excessive moisture condition.

B. Prior to remedial floor coating installation mechanically prepare the concrete surface to provide a concrete surface profile in accordance with ASTM D4259.

C. Mix and apply moisture remediation coating in accordance with manufacturer’s instructions.

**3.4 CEMENTITOUS UNDERLAYMENT:**

A. Install cementitious self-leveling underlayment as required to correct surface defects, floor flatness or levelness corrections to meet the tolerance requirements as or detailed on drawings, address non-moving cracks or joints, provide a smooth surface for the installation of floor covering, or meet elevation requirements detailed on drawings.

B. Mix and apply in accordance with manufacturer's instructions.

**3.5 PROTECTION**

A. Prior to the installation of the finish flooring, the surface of the underlayment should be protected from abuse by other trades by the use of plywood, tempered hardwood, or other suitable protection course

**3.6 FIELD QUALITY CONTROL**

A. Where specified, field sampling of products shall be conducted by a qualified, independent testing facility.

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# SECTION 09 29 00
# GYPSUM BOARD

## PART 1 - GENERAL

### 1.1 DESCRIPTION

This section specifies installation and finishing of gypsum board.

### 1.2 RELATED WORK

A. Installation of steel framing members for walls, partitions, furring, soffits, and ceilings: Section 09 22 16, NON-STRUCTURAL METAL FRAMING.

B. Sound deadening board: Section 07 21 13, THERMAL INSULATION.

C. Acoustical Sealants: Section 07 92 00, JOINT SEALANTS.

D. Gypsum base for veneer plaster: Not used.

E. Lead lined wallboard: Not used.

F. 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. LEED Submittals: Not required.

C. Manufacturer's Literature and Data:

1. Cornerbead and edge trim.
2. Finishing materials.
3. Laminating adhesive.
4. Gypsum board, each type.

D. 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.

E. Samples:
1. Cornerbead.
2. Edge trim.
3. Control joints.

F. Test Results:
1. Fire rating test, each fire rating required for each assembly.
2. Sound rating test.

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

In accordance with the requirements of ASTM C840.

**1.6 ENVIRONMENTAL CONDITIONS**

In accordance with the requirements of ASTM C840.

**1.7 APPLICABLE PUBLICATIONS**

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

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

C11-08.....Terminology Relating to Gypsum and Related Building Materials and Systems

C475-02.....Joint Compound and Joint Tape for Finishing Gypsum Board

C840-08.....Application and Finishing of Gypsum Board

C919-08.....Sealants in Acoustical Applications

C954-07.....Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases to Steel Stud from 0.033 in. (0.84mm) to 0.112 in. (2.84mm) in thickness

C1002-07.....Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs

C1047-05.....Accessories for Gypsum Wallboard and Gypsum Veneer Base

C1177-06.....Glass Mat Gypsum Substrate for Use as Sheathing

C1658-06.....Glass Mat Gypsum Panels

C1396-06.....Gypsum Board

E84-08.....Surface Burning Characteristics of Building Materials

C. Underwriters Laboratories Inc. (UL):
Latest Edition.....Fire Resistance Directory

D. Inchcape Testing Services (ITS):
Latest Editions.....Certification Listings

**PART 2 - PRODUCTS**

**2.1 GYPSUM BOARD**

A. Gypsum Board Materials General:
1. Recycled Content of Gypsum Panel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
2. Regional Materials: Gypsum panel products shall be manufactured within 500 miles of Project site.

B. Gypsum Board: ASTM C1396, Type X, 16 mm (5/8 inch) thick unless shown otherwise. Shall contain a minimum of 20 percent recycled gypsum.

C. Coreboard or Shaft Wall Liner Panels.
1. ASTM C1396, Type X.
2. ASTM C1658: Glass Mat Gypsum Panels,
3. Coreboard for shaft walls 300, 400, 600 mm (12, 16, or 24 inches) wide by required lengths 25 mm (one inch) thick with paper faces treated to resist moisture.

C. Water Resistant Gypsum Backing Board: ASTM C620, Type X, 16 mm (5/8 inch) thick.

D. Acoustically Improved Gypsum Board: "Quiet Rock 527", sound dampening gypsum wallboard, U.L. Fire Rated 1 hour, Class A in accordance with ASTM E119. Basis of Design: "Quiet Rock", by Serious Materials, 1250 Elko Drive, Sunnyvale, CA. 94089, (800-797-8159), or equivalent meets this specification.

E. Gypsum cores shall contain a minimum of 95 percent post industrial recycled gypsum content. Paper facings shall contain 100 percent post-consumer recycled paper content.

**2.2 GYPSUM SHEATHING BOARD**

A. Glass-Mat Gypsum Wall Sheathing: ASTM C 1177/1177M.
1. Type and Thickness: Type X, 5/8 inch (15.9 mm) thick.
2. Size: 48 by 96 inches (1219 by 2438 mm) for vertical installation.

B. Basis of Design: G-P Gypsum Corporation; Dens-Glass Gold.

**2.3 ACCESSORIES**

B. ASTM C1047, except form of 0.39 mm (0.015 inch) thick zinc coated steel sheet or rigid PVC plastic.

1. Basis of Design: Trim-Tex, Inc.

a. "L" Beads: "L Bead", by Trim-Tex, Inc.

b. "Over Sized L" Beads: "Oversized L Bead", by Trim-Tex, Inc.

c. Fast Caps: "Fast cap", by Trim-Tex, Inc.

d. Bull-Nose Caps and Beads: "Bull-Nose Fast Cap", by Trim-Tex, Inc., size as indicated.

e. "Wall Termination Trim" Beads: "Drive-In Bead", or "Snap Cap", by Trim-Tex, Inc.

f. "Corner Beads": "Corner Bead", by Trim-Tex, Inc.

g. "Bull-Nose" Beads: "Bull Nose Corner Bead", by Trim-Tex, Inc., size as indicated.

C. Flanges not less than 22 mm (7/8 inch) wide with punchouts or deformations as required to provide compound bond.

D. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C 834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.

1. Sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches (50 mm) wide, 10 by 10 or 10 by 20 threads/inch (390 by 390 or 390 by 780 threads/m), of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.

**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**

ASTM C475 and ASTM C840. Free of antifreeze, vinyl adhesives, preservatives, biocides and other VOC. Adhesive shall contain a maximum VOC content of 50 g/l.

**PART 3 - EXECUTION**

**3.1 GYPSUM BOARD HEIGHTS**

A. Extend all layers of gypsum board from floor to underside of structure overhead on following partitions and furring:
   1. Two sides of partitions:
      a. Fire rated partitions.
      b. Smoke partitions.
      c. Sound rated partitions.
      d. Full height partitions shown (FHP).
      e. Corridor partitions.
   2. One side of partitions or furring:
      a. Inside of exterior wall furring or stud construction.
      b. Room side of room without suspended ceilings.
      c. Furring for pipes and duct shafts, except where fire rated shaft wall construction is shown.
   3. Extend all layers of gypsum board construction used for fireproofing of columns from floor to underside of structure overhead, unless shown otherwise.

B. In locations other than those specified, extend gypsum board from floor to heights as follows:
   1. Not less than 100 mm (4 inches) above suspended acoustical ceilings.
   2. At ceiling of suspended gypsum board ceilings.
   3. At existing ceilings.

**3.2 INSTALLING GYPSUM BOARD**

A. Coordinate installation of gypsum board with other trades and related work.

B. Install gypsum board in accordance with ASTM C840, except as otherwise specified.

C. Moisture and Mold-Resistant Assemblies: Provide and install moisture and mold-resistant glass mat gypsum wallboard products with moisture-resistant surfaces complying with ASTM C1658 where shown and in

locations which might be subject to moisture exposure during construction.

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 assembles:
   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. For three-ply gypsum board assemblies, apply plies in same manner as for two-ply assemblies, except that heads of fasteners need only be driven flush with surface for first and second plies. Apply third ply of wallboard in same manner as second ply of two-ply assembly, except use fasteners of sufficient length enough to have the same penetration into framing members as required for two-ply assemblies.
7. No offset in exposed face of walls and partitions will be permitted because of single-ply and two-ply or three-ply application requirements.

8. Installing Two Layer Assembly Over Sound Deadening Board:
   a. Apply face layer of wallboard vertically with joints staggered from joints in sound deadening board over framing members.
   b. Fasten face layer with screw, of sufficient length to secure to framing, spaced 300 mm (12 inches) on center around perimeter, and 400 mm (16 inches) on center in the field.
9. 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.

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 UL Design No. U438 or FM WALL CONSTRUCTION 12-2/HR (Nonbearing for two-hour fire rating.
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. Two hour wall:
      a. Erect base layer (backing board) vertically on finish side of wall with end joints staggered. Fasten base layer panels to studs with 25 mm (one inch) long screws, spaced 600 mm (24 inches) on center.

b. Use laminating adhesive between plies in accordance with UL or FM if required by fire test.

c. Apply face layer of gypsum board required by fire test vertically over base layer with joints staggered and attach with screws of sufficient length to secure to framing staggered from those in base, spaced 300 mm (12 inches) on center.

2. 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.

3. 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 al 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 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 inch) thick gypsum board secured in such a manner as to provide solid substrate equivalent to undamaged surface.

D. Tape and refinish scratched, abraded or damaged finish surfaces including cracks and joints in non decorated surface to provide smoke tight construction, fire protection equivalent to the fire rated construction and STC equivalent to the sound rated construction.

**3.7 UNACCESSIBLE CEILINGS**

At Mental Health and Behavioral Nursing Units, areas accessible to patients and not continuously observable by staff (e.g., patient bedrooms, day rooms), ceilings should be a solid material such as gypsum board. This will limit patient access. Access doors are needed to access electrical and mechanical equipment above the ceiling. These doors should be locked to prevent unauthorized access and secured to ceiling using tamper resistant fasteners.

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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: As scheduled.

### 1.3 SUBMITTAL

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and pre-consumer recycled content. Include statement indicating costs for each product having recycled content.
2. Product Data for Credit EQ 4.1: For sealants, documentation including printed statement of VOC content.

B. Samples:

1. Acoustical units, each type, with label indicating conformance to specification requirements.
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

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):

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

**PART 2- PRODUCTS**

**2.1 MATERIALS - GENERAL**

A. Recycled Content: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent.

B. Low-Emitting Materials: Acoustical panel ceilings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

**2.2 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.

b. Extruded aluminum.

c. Fire resistant plastic (glass fiber) having a flame spread and smoke developed rating of not more than 25 when tested in accordance with ASTM E84.

2. Use same construction for cross runners as main runners. Use of lighter-duty sections for cross runners is not acceptable.
3. Use aluminum suspension in kitchens and aluminum or fire resistant plastic in toilets adjacent to shower areas, hydrotherapy, and swimming pools.

B. Exposed grid suspension system for support of lay-in panels:

1. Exposed grid width not less than 22 mm (7/8 inch) with not less than 8 mm (5/16 inch) panel bearing surface.
2. Fabricate wall molding and other special molding from the same material with same exposed width and finish as the exposed grid members.
3. On exposed metal surfaces apply baked-on enamel flat texture finish in color to match adjacent acoustical units.

**2.3 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.

**2.4 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).

**2.5 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).
2. Nailing type option for wood forms:

a. Upper portion designed for anchorage in concrete and positioning lower portion below surface of concrete approximately 25 mm (one inch).

b. Lower portion provided with not less than 8 mm (5/16 inch) hole to permit attachment of hangers.

3. Flush ceiling insert type:

a. Designed to provide a shell covered opening over a wire loop to permit attachment of hangers and keep concrete out of insert recess.

b. Insert opening inside shell approximately 16 mm (5/8 inch) wide by 9 mm (3/8 inch) high over top of wire.

c. Wire 5 mm (3/16 inch) diameter with length to provide positive hooked anchorage in concrete.

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.

**2.6 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 |

**2.7 ACOUSTICAL UNITS**

A. General:

1. ASTM E1264, weighing 3.6 kg/m$^2$ (3/4 psf) minimum for mineral fiber panels or tile.

2. Class A Flame Spread: ASTM 84

3. Minimum NRC (Noise Reduction Coefficient): 0.55 unless specified otherwise: ASTM C423.

4. Minimum CAC (Ceiling Attenuation Class): 40-44 range unless specified otherwise: ASTM E413.
5. Manufacturers standard finish, minimum Light Reflectance (LR) coefficient of 0.75 on the exposed surfaces.
6. Lay-in panels: Sizes as shown, edge conditions and models as scheduled.

B. Acoustical Ceiling Tile - Mineral base with water-based painted finish less than 10 g/l VOC, Form 2 - Water felted, minimum 16 mm (5/8 inch) thick. Mineral base to contain minimum 65 percent recycled content.
   1. Basis of Design:
      a. "Cortega", No. 704A, by Armstrong World Industries, or equivalent meets this specification.
      b. "Ultima Plank", No. 1981 and 1985, Size 60 by 24 by ¾ inches, by Armstrong World Industries, or equivalent meets this specification.

C. Decorative Acoustical Ceiling Panels - Fiber glass ceiling panels with water-based painted finish on both sides and edges, less than 10 g/l VOC, Form 2 - Water felted, minimum 3 inches thick. Fiberglass base to contain minimum 65 percent recycled content.
   1. Size: 4 foot by 8 foot, and 2 foot by 6 foot, locations as indicated.
   2. Basis of Design: "Capz" Acoustical Ceiling System, by Armstrong World Industries.

**2.8 ACOUSTICAL SEALANT**

A. Acoustical Sealant: Manufacturer's standard sealant complying with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
   1. Exposed and Concealed Joints: Nonsag, paintable, non-staining latex sealant.
   2. Acoustical sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

**2.9 ACCESS IDENTIFICATION**

A. Markers:
   1. Use colored markers with pressure sensitive adhesive on one side.

2. Make colored markers of paper of 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:

Color.....Service
Red.....Sprinkler System: Valves and Controls
Green.....Domestic Water: Valves and Controls
Yellow.....Chilled Water and Heating Water
Orange.....Ductwork: Fire Dampers
Blue.....Ductwork: Dampers and Controls
Black.....Gas: Laboratory, Medical, Air and Vacuum

**PART 3 EXECUTION**

**3.1 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.

**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 $m^2$ (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.

B. 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.

C. 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) or center so as to insure that specified requirements are not exceeded.
3. Support main runners by specially designed clips attached to carrying channels.

**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. Tile in concealed grid upward access suspension system:

1. Install acoustical tile with joints close, straight and true to line, and with exposed surfaces level and flush at joints.
2. Make corners and arises full, and without worn or broken places.
3. Locate acoustical units providing access as specified under Article, ACCESS.

E. 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.

**3.5 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 65 13
# RESILIENT BASE AND ACCESSORIES

## PART 1 - GENERAL

### 1.1 DESCRIPTION

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: Per finish schedule.

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. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.

C. 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.

D. Samples:

1. Base: 150 mm (6 inches) long, each type and color.
2. Resilient Stair Treads: 150 mm (6 inches) long.
3. Sheet Rubber Flooring: 300 mm (12 inches) square.
4. 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):

F1344-04.....Rubber Floor Tile

F1859-04.....Rubber Sheet Floor Covering without Backing

F1860-04.....Rubber Sheet Floor Covering with Backing

F1861-02.....Resilient Wall Base

C. Federal Specifications (Fed. Spec.):

RR-T-650E.....Treads, Metallic and Non-Metallic, Nonskid

**PART 2 - PRODUCTS**

**2.1 GENERAL**

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 RESILIENT TREADS**

A. Fed. Spec. RR-T-650, Composition A, Type 2, 5 mm (3/16 inch) thick on wear surface tapering to 3 mm (1/8 inch) thick at riser end.

B. Nosing shape to conform to sub-tread nosing shape.

**2.4 SHEET RUBBER FLOORING**

A. ASTM F1344, F1859 or F1860, 900 mm (36 inches) wide, 3 mm (1/8 inch) thick, smooth face, material by the same manufacturer as the rubber treads, color and pattern to match treads.

B. Use for stair landings.

C. Use rubber flooring made with a minimum of 90% consumer rubber where possible.

**2.5 PRIMER (FOR CONCRETE FLOORS)**

A. As recommended by the adhesive and tile manufacturer.

**2.6 LEVELING COMPOUND (FOR CONCRETE FLOORS)**

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

**2.7 ADHESIVES**

A. Use products recommended by the material manufacturer for the conditions of use.

B. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

**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 STAIR TREAD INSTALLATION**

A. Prepare surfaces to receive the treads in accordance with applicable portions of paragraph, preparation.

B. Layout of Treads.

1. No joints will be accepted in treads.,
2. Set full treads on intermediate and floor landings.

C. Application:

1. Apply adhesive uniformly with no bare spots.
2. Roll and pound treads to assure adhesion.

**3.6 SHEET RUBBER INSTALLATION.**

A. Prepare surfaces to receive sheet rubber in accordance with applicable portions of paragraph, preparation.

B. Layout of Sheet Rubber:

1. Use minimum number of joints compatible with material direction and symmetrical joint location.

2. Where sheet rubber intersect vertical stair members, other sheets, stair treads, and other resilient materials at the floor landings, material shall touch for the entire length within 5 mils (0.005 inch).
3. Install sheet rubber on floors and intermediate landings where resilient stair treads are installed; center joint with other flooring material under doors.

C. Application:
1. Apply adhesive uniformly with no bare spots.
2. Roll sheet rubber to assure adhesion.

**3.7 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 19
# RESILIENT TILE FLOORING

## PART 1 - GENERAL

### 1.1 DESCRIPTION:

A. This section specifies the installation of luxury vinyl tile, and accessories required for a complete installation.

### 1.2 RELATED WORK:

A. Sustainable Design Requirements: Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

B. Resilient Base: Section 09 65 13, RESILIENT BASE AND ACCESSORIES.

C. Subfloor Testing and Preparation: Section 09 05 16, SUBSURFACE PREPARATION FOR FLOOR FINISHES.

D. Removal of Existing Construction Containing Asbestos: Not used.

E. Color, Pattern and Texture for Resilient Tile Flooring and Accessories: Refer drawings.

### 1.3 SUBMITTALS:

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Sustainable Design Submittals as described below:

1. Volatile organic compounds per volume as described in PART 2 - PRODUCTS.
2. Postconsumer and pre-consumer recycled content as described in PART 2 - PRODUCTS.

C. Manufacturer's Literature and Data:

1. Description of each product.
2. Resilient material manufacturer’s recommendations for adhesives, underlayment, primers, and polish.
3. Application, installation and maintenance instructions.

D. Samples:

1. Tile: Each type, color, thickness and finish.
2. Edge Strips: Each type, color, thickness and finish.
3. Feature Strips: Each type, color, thickness and finish.

E. Shop Drawings:

1. Layout of patterns as shown on the construction documents.
2. Edge strip locations showing types and detail cross sections.

F. Test Reports:

1. Abrasion resistance: Depth of wear for each tile type and color and volume loss of tile, certified by independent laboratory. Tested per ASTM F510/F510M.
2. Moisture and pH test results as per Section 09 05 16, SUBSURFACE PREPARATION FOR FLOOR FINISHES.

**1.4 DELIVERY:**

A. Deliver materials to the site in original sealed packages or containers, clearly marked with the manufacturer's name or brand, type and color, production run number and date of manufacture.

B. Materials from containers which have been distorted, damaged or opened prior to installation are not acceptable.

**1.5 STORAGE:**

A. Store materials in a clean, dry, enclosed space off the ground, protected from harmful weather conditions and at temperature and humidity conditions recommended by the manufacturer. Protect adhesives from freezing. Store flooring, adhesives, and accessories in the spaces where they will be installed for at least 48 hours before beginning installation.

**1.6 QUALITY ASSURANCE:**

A. Installer Qualifications: A company specializing in installation with minimum three (3) years' experience and employs experienced flooring installers who have retained, and currently hold, an INSTALL Certification, or a certification from a comparable certification program.

1. Installers to be certified by INSTALL or a comparable certification program with the following minimum criteria:
   a. US Department of Labor approved four (4) year apprenticeship program, 160 hours a year.
   b. Career long training.
   c. Manufacturer endorsed training.
   d. Fundamental journeyman skills certification

B. Mockup: Build floor tile mockup to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Size: 9.3 sq. m (100 sq. ft.) for each type, color, and pattern. Locations as indicated on construction documents.

2. Contracting Officer Representative (COR) approved mockup may become part of the completed Project if undisturbed at time of Substantial Completion.

C. Furnish product type materials from the same production run.

**1.7 WARRANTY:**

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

**1.8 APPLICABLE PUBLICATIONS:**

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. ASTM International (ASTM):

D2047-11.....Test Method for Static Coefficient of Friction of Polish-Coated Flooring Surfaces as Measured by the James Machine

D2240-05(R2010).....Test Method for Rubber Property—Durometer Hardness

D4078-02(R2008).....Water Emulsion Floor Finish

E648-14c.....Critical Radiant Flux of Floor Covering Systems Using a Radiant Energy Source

E662-14.....Specific Optical Density of Smoke Generated by Solid Materials

E1155/E1155M-14.....Determining Floor Flatness and Floor Levelness Numbers

F510/F510M-14.....Resistance to Abrasion of Resilient Floor Coverings Using an Abrader with a Grit Feed Method

F710-11.....Preparing Concrete Floors to Receive Resilient Flooring

F925-13.....Test Method for Resistance to Chemicals of Resilient Flooring

F1344-12(R2013).....Rubber Floor Tile

F1700-13a.....Solid Vinyl Floor Tile

F1869-11.....Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

F2170-11.....Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in Situ Probes

F2195-13.....Linoleum Floor Tile

C. Code of Federal Regulation (CFR):

40 CFR 59.....Determination of Volatile Matter Content, Water Content, Density Volume Solids, and Weight Solids of Surface Coating

D. International Standards and Training Alliance (INSTALL):

**PART 2 - PRODUCTS**

**2.1 PERFORMANCE REQUIREMENTS:**

A. Provide adhesives, underlayment, primers, and polish recommended by resilient floor material manufacturer.

B. Critical Radiant Flux: 0.45 watts per sq. cm or more, Class I, per ASTM E648.

C. Smoke Density: Less than 450 per ASTM E662.

D. Slip Resistance - Not less than 0.5 when tested with ASTM D2047.

**2.2 RUBBER TILE: NOT USED.**

**2.3 LINOLEUM TILE: NOT USED.**

**2.4 SOLID VINYL-TILE:**

A. Tile Standard: ASTM F1700.

1. Class: // Class I, monolithic vinyl tile // // Class II, surface-decorated vinyl tile //.

2. Type: // A, smooth surface // // B, embossed surface //.

B. Thickness: // 2.0 mm (0.080 inch) // // 2.5 mm (0.100 inch) // // 3.0 mm (0.120 inch) // // 3.2 mm (0.125 inch) // // //.

C. Size: // 305 x 305 mm (12 x 12 inches) // // 457 x 457 mm (18 x 18 inches) // // 610 x 610 mm (24 x 24 inches) // // 914 x 914 mm (36 x 36 inches) // // 76 x 914 mm (3 x 36 inches) // // //.

**2.5 LUXURY VINYL TILE:**

A. ASTM F1700, Class III, Printed Film Vinyl Tile, Type // A // // B //.

B. Thickness: 12 mil (1/8 inch) // //.

C. Size: // //.

D. Provide products with recycled content with not less than // 30 // // // percent.

//E. Chemical Resistance: ASTM F925; pass. //

**2.6 ADHESIVES:**

A. Provide water resistant type adhesive for flooring, base and accessories as recommended by the manufacturer to suit substrate conditions. VOC content to be less than the 50 grams/L when calculated according to 40 CFR 59 (EPA Method 24). Submit manufacturer's descriptive data, documentation stating physical characteristics, and mildew and germicidal characteristics.

**2.7 PRIMER FOR CONCRETE SUBFLOORS:**

A. Provide in accordance with Section 09 05 16, SUBSURFACE PREPARATION FOR FLOOR FINISHES.

**2.8 LEVELING COMPOUND FOR CONCRETE FLOORS:**

A. Provide cementitious products with latex or polyvinyl acetate resins in the mix in accordance with Section 09 05 16, SUBSURFACE PREPARATION FOR FLOOR FINISHES.

**2.9 POLISH AND CLEANERS:**

A. Cleaners: As recommended in writing by floor tile manufacturer.

B. Polish: ASTM D4078.

**2.10 MOULDING:**

A. Provide tapered mouldings of vinyl as indicated on the construction documents for both edges and transitions of flooring materials specified. Provide vertical lip on moulding of maximum 6 mm (1/4 inch). Provide bevel change in level between 6 and 13 mm (1/4 and 1/2 inch) with a slope no greater than 1:2.

B. Fasteners for Aluminum Mouldings: Stainless steel of type required for substrate condition.

**PART 3 - EXECUTION**

**3.1 ENVIRONMENTAL REQUIREMENTS:**

A. Maintain flooring materials and areas to receive resilient flooring at a temperature above 20 degrees C (68 degrees F) for three (3) days before application, during application and two (2) days after application, unless otherwise directly by the flooring manufacturer for the flooring being installed. Maintain a minimum temperature of 13 degrees C (55 degrees F) thereafter. Provide adequate ventilation to remove moisture from area and to comply with regulations limiting concentrations of hazardous vapors.

B. Do not install flooring until building is permanently enclosed and wet construction in or near areas to receive tile materials is complete, dry and cured.

**3.2 SUBFLOOR TESTING AND PREPARATION:**

A. Prepare and test surfaces to receive resilient tile and adhesive as per Section 09 05 16, SUBSURFACE PREPARATION FOR FLOOR FINISHES.

1. Remove existing resilient floor and existing adhesive.

B. Prepare concrete substrates in accordance with ASTM F710.

**3.3 INSTALLATION:**

A. Install in accordance with manufacturer's instructions for application and installation unless specified otherwise.

B. Mix tile from at least two containers. An apparent line either of shades or pattern variance is not acceptable.

C. Tile Layout:

1. If layout is not shown on construction documents, lay tile symmetrically about center of room or space with joints aligned.
2. Vary edge width as necessary to maintain full size tiles in the field, no edge tile to be less than 1/2 the field tile size, except where irregular shaped rooms make it impossible.
3. Place tile pattern in the same direction; do not alternate tiles unless specifically indicated in the construction documents to the contrary. Match tile installation to approved mockup.

D. Application:

1. Adhere floor tile to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
2. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
3. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
4. Roll tile floor with a minimum 45 kg (100 pound) roller.

E. Seal joints at pipes with sealants in accordance with Section 07 92 00, JOINT SEALANTS.

F. Installation of Edge Strips:

1. Locate edge strips under center line of doors unless otherwise shown on construction documents.
2. Set resilient edge strips in adhesive. Anchor metal edge strips with anchors and screws.
3. Where tile edge is exposed, butt edge strip to touch along tile edge.
4. Where thin set ceramic tile abuts resilient tile, set edge strip against floor file and against the ceramic tile edge.

**3.4 CLEANING AND PROTECTION:**

A. Clean adhesive marks on exposed surfaces during the application of resilient materials before the adhesive sets. Exposed adhesive is not acceptable.

B. Keep traffic off resilient material for a minimum 72 hours after installation.

C. Clean flooring as recommended in accordance with manufacturer’s printed maintenance instructions and within the recommended time frame. As required by the manufacturer, apply the recommended number of coats and type of polish and/or finish in accordance with manufacturer’s written instructions.

D. When construction traffic occurs over tile, cover resilient materials with reinforced kraft paper properly secured and maintained until removal is directed by COR. At entrances and where wheeled vehicles or carts are used, cover tile with plywood, hardboard, or particle board over paper, secured and maintained until removal is directed by COR.

E. When protective materials are removed and immediately prior to acceptance, replace damaged tile and mouldings, re-clean resilient materials.

**3.5 LOCATION:**

A. Unless otherwise indicated in construction documents, install tile flooring, under areas where casework, laboratory and pharmacy furniture and other equipment occur.

B. Extend tile flooring for room into adjacent closets and alcoves.

- - - E N D - - -

# SECTION 09 91 00
# PAINTING

## PART 1-GENERAL

### 1.1 DESCRIPTION

A. 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 12 - FURNISHINGS, 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. Contractor option: Prefinished flush doors with transparent finishes: Section 08 14 00, WOOD DOORS.

C. Type of Finish, Color, and Gloss Level of Finish Coat: Refer Finish Schedule.

D. Asphalt and concrete pavement marking: Not used.

### 1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. LEED Submittals:

1. Product Data for Credit EQ 4.2: For paints and coatings, including printed statement of VOC content.

C. Manufacturer's Literature and Data:

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.

D. 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. Attach labels to panel stating the following:
   a. Federal Specification Number or manufacturers name and product number of paints used.
   b. Specification code number specified in Finish Schedule.
   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.

E. Manufacturers' Certificates indicating compliance with specified requirements:

1. Manufacturer's paint substituted for Federal Specification paints meets or exceeds performance of paint specified.

**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 $m^2$ (100 $ft^2$), 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):

ACGIH TLV-BKLT-2008.....Threshold Limit Values (TLV) for Chemical Substances and Physical Agents and Biological Exposure Indices (BEIs)

ACGIH TLV-DOC-2008.....Documentation of Threshold Limit Values and Biological Exposure Indices, (Seventh Edition)

C. American National Standards Institute (ANSI):

A13.1-07.....Scheme for the Identification of Piping Systems

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

D260-86.....Boiled Linseed Oil

E. Commercial Item Description (CID):

A-A-1555.....Water Paint, Powder (Cementitious, White and Colors) (WPC) (cancelled)

A-A-3120.....Paint, For Swimming Pools (RF) (cancelled)

F. Federal Specifications (Fed Spec):

TT-P-1411A.....Paint, Copolymer-Resin, Cementitious (For Waterproofing Concrete and Masonry Walls) (CEP)

G. Master Painters Institute (MPI):

No. 4-07.....Interior/ Exterior Latex Block Filler

No. 5-07.....Exterior Alkyd Wood Primer

No. 7-07.....Exterior Oil Wood Primer

No. 8-07.....Exterior Alkyd, Flat MPI Gloss Level 1 (EO)

No. 9-07.....Exterior Alkyd Enamel MPI Gloss Level 6 (EO)

No. 10-07.....Exterior Latex, Flat (AE)

No. 11-07.....Exterior Latex, Semi-Gloss (AE)

No. 18-07.....Organic Zinc Rich Primer

No. 31-07.....Polyurethane, Moisture Cured, Clear Gloss (PV)

No. 36-07.....Knot Sealer
No. 43-07.....Interior Satin Latex, MPI Gloss Level 4
No. 44-07.....Interior Low Sheen Latex, MPI Gloss Level 2
No. 45-07.....Interior Primer Sealer
No. 46-07.....Interior Enamel Undercoat
No. 47-07.....Interior Alkyd, Semi-Gloss, MPI Gloss Level 5 (AK)
No. 48-07.....Interior Alkyd, Gloss, MPI Gloss Level 6 (AK)
No. 49-07.....Interior Alkyd, Flat, MPI Gloss Level 1 (AK)
No. 50-07.....Interior Latex Primer Sealer
No. 51-07.....Interior Alkyd, Eggshell, MPI Gloss Level 3
No. 52-07.....Interior Latex, MPI Gloss Level 3 (LE)
No. 53-07.....Interior Latex, Flat, MPI Gloss Level 1 (LE)
No. 54-07.....Interior Latex, Semi-Gloss, MPI Gloss Level 5 (LE)
No. 59-07.....Interior/Exterior Alkyd Porch & Floor Enamel, Low Gloss (FE)
No. 60-07.....Interior/Exterior Latex Porch & Floor Paint, Low Gloss
No. 66-07.....Interior Alkyd Fire Retardant, Clear Top-Coat (ULC Approved) (FC)
No. 67-07.....Interior Latex Fire Retardant, Top-Coat (ULC Approved) (FR)
No. 68-07.....Interior/ Exterior Latex Porch & Floor Paint, Gloss
No. 71-07.....Polyurethane, Moisture Cured, Clear, Flat (PV)
No. 74-07.....Interior Alkyd Varnish, Semi-Gloss
No. 77-07.....Epoxy Cold Cured, Gloss (EC)
No. 79-07.....Marine Alkyd Metal Primer
No. 90-07.....Interior Wood Stain, Semi-Transparent (WS)
No. 91-07.....Wood Filler Paste
No. 94-07.....Exterior Alkyd, Semi-Gloss (EO)
No. 95-07.....Fast Drying Metal Primer
No. 98-07.....High Build Epoxy Coating
No. 101-07.....Epoxy Anti-Corrosive Metal Primer
No. 108-07.....High Build Epoxy Coating, Low Gloss (EC)
No. 114-07.....Interior Latex, Gloss (LE) and (LG)
No. 119-07.....Exterior Latex, High Gloss (acrylic) (AE)
No. 135-07.....Non-Cementitious Galvanized Primer

No. 138-07.....Interior High Performance Latex, MPI Gloss Level 2 (LF)

No. 139-07.....Interior High Performance Latex, MPI Gloss Level 3 (LL)

No. 140-07.....Interior High Performance Latex, MPI Gloss Level 4

No. 141-07.....Interior High Performance Latex (SG) MPI Gloss Level 5

H. Steel Structures Painting Council (SSPC):

SSPC SP 1-04 (R2004)....Solvent Cleaning

SSPC SP 2-04 (R2004)....Hand Tool Cleaning

SSPC SP 3-04 (R2004)....Power Tool Cleaning

**PART 2 - PRODUCTS**

**2.1 MATERIALS**

A. Cementitious Paint (CEP): TT-P-1411A Paint, Copolymer-Resin, Cementitious (CEP), Type 1 for exterior use, Type II for interior use.

B. Wood Sealer: MPI 31 (gloss) or MPI 71 (flat) thinned with thinner recommended by manufacturer at rate of about one part of thinner to four parts of varnish.

C. Plastic Tape:

1. Pigmented vinyl plastic film in colors as scheduled.
2. Pressure sensitive adhesive back.
3. Widths as shown.

D. Identity markers options:

1. Pressure sensitive vinyl markers.
2. Snap-on coil plastic markers.

E. Aluminum Paint (AP): MPI 1.

F. Interior/Exterior Latex Block Filler: MPI 4.

G. Exterior Latex, Flat (AE): MPI 10.

H. Exterior Latex, Semi-Gloss (AE): MPI 11.

I. Organic Zinc rich Coating (HR): MPI 22.

J. Cementitious Galvanized Metal Primer: MPI 26.

K. Interior Satin Latex: MPI 43.

L. Interior Primer Sealer: MPI 45.

M. Interior Latex Primer Sealer: MPI 50.

N. Interior Latex, MPI Gloss Level 3 (LE): MPI 52.

O. Interior Latex, Flat, MPI Gloss Level 1 (LE): MPI 53.

P. Interior Latex, Semi-Gloss, MPI Gloss Level 5 (LE): MPI 54.

Q. Epoxy Cold Cured, Gloss (EC): MPI 77.

R. High Build Epoxy Coating: MPI 98.

S. Epoxy Anti-Corrosive Metal Primer: MPI 101.

T. Interior latex, Gloss (LE) and (LG): MPI 114.

U. Exterior Latex, High Gloss (acrylic) (AE): MPI 119.

V. Waterborne Galvanized Primer: MPI 134.

X. Non-Cementitious Galvanized Primer: MPI 135.

Y. Interior High Performance Latex, MPI Gloss Level 4: MPI 140.

**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. Paint materials shall conform to the restrictions of the local Environmental and Toxic Control jurisdiction.

1. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction and, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

a. Flat Paints and Coatings: 50 g/L.

b. Nonflat Paints and Coatings: 150 g/L.

c. Dry-Fog Coatings: 400 g/L.

d. Primers, Sealers, and Undercoaters: 200 g/L.

e. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.

f. Zinc-Rich Industrial Maintenance Primers: 340 g/L.

g. Pretreatment Wash Primers: 420 g/L.

h. Shellacs, Clear: 730 g/L.

i. Shellacs, Pigmented: 550 g/L.

j. Exterior Latex Coatings: 50g/l

2. Lead-Base Paint:

a. Comply with Section 410 of the Lead-Based Paint Poisoning Prevention Act, as amended, and with implementing regulations promulgated by Secretary of Housing and Urban Development.
b. Regulations concerning prohibition against use of lead-based paint in federal and federally assisted construction, or rehabilitation of residential structures are set forth in Subpart F, Title 24, Code of Federal Regulations, Department of Housing and Urban Development.
c. For lead-paint removal, see Section 02 83 33.13, LEAD-BASED PAINT REMOVAL AND DISPOSAL.

3. Asbestos: Materials shall not contain asbestos.
4. Chromate, Cadmium, Mercury, and Silica: Materials shall not contain zinc-chromate, strontium-chromate, Cadmium, mercury or mercury compounds or free crystalline silica.
5. Human Carcinogens: Materials shall not contain any of the ACGIH-BKLT and ACGHI-DOC confirmed or suspected human carcinogens.
6. Use high performance acrylic paints in place of alkyd paints, where possible.
7. 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.

**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).
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. Masonry, Concrete, Cement Plaster:
   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. Remove loose mortar in masonry work.
   4. Replace mortar and fill open joints, holes, cracks and depressions with new mortar specified in Section 04 05 13, MASONRY MORTARING. Do not fill weep holes. Finish to match adjacent surfaces.
   5. 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 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 [Plaster, 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.

I. 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:

1. Use same kind of primer specified for exposed face surface.
   a. Interior wood except for transparent finish: MPI 45 (Interior Primer Sealer) or MPI 46 (Interior Enamel Undercoat), thinned if recommended by manufacturer.
   b. Transparent finishes as specified under Transparent Finishes on Wood except Floors.

F. Metals:

1. Steel and iron: MPI 95 (Fast Drying Metal Primer).
2. Zinc-coated steel and iron: MPI 134 (Waterborne Galvanized Primer).
3. Machinery not factory finished: MPI 9 (Exterior Alkyd Enamel (EO)).

G. Gypsum Board:

1. Surfaces scheduled to have MPI 53 (Interior Latex, Flat), MPI Gloss Level 1 LE; MPI 52 (Interior Latex, Egg Shell), MPI Gloss Level 3 (LE), use MPI 50 (Primer Sealer, Latex, Interior).
2. Surfaces scheduled to receive vinyl coated fabric wallcovering: Use MPI 45 (Interior Primer Sealer).

**3.6 EXTERIOR FINISHES**

A. Apply following finish coats where scheduled.

B. Steel and Ferrous Metal:

1. Two coats of MPI 94 (Exterior Alkyd, Semi-Gloss (EO)) on exposed surfaces.

D. Machinery without factory finish except for primer: One coat MPI 8 (Exterior Alkyd, Flat (EO)).

E. Concrete Masonry Units, Cement Plaster, Concrete:

1. General:
   a. Match existing Masonry Units, Mortar, Cement Plaster, Concrete.
   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 per Finish Schedule.

B. Metal Work:

1. Apply to exposed surfaces.
2. Omit body and finish coats on surfaces concealed after installation except electrical conduit containing conductors over 600 volts.
3. Ferrous Metal, Galvanized Metal, and Other Metals Scheduled:
   a. Apply two coats of MPI 47 (Interior Alkyd, Semi-Gloss (AK)) unless specified otherwise.
   b. 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.
   c. Machinery: One coat MPI 9 (Exterior Alkyd Enamel (EO)).

C. Gypsum Board:

1. One coat of MPI 50 (Interior Primer Sealer, Sealer, Latex).
2. MPI 53 (Interior Latex, Flat), MPI Gloss Level 1 LE)); MPI 52 (Interior Latex, Egg Shell, MPI Gloss Level 3 (LE).

D. Masonry and Concrete Walls:

1. Over MPI 4 (Interior/Exterior Latex Block Filler) on CMU surfaces.
2. Two coats of MPI 53 (Interior Latex, Flat, MPI Gloss Level 1 (LE)), or MPI 52 (Interior Latex, MPI Gloss Level 3 (LE)).

E. 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 45 (Interior Primer Sealer), MPI 46 (Interior Enamel Undercoat) plus one coat of MPI 47 (Interior Alkyd, Semi-Gloss (AK)) (SG).

**3.8 REFINISHING EXISTING PAINTED SURFACES**

A. Clean, patch and repair existing surfaces as specified under surface preparation.

B. Remove and reinstall items as specified under surface preparation.

C. Remove existing finishes or apply separation coats to prevent non compatible coatings from having contact.

D. Patched or Replaced Areas in Surfaces and Components: Apply spot prime and body coats as specified for new work to repaired areas or replaced components.

E. Except where scheduled for complete painting apply finish coat over plane surface to nearest break in plane, such as corner, reveal, or frame.

F. In existing rooms and areas where alterations occur, clean existing stained and natural finished wood retouch abraded surfaces and then give entire surface one coat of MPI 71 (Polyurethane, Moisture Cured, Clear Flat (PV)).

G. Refinish areas as specified for new work to match adjoining work unless specified or scheduled otherwise.

H. Coat knots and pitch streaks showing through old finish with MPI 36 (Knot Sealer) before refinishing.

I. Sand or dull glossy surfaces prior to painting.

J. Sand existing coatings to a feather edge so that transition between new and existing finish will not show in finished work.

**3.9 PAINT COLOR**

A. Color and gloss of finish coats AS SCHEDULED.

B. For additional requirements regarding color see Articles, REFINISHING EXISTING PAINTED SURFACE and MECHANICAL AND ELECTRICAL FIELD PAINTING SCHEDULE.

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.

**3.10 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 as scheduled.

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 scheduled.
2. Paint colors as scheduled 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 94 (Exterior Alkyd, Semi-gloss (EO)) MPI 9 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 11 (Exterior Latex, Semi Gloss (AE)) 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 47 (Interior Alkyd, Semi-Gloss (AK)) 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. 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) Steam line flanges, bare pipe, fittings, valves, hangers and supports over 94 degrees K (200 degrees F).

c. Paint electrical conduits containing cables rated 600 volts or more using two coats of MPI 9 (Exterior Alkyd Enamel (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 10 (Exterior Latex, Flat (AE)).

**3.11 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 and existing 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.

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 foundations 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.

**3.12 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 12 000 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 BACKGROUND | COLOR OF LETTERS | LEGEND BBREVIATIONS |
|---|---|---|---|---|
| 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 |
| Emergency Shower | | Green | White | Emg Shower |
| 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 |
| Fuel Oil - Grade | | Green | White | Fuel Oil-Grade __* |
| Boiler Water Sampling | | Yellow | Black | Sample |
| Chemical Feed | | Yellow | Black | Chem Feed |
| Continuous Blow-Down | | Yellow | Black | Cont. B D |
| Pumped Condensate | | Black | | Pump Cond |
| Pump Recirculating | | Yellow | Black | Pump-Recirc. |
| Vent Line | | Yellow | Black | Vent |
| Alkali | | Yellow | Black | Alk |
| Bleach | | Yellow | Black | Bleach |
| Detergent | | Yellow | Black | Det |
| Liquid Supply | | Yellow | Black | Liq Sup |
| Reuse Water | | Yellow | Black | Reuse Wtr |
| 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 |
| Ice Water | | | | |
| Supply | White | Green | White | Ice Wtr |
| Return | White | Green | White | Ice Wtr Ret |
| Reagent Grade Water | | Green | White | RG |
| Reverse Osmosis | | Green | White | RO |
| 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 |
| Silver Recovery | Green | White | Silver Rec |
| Oral Evacuation | Green | White | Oral Evac |
| 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, or as required for application.
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. Dental compressed air lines: Section 22 61 13.74, DENTAL COMPRESSED-AIR PIPING / Section 22 61 19.74, DENTAL COMPRESSED-AIR EQUIPMENT.
   c. Laboratory gas 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.
   d. Oral evacuation lines: Section 22 62 19.74, DENTAL VACUUM AND EVACUATION EQUIPMENT.
   e. 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.
   f. 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.

**3.14 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.

- - - E N D - - -

# SECTION 10 14 00
# SIGNAGE

## PART 1 - GENERAL

### 1.1 DESCRIPTION

A. This section specifies interior signage for room numbers, directional signs, code required signs, telephone identification signs and temporary interior signs.

B. This section also specifies exterior medical center identification signs, building identification signs, parking and traffic signs.

C. Installation of Government furnished dedication plaque and VA seal.

### 1.2 RELATED WORK

A. Electrical: Related Electrical Specification Sections.

B. Lighted EXIT signs for egress purposes are specified under Division 26, ELECTRICAL.

C. Not used.

D. Color Finish: Per local VA Requirements.

### 1.3 MANUFACTURER'S QUALIFICATIONS

Sign manufacturer shall provide evidence that they regularly and presently manufactures signs similar to those specified in this section as one of their principal products.

### 1.4 SUBMITTALS

A. Submit in accordance with Section 01 33 00, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.

B. LEED Submittals:

1. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regionally manufactured materials. Include statement indicating cost for each regionally manufactured material.
   a. Include statement indicating location of manufacturer and distance to Project for each regionally manufactured material.
2. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.

C. Samples: Sign panels and frames, with letters and symbols, each type. Submit 2 sets. One set of samples will be retained by Resident Engineer, other returned to Contractor.

1. Sign Panel, 200 mm x 250 mm (8 inches x 10 inches), with letters.

2. Color samples of each color, 150 mm x 150 mm (6 inches x 6 inches. Show anticipated range of color and texture.
3. Sample of typeface, arrow and symbols in a typical full size layout.

D. Manufacturer's Literature:
1. Showing the methods and procedures proposed for the concealed anchorage of the signage system to each surface type.
2. Manufacturer’s printed specifications, anchorage details, installation and maintenance instructions.

E. Samples: Sign location plan, showing location, type and total number of signs required.

F. Shop Drawings: Scaled for manufacture and fabrication of sign types. Identify materials, show joints, welds, anchorage, accessory items, mounting and finishes.

G. Full size layout patterns for dimensional letters.

**1.5 DELIVERY AND STORAGE**

A. Deliver materials to job in manufacturer's original sealed containers with brand name marked thereon. Protect materials from damage.

B. Package to prevent damage or deterioration during shipment, handling, storage and installation. Maintain protective covering in place and in good repair until removal is necessary.

C. Deliver signs only when the site and mounting services are ready for installation work to proceed.

D. Store products in dry condition inside enclosed facilities.

**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):
B209-07.....Aluminum and Aluminum-Alloy Sheet and Plate
B221-06.....Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and tubes.

C. Federal Specifications (Fed Spec):
MIL-PRF-8184F.....Plastic Sheet, Acrylic, Modified.
MIL-P-46144C.....Plastic Sheet, Polycarbonate

**1.7 MINIMUM SIGN REQUIREMENTS**

A. Permanent Rooms and Spaces:

1. Tactile and Braille Characters, raised minimum 0.793 mm (1/32 in). Characters shall be accompanied by Grade 2 Braille.
2. Type Styles: Characters shall be uppercase, Helvetica Medium, Helvetica Medium Condensed and Helvetica Regular.
3. Character Height: Minimum 16 mm (5/8 in) high, Maximum 50 mm (2 in).
4. Symbols (Pictograms): Equivalent written description shall be placed directly below symbol, outside of symbol's background field. Border dimensions of symbol background shall be minimum 150 mm (6 in) high.
5. Finish and Contrast: Characters and background shall be eggshell, matte or other non-glare finish with adequate contrast with background.
6. Mounting Location and Height: As shown. Mounted on wall adjacent to the latch side of the door and to avoid door swing and protruding objects.

B. Overhead Signs:

1. Type Styles: As shown. Characters shall have a width-to-height ratio between 3:5 and 1:1. Characters shall have a stroke width-to-height ratio of between 1:5 and 1:10.
2. Character Height: minimum 75 mm (3 in) high for overhead signs. As shown, for directional signs.
3. Finish and Contrast: Same as for signs of permanent rooms and spaces.
4. Mounting Location and Height: As shown.

**1.8 COLORS AND FINISHES:**

Match existing signage. Verify with local VA.

**PART 2 - PRODUCTS**

**2.1 GENERAL**

A. Signs of type, size and design shown on the drawings and as specified.

B. Signs complete with lettering, framing and related components for a complete installation.

C. Provide graphics items as completed units produced by a single manufacturer, including necessary mounting accessories, fittings and fastenings.

D. Do not scale drawings for dimensions. Contractor to verify and be responsible for all dimensions and conditions shown by these drawings. Resident Engineer to be notified of any discrepancy in drawing, in

field directions or conditions, and/or of any changes required for all such construction details.

E. The Sign Contractor, by commencing work of this section, assumes overall responsibility, as part of his warranty of work, to assure that assemblies, components and parts shown or required within the work of the section, comply with the Contract Documents. The Contractor shall further warrant: That all components, specified or required to satisfactorily complete the installation are compatible with each other and with conditions of installations.

F. Regional Materials: Panel signs shall be manufactured within 500 miles of Project site.

**2.2 PRODUCTS**

A. Aluminum:

1. Sheet and Plate: ASTM B209.
2. Extrusions and Tubing: ASTM B221.

B. Cast Acrylic Sheet: MIL-PRF-8184F; Type II, class 1, Water white non-glare optically clear. Matt finish water white clear acrylic shall not be acceptable.

C. Polycarbonate: MIL-P-46144C; Type I, class 1.

D. Vinyl: 0.1 mm thick machine cut, having a pressure sensitive adhesive and integral colors.

E. Adhesives: As recommended by sign manufacturer and with a VOC content of 70 g/L or less for adhesives used inside the weatherproofing system and applied on-site when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. Electrical Signs:

1. General: Furnish and install all lighting, electrical components, fixtures and lamps ready for use in accordance with the sign type drawings, details and specifications.
2. Refer to Electrical Specifications Section, Division 26, ELECTRICAL, to verify line voltages for sign locations that require electrical signs.
3. Quality Control: Installed electrical components and sign installations are to bear the label and certification of Underwriter’s Laboratories, Inc., and are to comply with National Electrical Code as well as applicable federal, state and local codes for installation techniques, fabrication methods and general product safety.

4. Ballast and Lighting Fixtures: See Electrical Specifications.

G. Concrete Post Footings: Not used.

H. Steel: See Section 05 12 00, STRUCTURAL STEEL FRAMING.

**2.3 SIGN STANDARDS**

A. Topography:

1. Type Style: Helvetica Medium and Helvetica Medium Condensed. Initial caps or all caps as indicated in Sign Message Schedule.
2. Arrow: See graphic standards in drawings.
3. Letter spacing: See graphic standards on drawings.
4. Letter spacing: See graphic standards on drawings.
5. All text, arrows, and symbols to be provided in size, colors, typefaces and letter spacing shown. Text shall be a true, clean, accurate reproduction of typeface(s) shown. Text shown in drawings are for layout purposes only; final text for signs is listed in Sign Message Schedule.

B. Project Colors and Finishes: Match existing signs.

**2.4 SIGN TYPES**

A. General:

1. The interior sign system is comprised of sign types families that are identified by a letter and number which identify a particular group of signs. An additional number identifies a specific type of sign within that family.

a. IN indicates a component construction based sign.

1. The exterior sign system shall be comprised of sign types families that are identified by a letter and number which identify a particular group of signs. An additional number identifies a specific type of sign within that family.
2. EI designation indicates exterior internally illuminated sign.
3. EN designation indicates exterior non-illuminated sign.

B. Interchangeable Component System:

1. Sign Type Families: 03, 04, 05, 06, 07, 08, 09 10, 11 12, 13, 14, 15, 16 and 17.
2. Interior sign system capable of being arranged in a variety of configurations with a minimum of attachments, devices and connectors.

a. Interchangeable nature of the system shall allow for changes of graphic components of the installed sign, without changing sign in its entirety.

b. Component Sign System is comprised of the following primary components:

1) Rail Back utilizing horizontal rails, spaced to allow for uniform, modular sizing of sign types.

2) Rail Insert mounted to back of Copy Panels to allow for attachment to Rail Back.

3) Copy Panels, made of a variety of materials to allow for different graphic needs.

4) End Caps which interlock to Rail Back to enclose and secure changeable Copy Panels.

5) Joiners and Accent Joiners connect separate Rail Backs together.

6) Top Accent Bars which provide decorative trim cap that encloses the top of sign or can connect the sign to a Type 03 Room Number Sign.

c. Rail Back, Rail Insert and End Caps in anodized extruded aluminum to allow for tight tolerances and consistent quality of fit and finish.

d. Signs in system shall be convertible in the field to allow for enlargement from one size to another in height and width through use of Joiners or Accent Joiners, which connect Rail Back panels together blindly, providing a butt joint between Copy Panels. Accent Joiners shall connect Rail Backs together with a visible 3 mm (1/8") horizontal rib, flush to the adjacent copy insert surfaces.

e. Sign configurations shall vary in width from 225 mm (9 inches) to 2050 mm (80 inches), and have height dimensions of 50 mm (2 inches), 75 mm (3 inches), 150 mm (6 inches), 225 mm (9 inches) and 300 mm (12 inches). Height shall be increased beyond 300 mm (12 inches), by repeating height module in full or in part.

3. Rail Back functions as internal structural member of sign using 6063T5 extruded aluminum and anodized black.

a. Shall accept an extruded aluminum or plastic insert on one sign or on both sides, depending upon sign type.

b. Shall be convertible in field to allow for connection to other Rail Back panels, so that additive changes can be made to sign unit.
c. Rail shall allow for a variety of mounting devices including wall mounting for screw-on applications, using pressure sensitive tape, freestanding mount, ceiling mount and other mounting devices as needed.

4. Rail Insert functions as a mounting device for Copy Panels on to the Rail Back. The Rail Insert mounts to the back of the Copy Panel with adhesive suitable for use with the particular copy insert material.
   a. Shall allow Copy Panels to slide or snap into the horizontal Rail Back for ease of changeability.
   b. Shall mount to the back of the Copy Panel with adhesive suitable for use with particular Copy Panel material.
5. Copy Panels shall accept various forms of copy and graphics, and attaches to the Rail Back with the Rail Insert. Copy Panels shall be either ABS plastic with integral color or an acrylic lacquer finish; photo polymer; or, acrylic.
   a. Interchangeable by sliding horizontally from either side of sign, and to other signs in system of equal or greater width or height.
   b. Cleanable without use of special chemicals or cleaning solutions.
   c. Copy Insert Materials.
      1) ABS Inserts - 2.3 mm (.090 inches) extruded ABS plastic core with .07 mm (.003 inches) acrylic cap bonded during extrusion/texturing process. Pressure bonded to extruded Rail Insert using adhesive. Background color is either integral or painted in acrylic lacquer. ABS inserts finished in a chromium industries #HM335RA texture pattern to prevent glare.
      2) Photo polymer Inserts - 3 mm (.125 inches) phenolic photo polymer with raised copy etched to 2.3 mm (.0937 inches), bonded to an ABS plastic or extruded aluminum insert with adhesive. Background color is painted in acrylic enamel.
      3) Changeable Paper/ Insert Holder - Extruded insert holder with integral Rail Insert for connection with structural back panel in 6063T5 aluminum with a black anodized finish. Inserts into holder are paper with a clear 0.7 mm (.030 inches) textured cover. Background color is painted in acrylic lacquer.

4) Acrylic - 2 mm (.080 inches) non-glare acrylic. Pressure bonded to extruded Rail Insert using adhesive. Background color is painted in acrylic lacquer or acrylic enamel.
5) Extruded 6063T5 aluminum with a black anodized finish Insert Holder with integral Rail Insert for connection with Structural Back Panel to hold a 0.7 mm (.030 inches) textured polycarbonate insert and a Sliding Tile which mounts in the Inset Holder and slides horizontally.
6) End Caps - Extruded using 6063T5 aluminum with a black anodized. End Caps interlock with Rail Back with clips to form an integral unit, enclosing and securing the changeable Copy Panels, without requiring tools for assembly.
   a) Shall be interchangeable to either end of sign and to other signs in the system of equal height.
   b) Mechanical fasteners can be added to the End Caps that will secure it to Rail Back to make sign tamper resistant.
7) Joiners - Extruded using 6063T5 aluminum with a black anodized finish. Rail Joiners connect Rail Backs together blindly, providing a butt joint between Copy Inserts.
8) Accent Joiners - Extruded using 6063T5 aluminum with a mirror polished finish. Joiner shall connect Rail Backs together with a visible 3 mm (.125 inches) horizontal rib, flush to the adjacent Copy Panel surfaces.
9) Top Accent Rail - Extruded using 6063T5 aluminum with a mirror polished finish. Rail shall provide 3 mm (.125 inches) high decorative trim cap, which butts flush to adjacent Copy Panel and encloses top of Rail Back and Copy Panel.
10) Typography
   a) Vinyl First Surface Copy (non-tactile) - Applied Vinyl copy.
   b) Subsurface Copy Inserts - Textured 1 mm (.030 inches) clear polycarbonate face with subsurface applied Vinyl copy. Face shall be back sprayed with paint and laminated to an extruded aluminum carrier insert.
   c) Integral Tactile Copy Inserts - phenolic photo polymer etched with 2.3 mm (.0937 inches) raised copy.

d) Silk-screened First Surface Copy (non-tactile) - Injection molded or extruded ABS plastic or aluminum insert with first surface applied enamel silk-screened copy.

C. Sign Type Family 01, 02.01 thru 02.05, 08, 09 and 20:
   1. All text and graphics are to be first surface silk-screened.
   2. IN-01.12 & IN-01.13: Refer to Sign Type 03 specification for tactile and Braille portion of sign.
   3. IN-02.4: All text and graphics are to be first surface vinyl letters.
   4. IN-01.1: Preparation of artwork for reproduction of "fire and emergency evacuation maps" is by manufacturer.

D. Sign Type Families 03:
   1. Tactile sign is to be made from a material that provides for letters, numbers and Braille to be integral with sign plaque material such as: photosensitive polyamide resin, etched metal, sandblasted phenolic or embossed material. Do not apply letters, numbers and Braille with adhesive.
   2. Numbers, letters and Braille to be raised 0.793 mm (.0312 inches) from the background surface. The draft of the letters, numbers and Braille to be tapered, vertical and clean.
   3. Braille dots are to conform with standard dimensions for literary Braille; (a) Dot base diameter: 1.5 mm (.059 inches) (b) Inter-dot spacing: 2.3 mm (.090 inches) (c) Horizontal separation between cells: 6.0 mm (.241 inches) (d) Vertical separation between cells: 10.0 mm (.395 inches)
   4. Entire assembly is painted in specified color. After painting, apply white or other specified color to surface of the numbers and letters. Entire sign is to have a protective clear coat sealant applied.
   5. Complete sign is to have an eggshell finish (11 to 19 degree on a 60 degree glossmeter).

E. Sign Type Family 04 and 11:
   1. All text and graphics are to be first surface applied vinyl letters.
   2. IN-04: When a Type IN-04 is to be mounted under a Type IN03, a connecting Accent Joiner is to be used to create a singular integrated sign.

F. Sign Type 05:

1. Text if added to Copy Insert module to be first surface applied vinyl letters.

G. Sign Type Family 06 and 07:
1. A11 text and graphics are to be first surface applied vinyl letters except for under sliding tile.
2. Protect text, which is covered by sliding tile, so tile does not wear away letters.

H. Sign Type Family 10:
1. Pocket depth is to be 0.3 mm (.0150 inches).

I. Sign Type Family 12 and 13:
1. A11 text and graphics are to be first surface applied vinyl letters.
2. IN-12: Provide felt, cork or similar material on bottom of desk mounting bracket to protect counter surfaces.

J. Sign Type Family 14, 15,and 16:
1. A11 text and graphics are to be first surface applied vinyl letters.
2. IN-14.06: When added to top of IN-14.01, IN-14.04, or IN-14.05 a connecting Accent Joiner is to be used to create a singular integrated sign.
3. Ceiling mounted signs required mounting hardware on the sign that allows for sign disconnection, removal and reinstallation and reconnection.

K. Sign Type Family 17:
1. A11 text and graphics are to be first surface applied vinyl letters.
2. IN-17: Directory constructed using elements of the Component System.

L. Sign Type Family 18:
1. A11 text and graphics are to be first surface applied stylus cut vinyl letters.
2. Provide in specified typeface, color and spacing, with each message or message group on a single quick release backing sheet.

M. Sign Type Family 19:
1. Dimensional letters are mill or laser cut acrylic in the size and thickness noted in the drawings.
2. Draft of letters is perpendicular to letters face.
3. All corners such as where a letter stem and bar intersect are to be square so the letter form is accurately reproduced.
4. Paint letters with acrylic polyurethane in specified color and finish.

N. Sign Type Family (See Specialty Signs Section) 21:
   1. IN-21.01: 57 mm (2.25 inches) polished aluminum tube mounted to weighted 356 mm (14 inches) diameter polished aluminum base. Sign bracket to hold a 6 mm (.25 inches) sign plaque.
   2. IN-21.02: 57 mm (2.25 inches) polished aluminum tube vertical support mounted to a weighted polished 57 mm (2.25 inches) aluminum tubular base. Rail Back mechanically connected to vertical supports with Copy Panel attached to front and back.
   3. IN-21.03 & 21.04: IN-21.02: 57 mm (2.25 inches) polished aluminum tube vertical support mounted to a weighted polished 57 mm (2.25 inches) aluminum tubular base. Rail Back mechanically connected to vertical supports with hinged locking glass door. Black felt covered changeable letter board or tan vinyl impregnated cork tack surface as background within case.

O. Sign Type Family 22:
   1. IN-22.01: Extruded aluminum clip anodized black containing rollers to pinch and release paper. End caps are black plastic.
   2. IN-22.02: Patient Information holder constructed of 18 gauge formed sheet metal painted in specified color. Polished aluminum connecting rods and buttons. Button covers for mounting screws are to permanently attach and securely conceal screws.

P. Temporary Interior Signs:
   1. Fabricated from 50 kg (110 pound) matte finished white paper cut to 100 mm (4 inch) wide by 300 mm (12 inch) long. Punched 3 mm (.125 inch) hole with edge of hole spaced 13 mm (.5 inch) in from edge and centered on 100 mm (4 inch) side. Reinforce hole on both sides with suitable material that prevents tie form pulling through hole. Ties are steel wire 0.3 mm (0.120 inch) thick attached to tag with twist leaving 150 mm (6 inch) long free ends.
   2. Mark architectural room number on sign, with broad felt marker in clearly legible numbers or letters that identify room, corridor or space as shown on floor plans.
   3. Install temporary signs to all rooms that have a room, corridor or space number. Attach to door frame, door knob or door pull.
      a. Doors that do not require signs are: corridor doors in corridor with same number, folding doors or partitions, toilet doors, bathroom doors within and between rooms, closet doors within

rooms, communicating doors in partitions between rooms with corridor entrance doors.

b. Replace and missing damaged or illegible signs.

**2.5 FABRICATION**

A. Design components to allow for expansion and contraction for a minimum material temperature range of 56 °C (100 °F), without causing buckling, excessive opening of joints or over stressing of adhesives, welds and fasteners.

B. Form work to required shapes and sizes, with true curve lines and angles. Provide necessary rebates, lugs and brackets for assembly of units. Use concealed fasteners whenever and wherever possible.

C. Shop fabricate so far as practicable. Joints fastened flush to conceal reinforcement, or welded where thickness or section permits.

D. Contact surfaces of connected members be true. Assembled so joints will be tight and practically unnoticeable, without use of filling compound.

E. Signs shall have fine, even texture and be flat and sound. Lines and miters sharp, arises unbroken, profiles accurate and ornament true to pattern. Plane surfaces be smooth flat and without oil-canning, free of rack and twist. Maximum variation from plane of surface plus or minus 0.3 mm (0.015 inches). Restore texture to filed or cut areas.

F. Level or straighten wrought work. Members shall have sharp lines and angles and smooth su1rfaces.

G. Extruded members to be free from extrusion marks. Square turns and corners sharp, curves true.

H. Drill holes for bolts and screws. Conceal fastenings where possible. Exposed ends and edges mill smooth, with corners slightly rounded. Form joints exposed to weather to exclude water.

I. Finish hollow signs with matching material on all faces, tops, bottoms and ends. Edge joints tightly mitered to give appearance of solid material.

J. All painted surfaces properly primed. Finish coating of paint to have complete coverage with no light or thin applications allowing substrate or primer to show. Finished surface smooth, free of scratches, gouges, drips, bubbles, thickness variations, foreign matter and other imperfections.

K. Movable parts, including hardware, are be cleaned and adjusted to operate as designed without binding of deformation of members. Doors

and covers centered in opening or frame. All contact surfaces fit tight and even without forcing or warping components.

L. Pre-assemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for re-assembly and coordinated installation.

M. No signs are to be manufactured until final sign message schedule and location review has been completed by the Resident Engineer & forwarded to contractor.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

A. Protect products against damage during field handling and installation. Protect adjacent existing and newly placed construction, landscaping and finishes as necessary to prevent damage during installation. Paint and touch up any exposed fasteners and connecting hardware to match color and finish of surrounding surface.

B. Mount signs in proper alignment, level and plumb according to the sign location plan and the dimensions given on elevation and sign location drawings. Where otherwise not dimensioned, signs shall be installed where best suited to provide a consistent appearance throughout the project. When exact position, angle, height or location is in doubt, contact Resident Engineer for clarification.

C. Contractor shall be responsible for all signs that are damaged, lost or stolen while materials are on the job site and up until the completion and final acceptance of the job.

D. Remove or correct signs or installation work Resident Engineer determines as unsafe or as an unsafe condition.

E. At completion of sign installation, clean exposed sign surfaces. Clean and repair any adjoining surfaces and landscaping that became soiled or damaged as a result of installation of signs.

F. Locate signs as shown on the Sign Location Plans.

G. Certain signs may be installed on glass. A blank glass back up is required to be placed on opposite side of glass exactly behind sign being installed. This blank glass back up is to be the same size as sign being installed.

H. Contractor will be responsible for verifying that behind each sign location there are no utility lines that will be affected by

installation of signs. Any damage during installation of signs to utilities will be the sole responsibility of the Contractor to correct and repair.

I. Furnish inserts and anchoring devices which must be set in concrete or other material for installation of signs. Provide setting drawings, templates, instructions and directions for installation of anchorage devices which may involve other trades.

- - - END - - -

# SECTION 10 26 00
# WALL AND DOOR PROTECTION

## PART 1 - GENERAL

### 1.1 DESCRIPTION

This section specifies wall guards (crash rails or bumper guards), handrail/wall guard combinations, corner guards and door/door frame protectors.

### 1.2 RELATED WORK

A. Structural steel corner guards: 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: Refer to Drawings.

### 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/Door Frame Protectors.

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):

A167-99(R2004).....Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

B221-07.....Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes

D256-06.....Impact Resistance of Plastics

D635-06.....Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position

E84-07.....Surface Burning Characteristics of Building Materials

C. The National Association of Architectural Metal Manufacturers (NAAMM):

AMP 500 Series.....Metal Finishes Manual

D. National Fire Protection Association (NFPA):

80-06.....Standard for Fire Doors and Windows

E. Society of American Automotive Engineers (SAE):

J 1545-05.....Instrumental Color Difference Measurement for Exterior Finishes.

F. Underwriters Laboratories Inc. (UL):

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. // Aluminum alloy used for colored anodizing coating shall be as required to produce specified color. //

C. Resilient Material:

1. Extruded and injection molded acrylic vinyl or extruded polyvinyl chloride meeting following requirements:

a. 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).

b. Class 1 fire rating when tested in accordance with ASTM E84, having a maximum flame spread of 25 and a smoke developed rating of 450 or less.

c. Rated self extinguishing when tested in accordance with ASTM D635.

d. Material shall be labeled and tested by Underwriters Laboratories or other approved independent testing laboratory.
e. 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.
f. Same finish on exposed surfaces.

**2.2 CORNER GUARDS**

A. Resilient, Shock-Absorbing Corner Guards: Surface mounted type of 30 mm (1-1/4 inch radius) 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. 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. Basis of Design: "Acrovyn" Corner Guards, by Construction Specialties, or equivalent meets this specification.
B. Stainless Steel Corner Guards: Fabricate of 1.6 mm (0.0625-inch) thick stainless steel. Form guards of dimensions and to contour shown.

**2.3 WALL GUARDS AND HANDRAILS**

A. Resilient Wall Guards and Handrails:
   1. Handrail/Wall Guard Combination: Snap-on covers of resilient material, minimum 2 mm (0.078-inch) thick, shall be free-floated on a continuous, extruded aluminum retainer, minimum 1.8 mm (0.072-inch) thick, anchored to wall at maximum 760 mm (30 inches) on center.
   2. Provide handrails and wall guards (crash rails) with prefabricated and closure caps, inside and outside corners, concealed splices, cushions, mounting hardware and other accessories as required. End caps and corners shall be field adjustable to assure close alignment with handrails and wall guards (crash rails). Screw or bolt closure caps to aluminum retainer.
   3. Basis of Design: "Acrovyn" Wall Guards/Handrails, by Construction Specialties, or equivalent meets this specification.

**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. Aluminum:

1. Exposed aluminum: AAC22A31 chemically etched medium matte, with clear anodic coating, Class II Architectural, 0.4 mil thick.
2. Concealed aluminum: Mill finish as fabricated, uniform in color and free from surface blemishes.

C. Stainless Steel: NAAMM finish Number 4.

D. Resilient Material: Embossed texture and color in accordance with SAE J 1545 and per Finish Schedule.

**PART 3 - INSTALLATION**

**3.1 RESILIENT CORNER GUARDS**

Install corner guards on walls in accordance with manufacturer's instructions.

**3.2 STAINLESS STEEL CORNER GUARDS**

Mount guards on external corners of interior walls, partitions and columns as shown.

**3.3 RESILIENT HANDRAIL WALL GUARD COMBINATIONS**

Secure guards to walls with brackets and fasteners in accordance with manufacturer's details and instructions.

**3.4 STAINLESS STEEL WALL GUARDS**

Space brackets at not more than three feet on centers and anchor to the wall in accordance with manufacturer's installation instructions.

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# SECTION 14 21 10

# TRACTION ELEVATOR – MODERNIZATION

## PART 1 - GENERAL

### 1.1 DESCRIPTION

A. This section specifies the engineering, furnishing and modernization of the complete traction elevator system as described herein and as indicated on the Contract drawings.

B. Items listed in the singular apply to each elevator in this specification except where noted.

C. Passenger Elevators P3-P12 must be overhead traction microprocessor control system, AC VVVF motor control, power operated car and hoistway doors. Elevator must be Class "A" loading rated as a minimum.

| ELEVATOR SCHEDULE | |
|---|---|
| Elevator Number | P3-P7 |
| Overall Platform Size | Field verify |
| Clear Inside Platform | Field verify |
| Rated Load – kg (lb) | 4500 Lbs. |
| Contract Speed - m/s (fpm) | 350 FPM |
| Total Travel – m (ft) | Field verify |
| Floors Served | B-4 |
| Number of Openings | 5 |
| Entrance Type & Size | Front |
| Type of Roping | 1:1 |

| ELEVATOR SCHEDULE | |
|---|---|
| Elevator Number | P8 |
| Overall Platform Size | Field verify |
| Clear Inside Platform | Field verify |
| Rated Load – kg (lb) | 4000 Lbs. |
| Contract Speed - m/s (fpm) | 350 FPM |

| ELEVATOR SCHEDULE | |
|---|---|
| Total Travel – m (ft) | Field verify |
| Floors Served | B-4 |
| Number of Openings | 5 |
| Entrance Type & Size | Front |
| Type of Roping | 1:1 |

| ELEVATOR SCHEDULE | |
|---|---|
| Elevator Number | P9-P10 |
| Overall Platform Size | Field verify |
| Clear Inside Platform | Field verify |
| Rated Load – kg (lb) | 3000 Lbs. |
| Contract Speed - m/s (fpm) | 350 FPM |
| Total Travel – m (ft) | Field verify |
| Floors Served | B-4 |
| Number of Openings | 5 |
| Entrance Type & Size | Front |
| Type of Roping | 1:1 |

| ELEVATOR SCHEDULE | |
|---|---|
| Elevator Number | P11-P12 |
| Overall Platform Size | Field verify |
| Clear Inside Platform | Field verify |
| Rated Load – kg (lb) | 2500 Lbs. |
| Contract Speed - m/s (fpm) | 350 FPM |
| Total Travel – m (ft) | Field verify |
| Floors Served | B-4 |

| ELEVATOR SCHEDULE | |
|---|---|
| Number of Openings | 5 |
| Entrance Type & Size | Front |
| Type of Roping | 1:1 |

**1.2 RELATED WORK**

A. Section 01 33 23 SPECIFICATIONS AND DRAWINGS FOR CONSTRUCTION (FAR 52.236-21) and, SPECIAL NOTES (VAAR 852.236-91), in GENERAL CONDITIONS.

B. Section 07 84 00, FIRESTOPPING: Sealing around penetrations to maintain the integrity of fire-rated construction.

C. SECTION 09 06 00, SCHEDULE FOR FINISHES: As a master format for construction projects, to identify interior and exterior material finishes for type, texture, patterns, color and placement.

D. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Requirements for seismic restraint of non-structural components.

E. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements that are common to more than one section.

F. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Low Voltage power and lighting wiring.

G. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.

H. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits for cables and wiring.

I. Section 26 05 73, OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY: Requirements for installing the over-current protective devices to ensure proper equipment and personnel protection.

J. Section 26 22 00, LOW-VOLTAGE TRANSFORMERS: Low voltage transformers.

K. Section 26 24 16, PANELBOARDS: Low voltage panelboards.

L. Section 26 43 13, TRANSIENT-VOLTAGE SURGE SUPPRESSION: Surge suppressors installed in panelboards.

M. Section 26 51 00, INTERIOR LIGHTING: Fixture and ballast type for interior lighting.

**1.3 QUALIFICATIONS**

A. Approval by the Contracting Officer is required for products and services of proposed manufacturers, suppliers, installers and must be

contingent upon submission of certificates by the Contractor stating the following:

1. Elevator contractor is currently and regularly engaged in the installation and or modernization of elevator equipment as one of his principal products.
2. Elevator contractor must have five (5) years of successful experience, trained supervisory personnel and facilities to install elevator equipment specified herein.

B. Welding at the project site must be performed by certified welders who have previously qualified by test as prescribed in American Welding Society Publications AWS Dl.1 to perform the type of work required. Certificates must be submitted for all workers employed in this capacity. A welding or hot work permit is required for each day and must be obtained from the VAMC safety department. Request permit one day in advance.

C. Electrical work must be performed by a Licensed Master Electrician and Licensed Journeymen Electricians as requirements by NEC. Certificates must be submitted for all workers employed in this capacity.

D. Approval will not be given to elevator contractors and manufacturers who have established on prior projects, either government, municipal, or commercial, a record of unsatisfactory elevator installations, have failed to complete awarded contracts within the contract period and do not have the requisite record of satisfactorily performing elevator installations of similar type and magnitude.

E. Approval of Elevator Contractor’s equipment must be contingent on the equipment manufacturer providing factory training, engineering and technical support, including all manuals, wiring diagrams and tools necessary for adjusting, maintenance, repair and testing of equipment to the VA for use by the VA’s designated Elevator Maintenance Service Provider.

F. Identifying an elevator maintenance service provider that must render services within two hours of receipt of notification, together with certification that the quantity and quality of replacement parts stock is enough to warranty continued operation of the elevator installation.

G. Equipment within a group of traction elevators must be the product of the same manufacturer.

H. The Contractor must provide and install safety devices that have been subjected to tests witnessed and certified by an independent

professional testing laboratory that is not a subsidiary of the firm that manufactures supplies or installs the equipment.

**1.4 APPLICABLE PUBLICATIONS**

A. The publications listed below form a part of this specification. Elevator installation must meet the requirements of the latest editions published and adopted by the United States Department of Veterans Affairs on the date contract is signed.

B. Federal Specifications (Fed. Spec.):

J-C-30B - Cable and Wire, Electrical (Power, Fixed Installation)

J-C-580 – Cord, Flexible and Wire, Fixture

W-S-610 – Splice Connectors

W-C-596F - Connector, Plug, Electrical; Connector, Receptacle, Electrical

W-F-406E - Fittings for Cable, Power, Electrical and Conduit, Metal, Flexible

HH-I-558C - Insulation, Blankets, Thermal (Mineral Fiber, Industrial Type)

W-F-408E - Fittings for Conduit, Metal, Rigid (Thick-Wall and Thin-wall Type)

RR-W-410 - Wire Rope and Strand

TT-E-489J - Enamel, Alkyd, Gloss, Low VOC Content

QQ-S-766 - Steel, Stainless and Heat Resisting, Alloys, Plate, Sheet and Strip

C. American Society of Mechanical Engineers (ASME):

A17.1 - Safety Code for Elevators and Escalators 2019

A17.2 - Inspectors Manual for Electric Elevators and Escalators

D. National Fire Protection Association:

NFPA 13 - Standard for the Installation of Sprinkler Systems

NFPA 70 - National Electrical Code (NEC)

NFPA 72 - National Fire Alarm and Signaling Code

NFPA 101 - Life Safety Code

NFPA 252 - Fire Test of Door Assemblies

E. International Building Code (IBC).

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

A1008/A1008M-09 - Steel, Sheet, Cold Rolled, Carbon, Structural, High-Strength Low-Alloy and High Strength Low-Alloy with Improved Formability

E1042-02 - Acoustically Absorptive Materials Applied by Trowel or Spray

G. Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS):
SP-58 - Pipe Hangers and Supports

H. Society of Automotive Engineers, Inc. (SAE):
J517-91 - Hydraulic Hose, Standard

I. Gauges:
Sheet and Plate: U.S. Standard (USS)
Wire: American Wire Gauge (AWG)

J. American Welding Society (AWS):
D1.1 - Structured Welding Code Steel

K. National Electrical Manufacturers Association (NEMA):
LD-3 - High-Pressure Decorative Laminates

L. Underwriter's Laboratories (UL):
486A - Safety Wire Connectors for Copper Conductors
797 - Safety Electrical Metallic Tubing

M. Institute of Electrical and Electronic Engineers (IEEE)

N. Regulatory Standards:
VA Barrier Free Design Handbook H-18-13
VA Seismic Design Manual H-18-8
Uniform Federal Accessibility Standards

O. National Elevator Industry, Inc.
NEII-1 Building Transportation Standards and Guidelines

**1.5 SUBMITTALS**

A. Submit in accordance with Specification Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA and SAMPLES.

B. Before execution of work, furnish information to evidence full compliance with contract requirements for proposed items. Such information must include, as required: Manufacturer's Name, Trade Names, Model or Catalog Number, Nameplate Data (size, capacity and rating) and corresponding specification reference (Federal or project specification number and paragraph). All submitted drawings and related elevator material must be forwarded to the Contracting Officer.

C. Shop Drawings:

1. Complete scaled and dimensioned layout in plan and section view showing the arrangement of equipment and all details of each elevator unit specified including:

a. Hoisting machines, controllers, power conversion devices, governors and all other components located in machine room.
b. Car, counterweight, sheaves, supporting beams, guide rails, brackets, buffers and size of car platform, car frame members and other components located in hoistway.
c. Rail bracket spacing and maximum vertical forces on guide rails in accordance with H 18-8 for Seismic Risk Zone 2 or greater.
d. Reaction at points of support and buffer impact loads.
e. Weight of principal parts.
f. Top and bottom clearances and over travel of car and counterweight.
g. Location of main line switch/shunt trip circuit breaker, switchboard panel, light switch and feeder extension points in the machine room.

2. Drawings of hoistway entrances and doors showing details of construction and method of fastening to the structural members of the building.
   a. If drywall construction is used to enclose hoistway, submit details of interface fastenings between entrance frames and drywall.
   b. Sill details including sill support.

D. Samples:
1. One each of stainless steel, 76 mm x 127 mm (3 in. x 5 in.).
2. One each of baked enamel, 76 mm x 127 mm (3 in. x 5 in.).
3. One each of color floor covering.
4. One each of protection pads, 76 mm x 127 mm (3 in. x 5 in.) if used.
5. One each car and hoistway Braille plate sample.
6. One each car and hall button sample.
7. One each car and hall lantern/position indicator sample.
8. One each wall and ceiling material finish sample.
9. One each car lighting sample.

E. Name of manufacturer, type or style designation and applicable data of the following equipment must be shown on the elevator layouts:
1. Hoisting Machine.
2. Hoisting Machine Motor, HP and RPM ratings, Voltage, Starting and Full Load Ampere and Number of Phases.
3. Controller.
4. Starters and Overload Current Protection Devices.

5. Car and Counterweight Safety Device; Type “B” safeties, Governor and Rope Gripper.
6. Electric Door Operator; HP, RPM, Voltage and Ampere rating of motor.
7. Hoistway Door Interlocks.
8. Car and Counterweight Buffers; maximum and minimum rated loads, maximum rated striking speed and stroke.
9. Cab Ventilation Unit; HP rating and CFM rating.
10. Hoist and Compensation Ropes, breaking strength, allowable working load and actual working load.

F. Complete construction drawings of elevator car enclosure showing dimensioned details, fastenings to platform, car lighting, ventilation, ceiling framing, top exits and location of car equipment.

G. Complete dimensioned detail of vibration isolating foundations for traction hoisting machines.

H. Dimensioned drawings showing details of:
1. All signal and operating fixtures.
2. Car and counterweight roller guides.
3. Hoistway door tracks, hangers and sills.
4. Door operator, infrared curtain units.

I. Cut sheets and drawings showing details of controllers and supervisory panels.

J. Furnish certificates as required under: Paragraph "QUALIFICATIONS".

**1.6 WIRING DIAGRAMS**

A. Provide three complete sets of paper and one electronic set field wiring and straight-line wiring diagrams showing all electrical circuits in the hoistway, machine room and fixtures. Install one set coated with an approved plastic sealer and mounted in the elevator machine room as directed by the COR.

B. In the event field modifications are necessary during installation, diagrams must be revised to include all corrections made prior to and during the final inspection. Corrected diagrams must be delivered to the Resident Engineer/Contracting Officer within thirty (30) days of final acceptance.

C. Provide the following information relating to the specific type of microprocessor controls installed:
1. Owner's information manual, containing job specific data on major components, maintenance and adjustment.
2. System logic description.

3. Complete wiring diagrams needed for field troubleshooting, adjustment, repair and replacement of components. Diagrams must be base diagrams, containing all changes and additions made to the equipment during the design and construction period.
4. Changes made during the Construction and Warranty periods must be noted on the drawings in adequate time to have the finalized drawings reproduced for mounting in the machine room no later than six months prior to the expiration of the warranty period.

**1.7 PERFORMANCE STANDARDS**

A. The elevators must meet the highest standards of the industry and specifically the following:
   1. Contract speed is high speed in either direction of travel with rated capacity load in the elevator. Speed variation under all load conditions, regardless of direction of travel, must not vary more than three (3) percent.
   2. The controlled rate of change of acceleration and retardation of the car must not exceed 0.1G per ft/s/s and the maximum acceleration and retardation must not exceed 0.2G per ft/s/s.
   3. Starting, stopping and leveling must be smooth and comfortable without appreciable steps of acceleration and deceleration.

B. Passenger/Service door operator must open the car door and hoistway door at 76.2 cm (2.5-ft) per second and close at 30.5 cm (1 ft) per second. Freight door operators must open and close at 30.5 cm (1 ft) per second.

C. Floor level stopping accuracy must be within 3 mm (.125 in.) above or below the floor, regardless of load condition.

D. Noise and Vibration Isolation: All elevator equipment including their supports and fastenings to the building, must be mechanically and electrically isolated from the building structure to minimize objectionable noise and vibration transmission to car, building structure, or adjacent occupied areas of building.

E. Sound Isolation: Noise level relating to elevator equipment operation in machine room must not exceed 80 decibels. All decibel readings must be taken 91.4 cm (3 ft) off the floor and 91.4 cm (3 ft) from equipment.

F. Airborne Noise: Measured noise level of elevator equipment during operation must not exceed 50 decibels in elevator lobbies and 60

decibels inside car under any condition including door operation and car ventilation exhaust blower on its highest speed.

**1.8 WARRANTY**

A. Submit all labor and materials furnished regarding elevator system and installation to terms of "Warranty of Construction" articles of FAR clause 52.246-21. The One-Year Warranty and Guarantee Period of Service must commence and run concurrent after final inspection, completion of performance test and upon acceptance of each elevator.

B. During warranty period if a device is not functioning properly in accordance with specification requirements, more maintenance than the contract requires keeping device operational, device must be removed and a new device meeting all requirements must be installed as part of work until satisfactory operation of installation is obtained. Period of warranty must start anew for such parts from date of completion of each new installation performed, in accordance with foregoing requirements.

**1.9 POWER SUPPLY**

A. Power supply requirements in each machine room, see Specification 26 05 19, Electrical specifications and Electrical drawings.

B. Main Line Fused Disconnect Switch/Shunt Trip Circuit Breaker for each controller must be located inside the machine room at the strike side of the machine room door and lockable in the “Off” position.

C. Provide Surge Suppressors to protect the elevator equipment.

**1.10 EMERGENCY POWER SUPPLY**

A. Emergency power supply, its starting means, transfer switch for transfer of elevator supply from normal to emergency power, two pair of conductors in a conduit from an auxiliary contact on the transfer switch (open or closed contacts as required by Elevator Controller Manufacturer) to terminals in the group elevator controller and other related work must be provided by the Electrical Contractor.

B. Upon loss of normal power supply there must be a delay before transferring to emergency power of 10 seconds minimum to 45 seconds maximum, the delay must be accomplished through an adjustable timing device.

C. Prior to the return of normal power an adjustable timed circuit must be activated that will cause all cars to remain at a floor if already there or stop and remain at the next floor if in flight. Actual transfer of power from emergency power to normal building power must take place after all cars are stopped at a floor with their doors open.

D. Car lighting circuits must be connected to the emergency power panel.

**1.11 ELEVATOR MACHINE ROOM AND MACHINE SPACE**

A. Provide a machine room that meets the requirements of ASME A17.1, NEC, NFPA and IBC. The elevator drive machine and elevator controller must be in the same code approved machine room.

B. Provide stairs and landing for access to the machine room. The landing must be large enough to accommodate full opening of the door plus 61 cm (24 in.).

C. Locate the shunt trip breaker/main line disconnect and machine room light switch on the lock side of the door inside the machine room.

D. Locate sprinkler pipes to provide 213.3 cm (7 ft) head clearance. Do not locate sprinkler heads, heat detectors and smoke detectors directly over elevator equipment.

**1.12 HOISTWAY LIGHTING**

A. Provide lighting throughout the entire hoistway with 3-way switches at the top and bottom of the hoistway accessible from elevator hoistway entrance prior to entering the pit or stepping onto the car top.

B. Lighting must illuminate top of elevator cab when it is at the top floor and the pit when at the bottom floor.

**1.13 TOOL CABINET**

A. Provide a metal parts/tool cabinet, having two shelves and hinged doors. Cabinet must be 1219 mm (48 in.) high, 762 mm (30 in.) wide and 457 mm (18 in.) deep.

**1.14 WORK SCHEDULE**

A. Before starting work submit a detailed work schedule for approval and arrange with COR sequence of procedure, means of access to premises, space for storage, use of approaches, corridors, stairways, elevators, location of temporary partitions, disposal of trash and recyclable materials. The COR must be notified twenty (20) calendar days, in writing, in advance of starting work on elevators. No work may begin on any elevator until all materials for that elevator have been delivered to the site and verified by the Contracting Officer and/or Contracting Officer’s Representative. The phasing of work on the elevators must be coordinated with the Contracting Officer and/or the Contracting Officer’s Representative.

**1.15 SAFETY PRECAUTIONS**

A. Buildings will be occupied during execution of work. Work must be conducted in a manner to afford maximum protection of patients, public, employees, building and facilities to prevent unreasonable delay or interference with normal functioning of hospital activities.

B. Where an adjacent elevator is in operation, isolate the elevators from each other with suitable barriers between them, extending from the pit floor to bottom of the slab at top of hoistway, while work is in progress. Remove partition when work is completed.

C. Provide fire extinguishers that are always readily available.

D. It must be the obligation of the contractor to maintain a free and clear passageway in each elevator lobby. Parts and tools must be kept within the confines of entrance partitions. Trash and debris must be removed daily.

E. Provide fire rated partition during the modernization of elevators. Barrier must extend to the full height of the elevator entrance and must be dust and vapor proof with dust absorbing mats at access points.

**1.16 REMOVAL OF MATERIALS AND EQUIPMENT**

A. Material and equipment that are not specified to be reused or retained under contract must be removed daily from the site at the expense of the contractor. The contractor must receive title to all material and equipment not specified to be reused as of date of withdrawal from service. The government does not warranty condition of the material to which contractor must obtain title, nor must the government be liable for damage before or after title passes to contractor.

**PART 2 – PRODUCTS**

**2.1 MATERIALS**

A. Where stainless steel is specified, it must be corrosion resisting steel complying with Fed. Spec. QQ-S-766, Class 302 or 304, Condition A with Number 4 finish on exposed surfaces. Stainless steel must have the grain of belting in the direction of the longest dimension and surfaces must be smooth and without waves. During installation stainless steel surfaces must be protected with suitable material.

B. Where cold rolled steel is specified, it must be low-carbon steel rolled to stretcher level standard flatness, complying with ASTM A109.

**2.2 MANUFACTURED PRODUCTS**

A. Materials, devices and equipment furnished must be of current production by manufacturers regularly engaged in the manufacture of such items. The elevator equipment, including controllers, door operators and supervisory system must be the product of manufacturers of established reputation, provided such items are capably engineered and produced under coordinated specifications to ensure compatibility with the total operating system.

B. Manufacturers of equipment assemblies which include components made by others must assume complete responsibility for the final assembled unit. Components must be compatible with each other and with the total assembly for the intended service.

C. Mixing of manufactures related to a single system or group of components must be identified in the submittals.

D. Key operated switches provided for this elevator modernization, must be provide four (4) keys for each individual switch or lock. Provide different key tumblers for different switch and lock functions. Each key must have a tag bearing a stamped or etched legend identifying its purpose.

**2.3 CONDUIT AND WIREWAY**

A. Remove existing and provide new conduit and wireway. Install electrical conductors, except traveling cable connected to the elevator, in rigid zinc-coated steel or aluminum conduit, electrical metallic tubing or metal wireways. Rigid conduit smaller than 19 mm (.75 in.) or electrical metallic tubing smaller than 12.5 mm (.50 in,) electrical trade size must not be used. All raceways completely embedded in concrete slabs, walls, or floor fill must be rigid steel conduit. Wireway (duct) must be installed in the hoistway and to the controller and between similar apparatus in the elevator machine room. Fully protect self-supporting connections, where approved, from abrasion or other mechanical injury. Flexible metal conduit not less than 9.375 mm(.375 in.) electrical trade size may be used, not exceeding 457 mm (18 in.) in length unsupported, for short connections between risers and limit switches, interlocks and for other applications permitted by NEC.

B. All conduit terminating in steel cabinets, junction boxes, wireways, switch boxes, outlet boxes and similar locations must have approved insulation bushings. Install a steel lock nut under the bushings if they are constructed completely of insulating materials. Protect the conductors at ends of conduits not terminating in steel cabinets or boxes by terminal fittings having an insulated opening for the conductors.

C. Rigid conduit and EMT fittings using set screws or indentations as a means of attachment must not be used.

D. Connect motor or other items subject to movement, vibration, or removal to the conduit or EMT systems with flexible, steel conduits.

**2.4 CONDUCTORS**

A. Remove existing and provide new. Conductors must be stranded or solid coated annealed copper in accordance with Federal Specification J-C-30B for Type RHW or THW. Where 16 and 18 AWG are permitted by NEC, single conductors, or multiple conductor cables in accordance with Federal Specification J-C-580 for Type TF may be used provided the insulation of single conductor cable and outer jacket of multiple conductor cable is flame retardant and moisture resistant. Multiple conductor cable must have color or number coding for each conductor. Conductors for control boards must be in accordance with NEC. Joints or splices are not permitted in wiring except at outlets. Tap connectors may be used in wireways provided they meet all UL requirements.

B. Provide all conduit and wiring between machine room, hoistway and fixtures.

C. All wiring must test free from short circuits or ground faults. Insulation resistance between individual external conductors and between conductors and ground must be a minimum of one megohm.

D. Where size of conductor is not given, voltage and amperes must not exceed limits set by NEC.

E. Provide equipment grounding. Ground the conduits, supports, controller enclosure, motor, platform and car frame and all other non-current conducting metal enclosures for electrical equipment in accordance with NEC. The ground wires must be copper, green insulated and sized as required by NEC. Bond the grounding wires to all junction boxes, cabinets and wire raceways.

F. Terminal connections for all conductors used for external wiring between various items of elevator equipment must be solderless pressure wire connectors in accordance with Federal Specification W-S-610. The Elevator Contractor may, at his option, make these terminal connections on #10 gauge or smaller conductors with approved terminal eyelets set on the conductor with a special setting tool, or with an approved pressure type terminal block. Terminal blocks using pierce-through serrated washers are not acceptable.

**2.5 TRAVELING CABLES**

A. Remove existing and provide new flexible traveling cables conforming to the requirements of NEC. Traveling cables must run from the junction box on the car directly to the controller in the machine room. Junction boxes on the car must be equipped with terminal blocks. Terminal blocks having pressure wire connectors of the clamp type that meet UL 486A

requirements for stranded wire may be used in lieu of terminal eyelet connections. Terminal blocks must have permanent indelible identifying numbers for each connection. Cables must be securely anchored to avoid strain on individual terminal connections. Flame and moisture resistant outer covering must remain intact between junction boxes. Abrupt bending, twisting and distortion of the cables must not be permitted.

B. Provide spare conductors equal to 10 percent of the total number of conductors furnished, but not less than 5 spare conductors in each traveling cable.

C. Provide shielded wires for the auto dial telephone system within the traveling cable, five (5) pair shielded wires for card reader, Ethernet cables required for Wi-FI and other systems, two (2) pair 14-gauge wires for 110 Volt power supply and wire for video display monitor if specified.

D. Traveling cables that contact the hoistway or elevator due to sway or change in position, provide shields or pads to the elevator and hoistway to prevent damage to the traveling cables.

E. Hardware cloth may be installed from the hoistway suspension point to the elevator pit to prevent traveling cables from rubbing or chafing and securely fastened and tensioned to prevent buckling. Hardware cloth is not required when traveling cable is hung against a flat wall.

**2.6 CONTROLLER AND SUPERVISORY PANEL**

A. Remove existing and provide new UL/CSA Labeled Controller. Mount all assemblies, power supplies, chassis switches and relays on a steel frame in a NEMA Type 1 General Purpose Enclosure. Cabinet must be securely attached to the building structure.

B. Properly identify each device on all panels by name, letter, or standard symbol which must be neatly stencil painted or decaled in an indelible and legible manner. Identification markings must be coordinated with identical markings used on wiring diagrams. The ampere rating must be marked adjacent to all fuse holders. All spare conductors to controller and supervisory panel must be neatly formed, laced and identified.

C. Controller must be provided with wiring and components for additional future travel if required.

**2.7 MICROPROCESSOR CONTROL SYSTEM**

A. Provide a new microprocessor control system with absolute position/speed feedback to control dispatching, signal functions, door operation and VVVF Drive for hoist motor control. Complete details of

the components and printed circuit boards, together with a complete operational description, must be submitted for approval. Add Regenerative Drive when economically advantages to the VA.

B. Controller manufacturer must provide factory training, engineering and technical support, including all manuals, wiring diagrams and tools necessary for adjusting, maintenance, repair and testing of equipment to the VA for use by the VA's designated Elevator Maintenance Service Provider.

C. Microprocessor dispatching system must evaluate building traffic demand including number of elevators in service, hall calls, car calls, elevator position, direction of travel, load in elevator, door status and select an elevator to answer hall calls for least possible passenger wait times.

D. Provide means for weighing carload for each elevator. When load in a car reaches an adjustable predetermined level of the rated capacity, that car must bypass registered landing calls until the load in the car drops below the predetermined level. Calls bypassed in this manner must remain registered for the next car. The initial adjustment of the load weighting bypass setting must be 60 to 100 percent.

E. If weight in the car is not commensurate with the number of registered car calls, cancel car calls. Systems that employ either load weighing or door protective device for activation of this feature are acceptable.

**2.8 MACHINE ROOM MONITOR**

A. Provide a monitor in each machine room, separate monitors for each passenger elevator group and each service elevator group. Provide a separate keyboard for each monitor.

B. The monitor must contain indicators to provide the following information:

1. The floor where each elevator is currently located.
2. The direction that each elevator is currently traveling or is scheduled to travel.
3. The location and direction of currently registered hall calls.
4. Elevators that are currently out of service.
5. Elevators that are currently bypassing hall calls.
6. Elevators that are currently engaged in passenger transfers.
7. Operations program under which entire group is currently operating.
8. Zone divisions of the entire group.

9. Door positions.
10. Status indication for elevators on independent service, car top inspection, fire service, earthquake protection and activated stop switch and alarm bell.

C. The maintenance terminal must be suitable for all troubleshooting procedures related to the specific type of microprocessor installed on this project.

**2.9 EMERGENCY POWER OPERATION**

A. The control system for Elevator(s) must provide for the operation of at least one car per elevator group on emergency power upon failure of the normal power supply.

B. Auxiliary equipment on elevator controllers, wiring between associated elevator controllers and wiring between elevator controllers and remote selector panel as required to permit the elevators to operate as detailed, must be provided by the Elevator Contractor.

C. Upon loss of normal power supply there must be a delay before transferring to emergency power of 10 seconds minimum to 45 seconds maximum, the delay must be accomplished through an adjustable timing device. After adjusting delay, the associated elevators must function the as on normal power or as follows:

1. Selector switch, Automatic position:
   a. Not more than one elevator at a time in each group must be automatically selected and returned to the main floor, at contract speed, cycle its car and hoistway doors and shut down, with "Door Open" button remaining operable.
   b. As each elevator reaches the designated floor and shuts down, another elevator must start and return to the designated floor.
   c. Elevators that have been manually removed from automatic service and are on independent service, fire service or medical emergency must receive an automatic return signal. Elevators on inspection service or out of service must not receive a signal.
   d. When an elevator is given a signal to return, and it is unable to start its movement to the designated floor within 30 seconds it must be by-passed. When an elevator is by-passed, another elevator must start and return.
   e. This process must continue until all elevators have returned to the designated floor and shut down.

f. Any elevator or elevators by-passed on initial return signal must be signaled again.
g. When all cars in group have returned to designated floor, one elevator in each group must be designated for automatic operation. Individual cars in each group must restart at 5 second intervals.
h. Elevator (s) keyed on to medical emergency service in the car prior to transfer to emergency power operation, medical emergency service must be retained. This elevator must be the first automatically selected elevator to operate on emergency power operation and complete its selected call demand. The elevator will return to the designated floor after the key switch is reset to normal position.

2. Selector switch, Manual operation:
   a. Selector switch must be mechanically and electrically interlocked to prevent the selection of more than one elevator from operating on emergency power.
   b. The selector switch must have positions marked with the number of each elevator controlled. It must also have a position marked "Automatic". When the selector switch is set to the automatic position, the medical emergency service car must operate on emergency power operation, or if none, the last car arriving at the designated floor must operate on emergency power operation.
   c. Change in selection of elevators must be by means of the selection switch and must occur only when the previous selected elevator is stopped at the designated floor.
   d. The selector switch must be locked out of operation when the system is in the normal mode of operation.
   e. Locate the selector switch above the hall push button at the designated level. The key switch must be a tumbler type lock furnished with four keys. The enclosure faceplate must be identified "Emergency Power Control" with 12.5 mm (.50 in.) engraved letters filled with black paint.

D. Prior to the return of normal power an adjustable timer circuit must activate that will cause all cars to remain at a floor if already there or stop and remain at the next floor if in flight. Actual transfer of power from emergency power to normal building power must take place after all cars are stopped at a floor with their doors open.

**2.10 FIREFIGHTER'S SERVICE**

A. Provide Firefighter's Service. Key switches must be KEO-K1.

1. Main Floor:
2. Alt. Floor:
3. Verify main and alternate floors with RE/CO or authorized representative.

**2.11 INDEPENDENT SERVICE**

A. Provide an INDEPENDENT SERVICE key switch on the face of the main car operating panel that must have its positions marked "ON" and "OFF". When the switch is in the "ON" position, the car must respond only to calls registered on its car dispatch buttons and must bypass all calls registered on landing push buttons. The car must start when a car call is registered, car call button or door close button is pressed, car and hoistway doors are closed and interlock circuits are made. When switch is returned to "OFF" position, normal service must be resumed.

**2.12 MEDICAL EMERGENCY SERVICE**

A. Provisions must be made for calling elevator(s) to floors served by the elevator on an emergency basis, operating independently from the dispatch signals and landing call signals.

B. Install key switches in the floor landing push button fixtures above the push buttons.

C. Provide a call registered light indicator adjacent to key switch. The key switch at the landings and in the car, must only be operable by authorized personnel with a key.

D. When a key switch is activated at any floor, the call register light indicator must illuminate at the call floor and inside the elevator. The elevator control system must instantly select an elevator to respond to the medical emergency call. Immediately upon selection, all car calls must be cancelled. If car is traveling away from the medical emergency call, it must slow down and stop at the nearest floor, maintain closed doors, reverse direction and proceed nonstop to the medical emergency call floor. If the car is traveling toward the medical emergency call floor, it must proceed to that floor nonstop. If at the time of selection, it is slowing down for a stop, the car must stop, maintain doors closed and start immediately toward the medical emergency floor.

E. Arriving at the medical emergency floor, the car must remain with doors open for 60 seconds. After this interval has expired and the car has

not been placed on medical emergency operation inside the car, the car must automatically return to normal service.

F. Provide an LED illuminated indicator light next to the Medical Emergency key switch the same size as the Fire Service indicator.
   1. Locate a “Medical Emergency” key switch above call buttons in the main car operating panel for selecting medical emergency service. Activation of the key switch will allow the car to accept a car call for any floor, close doors and proceed nonstop to the floor desired.
   2. After medical emergency call has been completed the elevator must return to normal operation after the key is removed.

G. In the center of the rear cab panel provide a back lighted "MEDICAL EMERGENCY" LED illuminated display that must flash on and off continuously when the car is assigned to this operation and until it is restored to normal service. "MEDICAL EMERGENCY" indicator must be a photographic negative type 1828 mm (72 in.) to center above the floor, 152 mm (6 in.) wide X 76 mm (3 in.) high, with 12 mm (.50 in.) high letters legible only when illuminated.

H. Elevators being operated on “Independent Service”, the medical emergency service indicator lights in the car operating panel and rear wall must be illuminated, buzzer must sound, and the “Audio Voice” system must direct the attendant to return the car to automatic operation.

I. If the car is out of service and unable to answer medical emergency calls, the call register light must not illuminate.

J. Each key switch must have its identity legible and indelible engraved in faceplates. All lettering must be 6 mm (.25 in.) high, filled with black paint.

K. When Phase I firefighter’s recall is activated, it must over-ride elevators on medical emergency service and return them to the main or alternate fire service recall floor. When the fire emergency floor has been identified the attendants may complete their medical emergency run on Phase II firefighter’s operation if life safety is not affected.

**2.13 SEISMIC REQUIREMENTS**

A. Meet the requirements of VA Seismic Design Manual H-18-8.

**2.14 ELEVATOR MACHINE BEAMS**

A. Reuse existing beams and add blocking beams as required by machine manufacturer.

**2.15 TRACTION HOIST MACHINE**

A. Provide new gearless traction machines with a brake, drive sheave and deflector sheave mounted in proper alignment on an isolated bedplate.

B. Provide hoist machine mounted direct drive, digital, closed-loop velocity encoder.

C. Drive sheaves must be free from cracks, sand holes and other imperfections that would tend to damage the hoist ropes. Sheave must be turned smooth and true with rope grooves of proper design to insure maximum traction and maximum life of the hoist ropes.

D. Hoisting machine brake must be drum or disc type and must stop and hold the elevator with 125 percent of rated load.

**2.16 DEFLECTOR SHEAVES**

A. Provide new deflector sheave with a metal guard mounted below the sheave and a guard to prevent ropes from jumping out of grooves. Securely fasten guard to sheave support beams.

B. Two-to-one idler sheaves on car and counterweight, if used, must be provided with metal guards that prevent foreign objects from falling between ropes and sheave grooves and to prevent ropes from jumping out of grooves.

**2.17 HOIST ROPES**

A. Provide elevator with the required number and size of new ropes to ensure adequate traction and required safety factor. Hoisting ropes must be pre-formed 8 x 19 or 8 x 25 traction steel, conforming to Federal Specification RR-W-410 with minimum nominal diameter of 12.5 mm (.50 in.).

B. Securely attach a corrosion resistant metal data tag to one hoisting rope fastening on top of the elevator.

**2.18 HOIST ROPE COMPENSATION**

A. Provide hoist rope compensation when required by elevator controller or drive machine manufacturer. Compensation must consist of a necessary number and size of encapsulated chains attached to the underside of car and counterweight frames.

1. Provide pit guide to minimize chain sway.
2. Provide take-up adjustment to compensate for hoist rope stretch.
3. Pad areas where compensation may strike car or hoistway items.

**2.19 GOVERNOR ROPE**

A. New Governor Rope must be 6 x 19 or 8 x 19 wire rope, preformed traction steel, uncoated, fiber core, conforming to Federal Specification RR-W-410 with minimum nominal diameter of 9 mm (.375 in,)

having a minimum safety factor of 5. Tiller rope construction is not acceptable.

B. Under normal operation rope must run free and clear of governor jaws, rope guards and other stationary parts.

C. Securely attach governor rope tag to governor rope releasing carrier.

**2.20 SPEED GOVERNOR**

A. Provide new centrifugal car driven governor to operate the car safety device. Governor must be complete with weighted pit tension sheave, governor release carrier and mounting base with protected cable sleeves.

B. Provide overspeed switch and a speed reducing switches when required.

C. The governor rope clamping device must be designed to prevent appreciable damage to or deformation of the governor rope that results from the stopping action of the device operating the safety.

D. Provide metal guard over top of governor rope and sheaves.

E. Where the elevator travel does not exceed 100 feet, the weight tension sheave may be mounted on a pivoted steel arm in lieu of operating in steel guides.

**2.21 CAR SAFETY DEVICE**

A. Provide new “Type B Safeties” on the elevator.

**2.22 ASCENDING CAR OVERSPEED PROTECTION**

A. Provide a device, direct acting on the suspension means, to prevent ascending over speed and unintended motion away from the landing when the doors are not closed and locked.

**2.23 CAR AND COUNTERWEIGHT BUFFERS**

A. Reuse existing, clean, refill with new oil, verify proper tags and paint as needed.

**2.24 COUNTERWEIGHTS**

A. The counterweight must be cleaned and all missing or damaged bolts, tie rods and frames members must be replaced.

B. Sub-weights must be added or removed from the counterweights frame to provide counterbalance equal to the weight of the complete car and 40 to 50 percent of the rated capacity, as required by the controller manufacturer. New sub-weights must be cast iron, flame cut hot rolled steel, or cast lead.

C. Reuse existing counterweight guard. If compensation chains are required remove counterweight guards.

**2.25 GUIDE RAILS, SUPPORTS AND FASTENINGS**

A. Retain existing car and counterweight guide rails and brackets.

B. Thoroughly clean all guide rails of dust, grease, oil, rust and other foreign substances. File and remove all rough edges and surfaces and tighten bracket bolts and guide clips for smooth and quiet operation of car and counterweight.

**2.26 NORMAL AND FINAL TERMINAL STOPPING DEVICES**

A. Mount new terminal slowdown switches and direction limit switches on the elevator or in hoistway to reduce speed and bring car to an automatic stop at the terminal landings.
   1. Switches must function with load up to and including 125 percent of rated elevator capacity at contract speed during normal operation.
   2. Switches, when opened, must permit operation of elevator in reverse direction of travel.

B. Mount new final terminal stopping switches in the hoistway.
   1. Switches must be positively opened should the car travel beyond the terminal direction limit switches.
   2. Switches must be independent of other stopping devices.
   3. Switches, when opened, must remove power from hoist motor, apply hoist machine brake and prevent operation of car in either direction.

**2.27 CROSSHEAD DATA PLATE AND CODE DATA PLATE**

A. Permanently attach a non-corrosive metal Data Plate to car crosshead.

B. Permanently attach a non-corrosive Code Data Plate to the controller.

**2.28 WORKMAN'S LIGHTS AND OUTLETS**

A. Provide new duplex GFCI protected receptacles and lamps with guards on top of each elevator car and beneath the platform. The receptacles must be in accordance with Fed. Spec. W-C-596 for Type D7, 2-pole, 3-wire grounded, rated for 15 amperes and 125 volts.

**2.29 CARTOP OPERATING DEVICE**

A. Provide a new cartop operating device.

B. The device must be activated by a toggle switch mounted in the device. The switch must be clearly marked "INSPECTION" and "NORMAL" on the faceplate, with 6 mm (.25 in.) letters.

C. Movement of the elevator must be accomplished by the continuous pressure on a direction button and a safety button.

D. Provide an emergency stop switch, push to stop/pull to run.

E. Provide permanent identification for the operation of all components in the device.

F. The device must be permanently attached to the elevator crosshead on the side of the elevator nearest to the hoistway doors used for accessing the top of the car.

**2.30 LEVELING DEVICE**

A. Elevator must be equipped with a new two-way leveling device to automatically bring the car to within 3 mm (.125 in.) of exact level with the landing for which a stop is initiated regardless of load in car or direction of travel.

B. If the car stops short or travels beyond the floor, the leveling device, within its zone must automatically correct this condition and maintain the car within 3 mm (.125 in.) of level with the floor landing regardless of the load carried.

**2.31 EMERGENCY STOP SWITCHES**

A. Provide an emergency stop switch, push to stop/pull to run, for the top-of-car device, pit, machine space, service panel and firefighter’s control panel inside the elevator. Mount stop switches in the pit adjacent to pit access door, at top of the pit ladder 1220 mm (48 in.) above the bottom landing sill and 1220 mm (48 in.) above the pit floor adjacent to the pit ladder.

B. Each stop switch must be red in color and must have "STOP" and "RUN" positions legibly and indelibly identified.

**2.32 MAIN CAR OPERATING PANEL**

A. Provide new main car operating panel in the car enclosure on the front return panel for passenger/service elevators. The top floor car call push button must not be more than 1219 mm (48 in.) above the finished floor. “Vandal Resistant” car push buttons and indicator lights must be LED illuminated, round with a minimum diameter of 25 mm (1 in.). Each button must contain an integral registration LED light which must illuminate upon registration of a call and must extinguish when that call is answered.

B. One-piece hinged front faceplate with edges beveled 15 degrees must have the firefighter’s service panel recessed into the upper section and the service operation panel recessed into the lower section fitted with hinged doors. Doors must have concealed hinges, be in the same front plane as the faceplate and fitted with key operated locks. Secure the faceplate with stainless steel tamperproof screws.

C. All terminology and tactile symbols on the faceplate must be on square or rectangular plates recessed into the faceplate with its surface flush with the surface of the faceplate. Use 6 mm (.25 in.) letters to

identify all devices in the faceplate. The tactile symbols with contrasting background must be 12.5 mm (0.5 in.) high raised .075 mm (.030 in.) on the plate. Surface mounted plates are not acceptable.

D. The upper section must contain the following items in order listed from top to bottom:
   1. Elevator number, 12.5 mm (.50 in.) high with black paint for contrast.
   2. Capacity plate information with black paint for contrast with freight loading class and number of passengers allowed.
   3. LED illuminated digital car position indicator with direction arrows.
   4. Emergency car lighting system consisting of a rechargeable battery, charger, controls and LED illuminated light fixture. The system must automatically provide emergency light in the car upon failure or interruption of the normal car lighting service and function irrespective of the position of the light control switch in the car. The system must maintain a minimum illumination of 1.0 foot-candle when measured 1219 mm (48 in.) above the car floor and approximately 305 mm (12 in.) in front of the car operating panel, for not less than four (4) hours.
   5. Firefighter’s Emergency Operation Panel must be 167.6 cm (66 in.) minimum to 183.0 cm (72 in.) maximum to the top of the panel above finished floor.
   6. Firefighter’s Emergency Indicator Light must be round with a minimum diameter of 25 mm (1 in.).
   7. Medical Emergency key switch marked “MEDICAL EMERGENCY” with two positions labeled “ON” and “OFF” and Medical Emergency Indicator Light located next to the card reader/key switch must be round with a minimum diameter of 25 mm (1 in.). Instruction for Medical Emergency operation must be engraved below the card reader/key switch and light.
   8. Key operated Independent Service Switch on the face of panel. (Delete if inside service panel.)
   9. Provide a Door Hold Button on the faceplate above the call buttons. It must have “DOOR HOLD” indelibly marked on the button. Button must light when activated. When activated, the door must stay open for a maximum of one minute. To override hold timer, push a car call button or door close button.

10. Provide round “Vandal Resistant” car push buttons and indictor lights, minimum diameter of 25 mm (1 in.) and LED illuminated, corresponding to the floors served. Car buttons must be legibly and indelibly identified by a floor number, letter, or symbol not less than 12.5 mm (.50 in.) high in the face of the button or indicator.
11. Door Open and Door Close buttons must be located below the car call buttons. They must have “OPEN” and “CLOSE” legibly and indelibly identified by letters in the face of the respective button. Door Open button must be located closest to the door jamb.
12. Red Emergency Alarm button that must be located below the car operating buttons. Mount the emergency alarm button not lower than 889 mm (35 in.) above the finished floor. It must be connected to audible signaling devices. Provide audible signaling devices including the necessary wiring.
13. Emergency Help push button must activate two-way communications by Auto Dial telephone system that is compatible with the VAMC’s telephone system. Help button must be LED illuminated and flash when call is acknowledged. Legibly and indelibly label the button “HELP” in the face of the button with 12.5 mm (.50 in.) high letters.

E. The service operation panel in the lower section must contain the following items:
1. Light switch labeled “LIGHTS” for controlling interior car lighting with its two positions marked “ON” and “OFF”.
2. Inspection switch that will disconnect normal operation and activate hoistway access switches at terminal landings. Switch must be labeled “ACCESS ENABLE” with its two positions marked “ON” and “OFF”.
3. Three position switch labeled “FAN” with its positions marked “HIGH”, “LOW” and “OFF” for controlling car ventilating blower.
4. Two-position spring return toggle switch or push button to test the emergency light and alarm device. It must be labeled “TEST EMERGENCY LIGHT AND ALARM”.
5. Two-position toggle switch labeled “Independent Service” with its positions marked “ON” and “OFF”. (Delete if on face of panel).
6. Two-position emergency stop switch, when operated, must interrupt power supply and stop the elevator independently of regular operating devices. Emergency stop switch must be marked “PUSH TO

STOP” and “PULL TO RUN”. Passenger or service elevator provide stop switch inside the service panel.

**2.33 AUXILIARY CAR OPERATING PANEL**

A. Where already existing, provide an auxiliary car operating panel in the front return panel opposite the main car operating panel. The auxiliary car operating panel must contain only those controls essential to passenger (public) operation. The auxiliary car operating panel faceplate must match the main car operating panel faceplate in material and general design. Secure the faceplate with stainless steel tamperproof screws.

1. Provide round “Vandal Resistant” car push buttons and indicator lights, minimum diameter 25 mm (1 in.) and LED illuminated corresponding to the floors served. Car buttons and indicator lights must be legibly and indelibly identified by a floor number, letter, or symbol not less than 12.5 mm (.50 in.) high in the face of the button or indicator light corresponding to the main car operating panel button or indicator light.
2. Door "OPEN" and door "CLOSE" buttons must be closest to the door jamb and the alarm button must be 889 mm (35 in.) above the finished floor. The Door Open button must be located closest to the door.
3. Cross-connect all buttons in the auxiliary car operating panels to their corresponding buttons in the main car operating panel. Registration of a car call must cause the corresponding button to illuminate in the main and auxiliary car operating panel.
4. Emergency Help push button must activate two-way communications by auto dial telephone that is compatible with the VAMC’s telephone system. Help button must be LED illuminated and flash when call is acknowledged. Legibly and indelibly label the button “HELP” in the face of the button with 12.5 mm (.50 in.) high letters.

B. All terminology and tactile symbols on the faceplate must be on square or rectangular plates recessed into the faceplate with its surface flush with the surface of the faceplate. Use 6 mm (.25 in.) letters to identify all devices in the faceplate. The tactile symbols with contrasting background must be 12.5 mm (0.5 in.) high raised .075 mm (.030 in.) on the plate. Surface mounted plates are not acceptable.

**2.34 CAR POSITION INDICATOR**

A. Provide an alpha-numeric digital car position indicator in the main car operating panel, consisting of numerals and arrows 63 mm (2.5 in.) high, to indicate position of car and direction of car travel. Locate

position indicator at the top of the main car operating panel, illuminated by light emitting diodes.

**2.35 AUDIO VOICE SYSTEM**

A. Provide digitized audio voice system. Audio voice must announce floor designations, direction of travel and special announcements. The voice announcement system must be a natural sounding human voice that receives messages and must comply with ADA requirements for audible car position indicators. The voice announcer must have two separate volume controls, one for the floor designations and direction of travel and another for special announcements. The voice announcer must have a full range loudspeaker, located on top of the cab. The audio voice unit must contain the number of ports necessary to accommodate the number of floors, direction messages and special announcements. Install voice announcer per manufacturer's recommendations and instructions. The voice system must be the product of a manufacturer of established reputation. Provide manufacturer literature and list of voice messages.

1. Fire Service Message.
2. "Please do not block doors".
3. Provide special messages as directed by COR.

**2.36 AUTO DIAL TELEPHONE SYSTEM**

A. Provide a complete, ADA compliant, auto dial communication system that is compatible with the VAMC's telephone system.

B. Two-way communication device must be in full compliance with ASME A17.1 Rule 2.27.1.1 (2019) or later editions.

**2.37 CORRIDOR OPERATING DEVICES**

A. Provide new corridor operating device faceplates from not less than 3 mm (.125 in.) thick flat stainless steel with all edges beveled 15 degrees.

B. Corridor push button faceplates must be sized to accommodate corridor pictograph on faceplate. The centerline of the landing push buttons must be 106.6 cm (42 in.) above the corridor floor.

C. Elevator Corridor Call Station Pictograph must be engraved in the faceplate.

D. Fasten all corridor operating device and signal device faceplates with stainless steel tamperproof screws.

E. All terminology and tactile symbols on the faceplate must be raised .030 inch with contrasting background, on square or rectangular plates recessed into the faceplate with its surface flush with the surface of the faceplate. The handicapped markings with contrasting background

must be 12.5 mm (.5 in.) high raised .030 inch on the plate, square or rectangular. Use 6 mm (.25 in.) letters to identify all other devices in the faceplate. Surface mounted plates are not acceptable.

F. Provide new risers of landing call buttons for each elevator or group of elevators as shown on contract drawings.

G. “Vandal Resistant” hall buttons and indicator lights must be LED illuminated upon registration of a call and must extinguish when that call is answered.

H. The direction of each button must be legibly and indelibly identified by arrows not less than 12.5 mm (.50 in.) high in the face of each button.

I. Hall call buttons must not re-open the doors while the car and hoistway doors are closing at that floor, the call must be registered for the next available elevator. Calls registered must be canceled if closing doors are re-opened by means of "DOOR OPEN" button or infrared curtain unit.

J. Provide emergency power indicator light, medical emergency key switch and indicator light, fire service recall key switch and indicator light, firefighter’s recall instruction, communication failure light, audible enunciator and reset key switch in the fixture at the designated main floor.

K. Remove old fixtures, repair and refinish walls.

L. Submit design of hall pushbutton fixtures for approval.

**2.38 CORRIDOR ARRIVAL LANTERN/POSITION INDICATOR**

A. Provide new combination corridor arrival lantern/position indicator digital display mounted in existing position or above hoistway entrances at each floor in healthcare facilities. For non-healthcare facilities provide combination fixtures only at main and alternate fire recall floors unless specified for all floors. Provide each terminal landing with "UP" or "DOWN", minimum 63 mm (2.5 in.) high arrow lanterns and each intermediate landing with "UP" and "DOWN" arrow lanterns. Each lens must be LED illuminated of proper intensity, shielded to illuminate individual lens only. The lenses in each lantern must be illuminated green to indicate "UP" travel and red to indicate "DOWN" travel. Lanterns must signal in advance of car arrival at the landing indicating the direction of travel. Corridor lanterns must not be illuminated when a car passes a floor without stopping. Each lantern must be equipped with an audible electronic chime which must sound once

for "UPWARD" bound car and twice for "DOWNWARD" bound car. Audible signal must not sound when a car passes the floor without stopping. Provide adjustable sound level on audible signal. Car riding lanterns are not acceptable.

B. Install alpha-numeric digital position indicator between the arrival lanterns. Indicator faceplate must be stainless steel. Numerals must be not less than 63 mm (2.5 in.) high with direction arrows. Cover plates must be readily removable for re-lamping. The appropriate direction arrow must be illuminated during entire travel of car in corresponding direction.

C. Remove old fixtures, repair and refinish walls.

**2.39 HOISTWAY ACCESS**

A. Provide new hoistway access switches for elevator at top terminal landing to permit access to top of car and at bottom terminal landing to permit access to pit. Elevators with side slide doors, mount the access key switch 182.6 cm (6 ft.) above the corridor floor in the wall next to the strike jamb.

B. Exposed portion of each access switch or its faceplate must have legible, indelible legends to indicate "UP", "DOWN" and "OFF" positions.

C. Each access switch must be a constant pressure cylinder type lock having not less than five pins or five stainless steel disc combination with key removable only when switch is in the "OFF" position.

D. Lock must not be operable by any other key which will operate any other lock or device used for any other purpose at the VA Medical Center.

E. Arrange the hoistway switch to initiate and maintain movement of the car. When the elevator is operated in the down direction from the top terminal landing, limit the zone of travel to a distance not greater than the top of the car crosshead level with the top floor. Submit design and location of access switches for approval.

F. Provide emergency access for all hoistway entrances, keyways for passenger and service elevators.

**2.40 HOISTWAY ENTRANCES: PASSENGER/SERVICE ELEVATORS**

A. Clad existing entrance frames in stainless steel.

B. Clean and reuse existing hoistway sills, hanger supports, strut angles, fascia plates and toe guards.

C. Replace all damaged or missing dust covers.

D. Provide new stainless steel hoistway doors. Door panels must be flush hollow metal construction, not less than 32 mm (1.25 in.) thick, consisting of one continuous piece 16-gauge stainless steel on corridor side wrapped around the leading edge. Separate two plates by a sound-deadening material and reinforce by steel shapes welded to the plates at frequent intervals. Reinforce panels as required for installation of hangers, power-operating and door-opening devices. Top and bottom of door panels must have continuous stiffener channels welded in place. Reinforcement of the door panels must be a minimum of 1.0 mm (0.04 in.) in thickness and of the hat section type.

E. Hang doors on two-point suspension hangers having sealed ball-bearing sheaves not less than 76 mm (3 in.) in diameter, with non-metallic sound-reducing tires. Equip hangers with adjustable ball-bearing rollers to take upward thrust of panels. Provide two removable non-metallic door gibs of approved material and a separate fire gib at the bottom of each door panel. Gibs must be replaceable without removing of door panel. Door panels for each entrance must bear a BOCA label, Underwriters' label or labels from other accredited test laboratories may be furnished provided they are based on fire test reports and factory inspection procedures acceptable to the RE/CO or authorized representative. Fasten stainless steel sight guard of 14-gauge metal, extending full height of panel, to leading edge of fast speed panel of two-speed doors.

F. Provide new hardware, tracks, gibs, separate fire gibs, door rollers, door locks, drive roller assemblies and sill mounted closers or spirators.

G. Reuse Braille plates on both sides of door frame entrances located 1523 mm (60 in.) to center above finished floor. Replace damaged or missing Braille plates.

H. Provide unique car number on every elevator entrance at designated main and alternate fire service floor levels, minimum 76 mm (3 in.) in height.

I. Equip each hoistway entrance with new electrical/mechanical interlock, functioning as hoistway unit system, to prevent operation of elevator until all hoistway doors are locked in the closed position unless car is operating in the leveling zone or hoistway access switch is used.

J. Wiring installed from the hoistway riser to each door interlock must be NEC type SF-2 or equivalent.

**2.41 CAR AND COUNTERWEIGHT GUIDES**

A. Provide new adjustable roller guides, each assembled on a substantial metal base, to permit individual alignment to the guide rails.

B. Each guide must consisting of not less than three (3) wheels, each with a durable, resilient oil-resistant material tire rotating on ball bearings having sealed-in lubrication. Assemble rollers on a substantial metal base and mount to provide continuous spring pressure contact of all wheels with the corresponding rail surfaces under all conditions of loading and operation. Secure the roller guides at top and bottom on each side of car frame and counterweight frame. All mounting bolts must be fitted with nuts, flat washers, split lock washers and if required, beveled washers.

C. Provide sheet metal guards to protect rollers on top of car and counterweight.

D. Minimum diameter of car rollers must be 152 mm (6 in.). The entire elevator car must be properly balanced to equalize pressure on all guide rollers. Cars must be balanced in post-wise and front-to-back directions. Test for this balanced condition must be witnessed at time of final inspection.

E. Minimum diameter of counterweight rollers must not be less than 101 mm (4 in.). Properly balance counterweight frame to equalize pressure on all guide rollers. The Contractor must have the option of furnishing, for counterweight only, mechanically adjusted roller guide in lieu of spring-loaded roller guides as specified.

F. Equip car and counterweight with an auxiliary guiding device for each guide that must prevent the car or counterweight from leaving the rails if the normal guides fail. These auxiliary guides must not, during normal operation, touch the guiding surfaces of the rails. The auxiliary guides may be an extension of the normal guide mounting plate if that plate is fabricated from hot rolled steel. The portion of the auxiliary guide that contacts the rail surfaces in the event of loss of the normal guides must be lined with an approved bearing material to minimize damage to the rail guiding surfaces.

**2.42 CAR FRAME: PASSENGER/SERVICE ELEVATORS**

A. Reuse existing car frame. Tighten bolts and replace missing bolts.

**2.43 CAR PLATFORM: PASSENGER/SERVICE ELEVATORS**

A. The platform must be designed to withstand the forces developed under the loading class specified. Provide car entrance with new stainless-steel sill with machined or extruded door guide grooves and recessed

for platform guard. Cover underside and all exposed edges of wood filled platform with sheet metal of not less than 26-gauge, with all exposed joints and edges folded under. Fire resistant paint is not acceptable. Platform must have flexible composition flooring not less than 3 mm (.125 in.) thick. For color, see Section 09 06 00, SCHEDULE FOR FINISHES. Adhesive material must be type recommended by manufacturer of flooring. Lay flooring flush with threshold plate and base.

B. Provide a platform guard (toe guard) of not less than 12-guage sheet-steel on the entrance side, extend 76 mm (3 in.) beyond each side of entrance jamb. Securely brace platform guard to car platform and bevel bottom edge at a 60-75-degree angle from horizontal. Square platform sill with the hoistway sills to provide clearance that must not exceed 32 mm (1.25 in.).

C. Provide new isolation pads between the platform and car frame where needed. Use approved rubber pads or other approved material.

D. Provide new or reuse existing adjustable diagonal brace rods to hold platform firmly within car suspension frame.

E. Balance car front to back and side to side. Provide balancing frame and weights, properly located, to achieve the required true balance.

F. Provide a bonding wire between frame and platform.

**2.44 CAR ENCLOSURE: PASSENGER/SERVICE ELEVATORS (ALTERNATE)**

A. Reuse existing car enclosure. Refinish or replace damaged stainless-steel entrance panels.

B. Front return wall panel, entrance columns, entrance head-jamb and transom must be 14-gauge stainless steel. Transom must be full width of cab. Side and rear walls must be constructed of 14-gauge cold rolled steel. Coat exterior of walls with mastic sound insulation material approximately 2.5 mm (.10 in.) thick followed by a prime coat of paint.

D. Side and rear walls of passenger elevators may have raised panels covered in fire rated materials approved for use in elevator interior.

E. Side and rear walls of service elevators, up to the center line of the top handrail, must be covered with stainless steel. Side and rear walls to the ceiling must be covered with high pressure plastic laminate panels. Submit a method of fastening panels to steel walls.

F. Provide car top railings.

G. Provide an exit switch to prevent operation of the elevator when the emergency exit is open.

H. Provide duplex, GFCI protected receptacle in car. Locate flush-mounted receptacle on the centerline of the main car operating panel, 152 mm (6 in.) above the car floor.

I. Lighting for passenger/service elevators:

1. Provide stainless steel hanging ceiling frame. Construct frame of 3.125 mm (.125 in.) thick x 38 mm (1.50 in.) wide x 38 mm (1.50 in.) high "T" and "L" sections, divide ceiling into six panels.

2. Provide LED illuminated car light fixtures above the ceiling panels. Maintain a minimum light level of 50-foot candles at 914 mm (36 in.) above the finished floor.

J. Provide a blower unit arranged to exhaust through an opening in the canopy. Provide a stainless or chrome plated fan grill on the interior side of the opening. Provide screening over intake and exhaust end of blower. Provide 2-speed fan, with rated air displacement of 250 cfm and 400 cfm at respective speeds. Mount fan on top of car with rubber isolation to prevent transmission of vibration to car structure. Provide a 3-position switch to control the unit in the service panel.

K. Provide two sets of handrails with centerlines 762 mm and 1067 mm (30 in. and 42 in.) above the car floor, circumference not to exceed 15.2 cm (6 in.).

1. Locate handrails 38 mm (1.50 in.) from cab wall. Install handrails on side and rear walls. Conceal all handrail fastenings. Handrails must be removable from inside the car enclosure

L. Provide passenger and service cars with new horizontal sliding doors constructed the same as hoistway doors.

M. Provide new hardware, tracks, gibs, separate fire gibs, gate switch, door drive clutch assemblies and door restrictor.

N. Provide passenger car with single speed center opening horizontal sliding doors and service car with two-speed side opening horizontal sliding doors constructed the same as hoistway doors. Door panels must be not less than 16-gauge sheet steel and not less than 32 mm (1.25 in.) thick flush type construction with the hall side and leading edge wrapped in one continuous piece of 16-gauge stainless steel. Top and bottom of door panels must have continuous stiffener channels welded in place. Reinforcement of the door panels must be approximately 1.0 mm (0.04 in.) in thickness and of the hat section type. Reinforce each door panel for hangers, interlock mechanism, opening and closing

devices. Do not use hangers that are constructed integrally with the door panels.

O. Hang doors on two-point suspension hangers having sealed ball-bearing sheaves not less than 76 mm (3 in.) in diameter, with non-metallic sound-reducing tires. Equip hangers with adjustable ball-bearing rollers to take upward thrust of panels. Provide two non-metallic door gibs on each door panel and a separate fire gib. Gibs must be replaceable without removing of door panel. One door panel for each entrance must bear a BOCA label, Underwriters' label, or other labels may be furnished provided they are based on fire test reports and factory inspection procedures acceptable to the COR. Fasten stainless steel sight guard of 14-gauge metal, extending full height of panel, to leading edge of fast speed panel of two-speed doors.

**2.45 POWER DOOR OPERATORS: PASSENGER/SERVICE ELEVATORS**

A. Provide a new high-speed heavy-duty door operator to automatically open the car and hoistway doors simultaneously when the car is level with the floor and automatically close the doors simultaneously at the expiration of the door-open time. Provide microprocessor door control with circuitry to constantly monitor and automatically adjust door operation based upon velocity, position and motor current. Motor must be of the high-internal resistance type, capable of withstanding high currents resulting from stall without damage to door operator/motor. The door operator must open the car door and hoistway door simultaneously, at a speed up to 76.2 cm (2.5 ft) per second. Closing speed of the doors must be 305 mm (1 ft) per second. Reversal of direction of the doors from the closing to opening operation, whether initiated by obstruction of the infrared curtain or the door "OPEN" button, must be accomplished within 38 mm (1.50 in.) maximum of door movement. Emphasis is placed on obtaining quiet interlock and door operation; smooth, fast, dynamic braking for door reversals and stopping of the doors at extremes of travel.

B. Equip car doors with electric contact that prevents operation of car until doors are closed unless car is operating in leveling zone or hoistway access switch is used. Locate door contact to prevent its being tampered with from inside of car.

C. Car and hoistway doors must be manually operable in an emergency without disconnecting the power door operating equipment unless the car is outside the unlocking zone.

1. Doors must not open by power unless the elevator is in the leveling zone.
2. Provide infrared curtain unit. The device must cause the car and hoistway doors to reverse automatically to the fully open position should the unit be actuated while the doors are closing. Unit must function when the doors are not closed, except during firefighter's operation.

D. Should the doors be prevented from closing for more than a predetermined adjustable interval of 15 to 30 seconds by operation of the curtain unit, the doors must stay open, the audio voice message and a buzzer located on the car must sound only on automatic operation. **Do not provide door nudging.**

1. If an obstruction of the doors does not activate the photo-electric door control device and prevent the doors from closing for more than a predetermined adjustable interval of 15 to 30 seconds, the doors must reverse to the fully open position and remain open until the "Door Close" button re-establishes the closing cycle.

E. Provide door "OPEN" and "CLOSE" buttons. When the door "OPEN" button is pressed and held, the doors, if in the open position, must remain open and if the doors are closing, they must stop, reverse and re-open. Momentary pressure of the door "CLOSE" button must initiate the closing of the doors prior to the expiration of the normal door open time.

## PART 3 - EXECUTION

### 3.1 PREPARATION

A. Examine work of other trades on which the work of this Specification depends. Report defects to the RE/CO or authorized representative in writing that may affect the work of the elevator contractor.

B. Examine elevator hoistway openings for plumb, level, in line and that elevator pit is proper size, waterproofed and drained with necessary access door and ladder.

C. Examine machine room for proper illumination, heating, ventilation, electrical equipment and beams are correctly located complete with access stairs and door.

D. Before fabrication, take necessary job site measurements and verify where work is governed by other trades. Check measurement of space for equipment and means of access for installation and operation. Obtain dimensions from site for preparation of shop drawings.

E. Work required prior to the completion of the elevator installation:

1. Supply of electric feeder wires to the terminals of the elevator control panel, including circuit breaker.
2. Provide light and GFCI outlets in the elevator pit and machine room.
3. Furnish electric power for testing and adjusting elevator equipment.
4. Furnish circuit breaker panel in machine room for car and hoistway lights and receptacles.
5. Supply power for cab lighting and ventilation from an emergency power panel specified in Division 26, ELECTRICAL.
6. Machine room enclosed and protected from moisture, with self-closing, self-locking door and access stairs.
7. Provide fire extinguisher in machine room.

**3.2 ARRANGEMENT OF EQUIPMENT**

A. Arrange equipment in machine room so that major equipment components can be removed for repair or replacement without dismantling or removing other equipment in the same machine room. Locate controller near and visible to its respective hoisting machine.

**3.3 WORKMANSHIP, INSTALLATION AND PROTECTION**

A. Installations must be performed by Certified Elevator Mechanics and Apprentices to best possible industry standards. Details of the installation must be mechanically and electrically correct. Materials and equipment must be new and without imperfections.

B. Recesses, cutouts, slots, holes, patching, grouting, refinishing to accommodate installation of equipment must be included in the Contractor's work. All new holes in concrete must be core drilled.

C. Structural members must not be cut or altered. Work in place that is damaged or defaced must be restored equal to original new condition.

D. Finished work must be straight, plumb, level and square with smooth surfaces and lines. All machinery and equipment must be protected against dirt, water, or mechanical injury. At completion, all work must be thoroughly cleaned and delivered in perfect unblemished condition.

E. Sleeves for conduit and other small holes must project 51 mm (2 in.) above concrete slabs.

F. Hoist cables that are exposed to accidental contact in the machine room and pit must be completely enclosed with 16-gauge sheet metal or expanded metal guards.

G. Exposed gears, sprockets and sheaves must be guarded from accidental contact.

**3.4 CLEANING**

After completion of the installation and prior to final inspection, all equipment must be thoroughly cleaned of grease, oil, cement, plaster, dust and other debris.

B. Clean machine room and equipment.

C. Perform hoistway clean down.

D. Prior to final acceptance remove protective coverings from finished or ornamental surfaces. Clean and polish as required for type of material.

**3.5 PAINTING AND FINISHING**

A. All equipment, except specified as architectural finish, must be painted one coat of approved color, conforming to manufacturer's standard.

B. Hoist machine and motor must be painted manufacturer's standard finish and color.

C. Controller, sheave, car frame and platform, counterweight, beams, rails and buffers except their machined surfaces, cams, brackets and all other uncoated ferrous metal items must be painted one factory primer coat or approved equal.

D. Stencil or apply decal floor designations not less than 101 mm (4 in.) high on hoistway doors, fascia, or walls within door restrictor areas. The color of paint used must contrast with the color of the surfaces it is applied.

E. Elevator hoisting machine, controller, governor, main line switch/ shunt trip circuit breaker, safety plank and cross head of car must be identified by 101 mm (4 in.) high numerals and letters located as directed. Numerals must contrast with surrounding color and must be stenciled or decaled.

F. Hoistway Entrances of Passenger and Service Elevators:

1. Door panels, except stainless steel surfaces, must be given rust resistant treatment and a factory finish of one coat of baked-on primer and one factory finish coat of baked-on enamel.
2. Fascia plates, top and bottom shear guards, dust covers, hanger covers and other metalwork, including built-in or hidden work and structural metal, except stainless steel entrance frames and surfaces to receive baked enamel finish, must be given one approved prime coat in the shop and one field coat of paint of approved color.

G. Elevator Cabs for Passenger and Service Elevators:
   1. Interior and exterior steel surfaces must be given rust resistant treatment before finish is applied.
   2. Interior steel surfaces must be factory finished with one coat of paint of approved color.
   3. Give exterior faces of car doors one finish coat of paint of approved color.

**3.6 PRE-TESTS AND TESTS**

A. Pre-test the elevators and related equipment in the presence of the Resident Engineer/Contracting Officer or authorized representative for proper operation before requesting final inspection. Conduct final inspection at other than normal working hours, if required by RE/CO.
   1. The VA must obtain the services of an Independent Qualified Elevator Inspector, ANSI/ASME QEI-1 Certified, that must witness all tests. The QEI must utilize an Elevator Acceptance Inspection Form to record the results of inspection and all testing and to identify safety code and contract deficiencies. Specific values must be provided for all tests required by ASME A17.1, ASME A17.2 and contract documents. After completion of inspection and testing, the QEI must sign a copy of the completed form and provide it to the Contracting Officer. Within 14 days of the inspection, the QEI must also prepare a formal inspection report, including all test results and deficiencies. After successful completion of inspection and testing, the QEI must complete, sign and provide a certificate of compliance.
   2. Government must furnish electric power including necessary current for starting, testing and operating machinery of each elevator.
   3. Contractor must furnish the following test instruments and materials on-site and at the designated time of inspection: properly marked certified test weights, voltmeter, amp probe, thermometers, direct reading tachometer, megohm meter, vibration meter, sound meter, light meter, stopwatch and a means of two-way communication.
B. Inspect workmanship, equipment furnished and installation for compliance with specification.
C. Balance Tests: The percent of counterbalance must be checked by placing test weights in car until the car and counterweight are equal in weight when located at the mid-point of travel. If the actual percent of

counterbalance does not conform to the specification, the amount of counterweight must be adjusted until conformance is reached.

D. Full-Load Run Test: Elevator must be tested for a period of one-hour continuous run with full contract load in the car. The test run must consist of the elevator stopping at every floor, in either direction of travel, for not less than five or more than ten seconds per floor.

E. Speed Test: The actual speed of the elevator must be determined in both directions of travel with full contract load and no load in the elevator. Speed must be determined by applying a certified tachometer to the car hoisting ropes or governor rope. The actual measured speed of the elevator with all loads in either direction must be within three (3) percent of specified rated speed. Full speed runs must be quiet and free from vibration and sway.

F. Temperature Rise Test: The temperature rise of the hoist motor must be determined during the full load test run. Temperatures must be measured using thermometers. Under these conditions, the temperature rise of the equipment must not exceed 50 degrees Centigrade above ambient temperature. Test must start when all machine room equipment is within five (5) degrees Centigrade of the ambient temperature. Other tests for heat run on motors must be performed as prescribed by the Institute of Electrical and Electronic Engineers.

G. Car Leveling Test: Elevator car leveling devices must be tested for accuracy of leveling at all floors with no load in car and with contract load in car, in both directions of travel. Accuracy of floor level must be within plus or minus 3 mm (.125 in.) of level with landing floor for which the stop has been initiated regardless of load in car or direction of travel. The car leveling device must automatically correct over travel as well as under travel and must maintain the car floor within plus or minus 3 mm (.125 in.) of level with the landing floor regardless of change in load.

H. Brake Test: The action of the brake must be prompt and a smooth stop must result in the up and down directions of travel with no load and rated load in the elevator. Down stopping must be tested with 125 percent of rated load in the elevator.

I. Insulation Resistance Test: The elevator's complete wiring system must be free from short circuits and ground faults and the insulation resistance of the system must be determined by use of megohm meter, at the discretion of the Elevator Inspector conducting the test.

J. Safety Devices: Car and counterweight safety devices must be tested.

K. Overload Devices: Test all overload current protection devices in the system at final inspection.

L. Limit Stops:

1. The position of the car when stopped by each of the normal limit switches with no load and with contract load in the car must be accurately measured.
2. Final position of the elevator relative to the terminal landings must be determined when the elevator has been stopped by the final limits. The lower limit stop must be made with contract load in the elevator. Elevator must be operated at inspection speed for both tests. Normal limit stopping devices must be inoperative for the tests.

M. Oil Buffer Tests: These tests must be conducted with operating device and limit stops inoperative and with contract load in the elevator for the car buffer and with no load in the elevator for the counterweight buffer. Preliminary test must be made at the lowest (leveling) speed. Final tests must be conducted at contract speed. Buffers must compress and return to the fully extended position without oil leakage.

N. Operating and Signal System: The elevator must be operated by the operating devices provided and the operation signals and automatic floor leveling must function in accordance with requirements specified. Starting, stopping and leveling must be smooth and comfortable without appreciable steps of acceleration or deceleration.

O. Performance of the Elevator supervisory system must be witnessed and approved by the elevator inspector and a representative of the Contracting Officer.

P. Evidence of malfunction in any tested system or parts of equipment that occurs during the testing must be corrected, repaired, or replaced at no additional cost to the Government and the test repeated.

Q. If equipment fails test requirements and a re-inspection is required, the Contractor must be responsible for the cost of re-inspection; salaries, transportation expenses and per-diem expenses incurred by the elevator inspector and representative of the Contracting Officer.

**3.7 INSTRUCTION TO VA PERSONNEL**

A. Provide competent instruction to VA personnel regarding the operation of equipment and accessories installed under this contract, for a period equal to one eight-hour day. Instruction must commence after

completion of all work and at the time and place directed by the Resident Engineer/Contracting Officer or authorized representative.

B. Written instructions in triplicate relative to care, adjustments and operation of all equipment and accessories must be furnished and delivered to the Resident Engineer in independently bound folders. DVD recordings will also be acceptable. Written instructions must include correct and legible wiring diagrams, nomenclature sheet of all electrical apparatus including location of each device, complete and comprehensive sequence of operation, complete replacement parts list with descriptive literature and identification and diagrams of equipment and parts. Information must also include electrical operation characteristics of all circuits, relays, timers, electronic devices and related characteristics for all rotating equipment.

C. Provide supplementary instruction for any new equipment that may become necessary because of changes, modifications or replacement of equipment or operation under requirements of paragraph entitled "Warranty of Construction".

**3.8 GUARANTEE PERIOD OF SERVICE: ELEVATOR MAINTENANCE SERVICE AND INSPECTIONS**

A. Provide complete maintenance service and inspections during the modernization period for all elevators and on each elevator for one (1) year after completion and acceptance of each elevator in this specification by the Resident Engineer or Contracting Officer. This maintenance service must run concurrently with the warranty. Maintenance work must be performed by Certified Elevator Mechanics and Apprentices.

B. This contract covers full maintenance including emergency call back service, inspections and servicing the elevators listed in the schedule of elevators. The Elevator Contractor must perform:

1. Bi-weekly systematic examination of equipment.
2. During each maintenance visit the Elevator Contractor must clean, lubricate, adjust, repair and replace all parts as necessary to keep the equipment in like new condition and proper working order.
3. Furnishing all lubricant, cleaning materials, parts and tools necessary to perform the work required. Lubricants must be only those products recommended by the manufacturer of the equipment.
4. Equalizing tension, shorten or renew hoisting ropes.
5. As required, motors, controllers, selectors, leveling devices, operating devices, switches on cars and in hoistways, hoistway doors

and car doors or gate operating device, interlock contacts, car and counterweight guides, car door sills, hangers for doors, car doors or gates, signal system, car safety device, governors, tension sheaves and buffers must be cleaned, lubricated and adjusted.

6. Guide rails, overhead sheaves and beams, counterweight frames and bottom of platforms must be cleaned every three months. Car tops and machine room floors must be cleaned monthly. Accumulated rubbish must be removed from the pits monthly. A general cleaning of the entire installation including all machine room equipment and hoistway equipment must be accomplished quarterly. Cleaning supplies and vacuum cleaner must be furnished by the Contractor.
7. Maintain the performance standards set forth in this specification.
8. The operational system must be maintained to the standards specified hereinafter including any changes or adjustments required to meet varying conditions of hospital occupancy.
9. Always maintain smooth starting and stopping and accurate leveling.

C. Maintenance service must not include the performance of work required because of improper use, accidents and negligence for which the Elevator Contractor is not directly responsible.

D. Provide 24-hour emergency call-back service that must consist of promptly responding to calls within two hours for emergency service should a shutdown or emergency develop between regular examinations. Overtime emergency call-back service must be limited to minor adjustments and repairs required to protect the immediate safety of persons and equipment in and about the elevator.

E. Service and emergency personnel must report to the Resident Engineer, Contracting Officer or authorized representative upon arrival at the hospital and again upon completion of the required work. A copy of the work ticket containing a complete description of the work performed must be given to the RE/CO or authorized representative.

F. The Elevator Contractor must maintain a logbook in the machine room. The log must list the date and time of all weekly examinations and all trouble calls. Each trouble call must be fully described including the nature of the call, necessary correction performed, or parts replaced.

G. Written “Maintenance Control Program” must be in place to maintain the equipment in compliance with ASME A17.1 Section 8.6.

- - - E N D - - -

# MCE: iControl Elevator Controls

**Prepared in accordance with Construction Specifications Institute (CSI) 14210**

Motion Control Engineering®
A Kinetek Company®

# Specification Guide: Architects and Consultants

## 1 iControl General Specifications

### 1.1 Code Compliance

The elevator controller shall use a microprocessor based logic system and shall comply with all applicable elevator and electrical safety codes including: (Contact MCE if a necessary code is not listed below.)

#### 1.1.1 Elevator Safety Code Compliance

- ASME A17.1/CSA B44
- NYC Appendix K
- Massachusetts 524 CMR
- Australia AS 1735
- New Zealand NZS 4332
- EN 81-72 for Firefighters Lifts

#### 1.1.2 Other Applicable Standards

- NFPA 70/CSA C22.1 Electrical Codes (U.S. & Canada)
- CSA B44.1/ASME A17.5 Elevator and Escalator Electrical Equipment Standards
- EN 12015 Emission Standards
- EN 12016 EMC Immunity Standards
- ADA & ICC/ANSI A117.1 Accessibility Standards

### 1.1.3 ADA Requirements

- The elevator controller shall comply with Title III of the Americans with Disabilities Act (ADA).
- Leveling Accuracy  The controller shall have a self-leveling feature that shall automatically bring the car to floor landings within a tolerance of 0.5" (12.7 mm) or better under all loading conditions up to the rated load.
- Hall Lanterns  The controller shall have outputs to drive the visible and audible signals that are required at each hoistway entrance to indicate which elevator car is answering a call. Audible signals shall sound once for up, twice for down.
- Car Position Indicators  The controller shall have a position indicator output to drive the required position indicator which shall indicate the corresponding floor numbers as the car passes or stops at a floor. An audible signal shall sound as the position indicator changes floors.
- Optional — A voice annunciator output shall be available to facilitate audible announcement of car direction and floor number.

## 1.2 Non-Proprietary Equipment

Only universally “Serviceable and Maintainable,” Non-proprietary elevator control equipment shall be accepted. Non-proprietary standards recognize specific owner’s rights:

- The right to all information needed for diagnosis, service, and repair.
- The right to access on-board computers, including the information they store and the ability to diagnose, repair, and/or reprogram these systems.
- The right to select from among multiple sources for maintenance and repair in a competitive marketplace.

### 1.2.1 OEM Products

MCE products carrying MCE identification labels do not have proprietary diagnostics.

MCE may manufacture products for the OEM (Original Equipment Manufacturer) market that do not carry MCE identification labels. These products may have proprietary diagnostics owned by the manufacturer.

Any of the statements below can be used to ensure that non-proprietary diagnostics are furnished regardless of the elevator manufacturer:

- Provide MCE non-proprietary diagnostics.
- Provide non-proprietary diagnostics by MCE.
- Provide non-proprietary diagnostics.

## 1.3 Environmental Considerations

The elevator controller shall operate within the following environmental conditions:

- Ambient temperature: 32F degrees to 104F degrees (0C degrees to 40C degrees). Higher temperature ranges are available.
- Humidity: non-condensing up to 95%
- Altitude: Up to 7500 feet (2286 m)

MCE specializes in the manufacture of control products for adverse environmental conditions. For example, dust-proof, water-proof, corrosion-resistant, explosion-proof, or air-conditioned controller cabinets can be engineered to meet specific applications. Please contact MCE Sales Engineering for details.

## 1.4 Controller

The elevator controller shall be microprocessor based and designed specifically for elevator applications. Elevator and drive logic shall be implemented independently of safety functions.

Elevator logic shall be implemented on a single processor to facilitate tight coordination between subsystems and enhance reliability. The implementation shall utilize a real-time, multi-tasking operating system to allow the processor to simultaneously execute elevator control logic, drive control logic, operator interface logic, and communication support.

The elevator controller shall provide the ability to access significant memory capacity for configuration parameter storage, event recording, real-time diagnostics, and program execution.

The elevator controller shall have an independent safety system in order to implement safety features required by code. The safety system implementation shall utilize solid state devices. No relays shall be used for safety logic. The safety subsystem shall incorporate a check redundant, dual-processor, dual-path, solid-state, ASME A17.1-2000 compliant implementation that meets CSA and CE standards.

The elevator controller shall be configured and packaged in such a way that external “jumpers” cannot be used (intentionally or unintentionally) while the elevator is running in any passenger mode of operation. Non-passenger modes of operation shall be provided, along with means to bypass safety functionality, to allow inspection testing and other setup and/or troubleshooting operations.

The elevator control logic configuration shall be fully field programmable. Changes in number of floors, I/O configuration, drive setup, eligibility etc. shall not require the replacement/reprogramming of EEPROMs or other storage devices. Further, changes in the controller configuration shall be user adjustable in the field.

The elevator controller shall have extensive diagnostic capability. A built-in LCD display or equivalent shall allow access to major user functions and diagnostic features. The display shall be a multi-character, multi-line type with associated keypad to allow users to enter information. The display shall show data and menus in readily understood character format. No numeric, hexadecimal, or binary codes are acceptable.

Dedicated indicators shall be provided in a conspicuous location on the elevator controller to indicate important system statuses, such as when the safety string is closed, when the door locks are closed, when the elevator is on Inspection/Access, etc. In addition, other special or error conditions detected by the main processor or safety subsystem shall be displayed.

The elevator controller shall support an interface for communication and interaction via a separate application program running on a Windows PC. This application shall communicate with the controller and allow the user to access controller configuration parameters, view real-time elevator status information, initiate and facilitate setup and adjustment procedures, and provide advanced troubleshooting capabilities. The PC application shall be designed specifically for elevator applications and shall graphically and dynamically display information from the controller.

A PC application shall provide facilities to manage elevator controller configuration parameters. The user shall be able to manage and manipulate parameters including:

- Retrieve from the elevator controller and view/edit
- Retrieve from the elevator controller and save to a file on the PC
- Retrieve from the PC, view/edit, and download to the elevator controller
- Manage separate configurations for multiple elevator controllers

The user shall be able to select specific groups or subsets of parameters to send or retrieve from the elevator controller.

A PC application display shall provide motor field (where applicable), armature and brake voltages, armature current, intended and actual car speeds and hoist machine RPM. The PC diagnostics and adjustment display shall include online context-sensitive parameter descriptions and help information for fault troubleshooting.

The controller shall maintain an event log that records noteworthy events or faults. They shall be displayed in chronological order and time stamped for analysis or review. Data displayed shall include the type of event or fault, the date and time it occurred, and the position of the car and status of various flags at the time of the occurrence. The event log shall be able to be saved and reviewed offline via the PC application.

Communication between the elevator controller and the PC application shall be via a standard 100 base T TCP/IP network connection. The elevator controller shall be compatible with standard networking equipment (cables, hubs, switches and routers etc.).

A PC application and elevator controller shall support remote connection via the internet. The elevator controller shall support up to four simultaneous PC connections (remote and/or local). A mechanism shall be provided to prevent the unauthorized alteration of elevator configuration parameters.

A controller test switch shall be provided. In the test position, this switch shall enable independent operation of the elevator, with the door open function deactivated, for purposes of adjustment and testing. The elevator shall not respond to hall calls and shall not interfere with any other car in a duplex or group installation.

Switches for controller inspection, enable, and up and down shall be provided to place the elevator on Inspection operation and allow the user to move the car from the machine room. The cartop inspection switch shall render the controller inspection switch inoperative.

The elevator control and safety functions shall be part of an integrated system designed for ease of use, with diagnostics and parameter adjustments accessible through a common user interface.

The brake supply shall be capable of providing at least four independently adjustable values of output voltage in order to provide smooth lifting, holding and releveling. These values shall be adjusted via computer parameters. Manual adjustment of resistor values shall not be required.

The elevator controller shall provide auto-tuning of the brake control values.

The controller shall provide logic to detect a failure of brake voltage to properly decay and relax a picked brake to hold/cooling position.

The brake control system shall include circuitry to detect insufficient brake current. This failure shall cause the elevator to be removed from service at the next stop and remain out of service until the condition is corrected.

For gearless applications, the drive control system shall use an optimized speed profile in a dual-nested-loop feedback system based on car position and speed. A speed feedback device (tachometer or encoder) shall permit continuous comparison of motor speed with the calculated speed profile to provide accurate control of acceleration and deceleration—right up to and including the final stop, regardless of direction of travel or load in the car. Drive subsystem control parameters shall be digitally adjustable through software and shall be stored in non-volatile FLASH memory.

For DC applications, the system shall include precise closed-loop motor field control. The system shall regulate motor field current throughout the range of operation via current feedback from the motor field. The system shall provide motor field current sensing which shall shut down the elevator if insufficient motor field current is detected.

The system shall provide adaptive gain parameters for optimum control of elevator speed throughout its travel.

The system shall use a device to establish car position to an accuracy of 0.1875" (4.76 mm) or better, using a quadrature signal operating over the entire length of the hoistway.

The system shall use an automatic two-way leveling device to control the leveling of the car to within 0.25" (6.35 mm) or better above or below the landing sill. Overtravel, undertravel, or rope stretch shall be compensated for and the car brought level to the landing.

A system for pre-torquing the hoist motor shall be made available to ensure consistently smooth starts. An electronic load sensor shall be required to implement the pre-torquing feature.

Pre-start sequencing shall be provided to safely energize the machine prior to the doors closing on a departing elevator, thus consistently improving floor-to-floor travel times.

Door pre-opening as the car approaches a landing shall be field adjustable to begin a maximum of six inches from level-at-floor position.

### 1.4.1 AC Flux Vector Drive

The control system shall utilize a flux vector AC drive.

The flux vector drive shall be capable of producing full torque at zero speed and shall not require DC injection braking in order to control car deceleration.

The drive shall be capable of controlling geared and gearless machines, induction and permanent magnet motors. The drive shall also work with different types of encoders such as EnDat, incremental, sine/cosine, and Hiperface.

The drive shall have built-in motor overload protection. External overload is not required.

The drive shall have the capability of being adjusted or programmed to achieve the required motor voltage, current, and frequency to properly match the characteristics of the AC elevator hoist motor.

The drive shall not create excessive audible noise from the elevator motor.

The drive shall be heavy-duty, capable of delivering sufficient current required to accelerate the elevator to contract speed with rated load. The drive shall provide speed regulation appropriate to the motor type.

For non-regenerative drives, means shall be provided to remove regenerated power from the drive DC power supply during dynamic braking. This power shall be dissipated in a resistor bank that is an integral part of the controller. Failure of the system to remove regenerated power shall cause the drive output to be removed from the hoist motor.

A regenerative drive option (PowerBack) is available to return power to the AC line during dynamic braking. This system is very effective for higher horsepower (above 30HP) and gearless applications.

A contactor shall be used to disconnect the hoist motor from the output of the drive unit each time the elevator stops. This contactor shall be monitored and the elevator shall not start again if the contactor has not returned to the de-energized position when the elevator stops.

The controller shall provide stepless acceleration and deceleration and provide smooth operation at all speeds.

For applications where the building power supply has a “Grounded Leg Delta” configuration, an isolation transformer should be used to minimize noise and prevent any damage to the drive during voltage fluctuations.

### 1.4.2 12-Pulse SCR Drive

The control system shall utilize a 12-pulse SCR drive. The 12-pulse SCR drive shall be designed as an integral part of the control system providing access and adjustment of all diagnostic and configuration parameters.

The controller shall provide precise speed control using advanced processing and operating system technology. A high speed FPGA device shall be dedicated to encoder speed processing.

The control system shall provide auto-tuning of Motor Field and Brake control values.

The control system shall include dynamic braking to assist in bringing the car to a smooth, controlled emergency stop and to help limit car speed in the event of brake failure.

The control system motor field supply shall be current regulated and functionally integrated with the 12-pulse SCR drive in order to accomplish motor field forcing and armature voltage limiting.

A drive isolation transformer shall be provided as part of the control system to further reduce power line distortion and line notching. The transformer shall be matched to the characteristics of the 12-pulse SCR drive and elevator hoist motor.

### 1.4.3 Quattro Drives

The control system shall fully support Magnetek Quattro Drives including:

- Magnetek Quattro AC
- Magnetek Quattro DC

## 1.5 ETA Dispatching

Individual elevators shall be dispatched in a manner which minimizes the average time it takes for hall calls to be answered. Elevator position, speed, door status and direction of the hall call shall be taken into account. Each iControl elevator controller shall be capable of dispatching groups of up to six cars. If the current controller dispatcher is taken off line, the next designated controller shall immediately assume dispatching control. Refer to the iCentral specification in Section 2 of this document for information regarding the stand alone group dispatcher.

There shall be four distinct dispatching modes: balanced, lobby-peak, demand-up-peak and demand-down-peak.

Balanced mode shall optimize elevator dispatching for periods when the up and down hall call demands are randomly distributed throughout the building and approximately equal. This mode shall minimize the average wait time of all hall calls, giving no preference to up versus down calls.

The lobby-peak mode shall optimize elevator dispatching for periods when the hall calls at the lobby(s), in a specific direction, are significantly higher than all other hall call demands in the building. Certain cars shall be designated to service up or down hall calls at the lobby(s). The remaining cars shall be dispatched in balanced mode, to answer all other hall calls in the building. This mode shall give priority service to up or down hall calls at the lobby floor(s) in order to accommodate disproportionately high traffic at the lobby. The cars that are selected for lobby-peak mode shall bypass all other hall calls.

Demand-up-peak (and down-peak) modes shall also be supported, for periods when the up (down) hall-call demand at all floors is significantly higher than the down (up) hall-call demand at all floors and give priority to all up (down) hall calls.

There shall be four ways in which the dispatching mode can be selected:

- Hardware switch
- Software switch
- Timer - software time schedule
- Automatic - software selected

In automatic mode, the dispatching software shall decide which mode to use. It shall evaluate the number of hall calls, car calls, their distribution and frequency as well as additional system inputs, to select the optimal dispatching mode to address the current building demand.

### 1.5.1 Parking

Eight user-defined parking schemes, to allow programming of multiple lobby and non-lobby parking configurations, shall be supported. It shall be possible to enable or disable these parking configurations manually or based on a time schedule. Time table choices shall include time of day, day of week, day of month, or day of year, allowing specification by name of day, occurrence of named day in the month, or by date.

The user shall select which cars may be parked at each programmed parking floor. If no cars are selected the system shall assume that all cars are eligible.

Zone/Sector parking shall be supported, allowing the user to divide the hoistway into multiple, contiguous floor zones in which idle cars shall be parked according to user-assigned priority.

Parking of cars with front and/or rear doors always closed, always opened, or opened for a programmed number of seconds shall be supported.

Parking logic shall be provided with shuffle delay timers (configurable parameter) to determine the wait time before parking idle cars, and re-parking non-lobby parked cars.

Dynamic-parking, to determine the optimal parking configuration for a building at any given time, shall be supported. Using artificial intelligence and learned historical data, predictions shall be made as to where the next building hall-call demands will most likely occur, and idle elevators shall be parked accordingly. The controller shall review data and refresh dynamic parking factors every fifteen minutes.

All time related configuration parameters used to park cars, including Lobby Parking Delay, Non-Lobby Parking Delay, Shuffle Delay, etc., shall be user programmable.

The user shall be able to specify whether lobby priority cars are to park with doors opened, closed, or opened for a specified amount of time. The user shall also be able to specify whether non-lobby priority cars are to park with doors opened, closed, or opened for a specified amount of time.

Combined dynamic and user-defined parking shall be supported. In this mode, the user shall be able to configure the essential parking floors and leave the rest of the parking floors undefined. Once all the user-defined parking floors are served, the dynamic parking scheme shall park the remaining idle elevators automatically.

### 1.5.2 Hall Call Eligibility

Eight, user programmable, Hall Call Eligibility configurations shall be supported. Each configuration shall specify that some cars are eligible to answer some types of hall calls while others are not. It shall be possible to activate any Hall Call Eligibility configuration manually or automatically by time table. Time table choices shall include time of day, day of week, day of month, or day of year, allowing specification by name of day, occurrence of named day in the month, or by date.

### 1.5.3 Artificial Intelligence

Artificial Intelligence shall be used to implement balanced mode, lobby-peak mode, automatic mode selection, and dynamic parking. In balanced mode, AI shall be used to determine the optimal hall-call assignment for each building configuration. In lobby-peak mode, AI shall be used to automatically determine the number of cars that shall be assigned for lobby-peak only service. In automatic mode, these methods shall be used to determine the optimum mode of operation at any given time. Finally, both methods shall be used to determine the optimum parking at any given time.

Artificial intelligence shall be an integral part of the system and shall therefore always be active.

### 1.6 Monitoring

A PC-based system monitoring application shall be available. At a minimum, monitoring shall be capable of providing system status, car location and travel direction, operating mode, door operation indication, dispatching ETAs, and security status.

The monitoring system shall be capable of remotely registering car and hall calls and of configuring hall call and car call restrictions in support of building security. The system shall be capable of implementing security overrides if required.

The monitoring system shall be capable of enabling Swing, Sabbath, and Auto-stop modes of operation on the group control and of acknowledging emergency alarm activity on any car in the group.

The monitoring system shall be capable of selecting group mode of operation including, Balanced, Lobby Peak, Demand Down, Demand Up, and Auto-mode (dynamic mode selection by group controller) when Operating Mode Configuration 1 is active on the group.

The monitoring system shall be capable of setting the group to Flood Operation mode when such mode is supported by the group control.

The monitoring system shall be capable of initiating recall of any car in the group to a selected floor and of controlling door operation of that car at the selected floor.

### 1.7 Reporting

A client/server based report collection and generation application shall be available. Based on historical data collected by the server, the report application shall provide, at a minimum, hall call performance, hall call analysis, traffic analysis, hall call log, car call log, event log, emergency log, maintenance log, and percent in service reports.

## 2 iCentral Independent Dispatcher

### 2.1 Overview

iCentral is the central dispatching option for iControl, providing a central point to coordinate dispatching, parking, special operating modes, emergency power response, security, and interaction with existing (legacy) controls. This option is used for the most demanding systems.

With iCentral, the iCue dispatching software runs on a dedicated Windows PC or an embedded micro controller. You configure and interact with iCue using a Windows XP personal computer running the iView graphical user interface. iView is also used to connect to individual elevator controllers in the iControl group. iView automatically provides the correct user interface depending on the type of control (dispatcher or elevator) you are accessing.

The standard iCentral enclosure is a single-door cabinet. The cabinet provides two fixed shelves (for a monitor and a KVM switch and iCue and iView computers respectively), a sliding keyboard/mouse tray, and a peripherals/equipment interconnect area configured to meet the requirements of the individual job. A typical equipment complement includes LAN and System Ethernet switches, SC-ION addressable input/output boards, serial communication bus drivers, a second computer, and modular terminals to accommodate machine room and hoistway field connections.

Using a predictive knowledge base along with current and historical traffic information and artificial intelligence, iCue anticipates and adapts to changing building traffic demand. The iCue dispatching engine continuously runs multiple scenarios to ensure that every decision maximizes efficiency. A dedicated 100 mega-baud network ensures that iCue always has real-time car status information to work with. Self-optimizing technology adapts without intervention – the longer it runs, the better it gets.

The iCue intelligent parking system allows selection of user defined, automatic, or hybrid operation parking. Cars may be parked manually or dynamically, by floor, or by building sector. iCue supports the SmartLINK hall call system, MCE-Ready fixtures, and predictive hall gong service.

### 2.2 Backup Dispatching Overview

In addition to performing car control functions, iControl elevator controllers can assume dispatching responsibilities for a group of elevators. One or more Local cars can be designated as an Alternate Dispatcher, meaning that they can act as a backup for a central dispatcher or as one of several potential dispatchers for a group that has no central dispatcher.

## 2.3 Group Features

### 2.3.1 High Level

- Non-Proprietary (open architecture, universally serviceable, manuals/drawings provided)
- System Configuration: MCE iView application running on standard PC
- Diagnostics: MCE iView application running on standard PC
- Diagnostic hall call placement: MCE iView application running on standard PC
- Ethernet TCP/IP communications between group and cars
- Software updates through download or CD
- Status Indicators (on-screen messages and individual status LEDs)
- External communications: TCP/IP Ethernet
- Backup dispatching automatically assumed by designated car in group (no additional cabinet required)
- Legacy group control accommodation: Cross Registration / Cross Cancellation
- Inputs and Outputs reconfigurable in the field via iView

### 2.3.2 Operating Features

Dispatching: Individual elevators shall be dispatched in a manner which minimizes the average time it takes for hall calls to be answered. Elevator position, speed, door status and direction of the hall call shall be taken into account.

There shall be four distinct dispatching modes: balanced, lobby-peak, demand-up-peak and demand down-peak.

- Balanced mode shall optimize elevator dispatching for periods when the up and down hall call demands are randomly distributed throughout the building and approximately equal. This mode shall minimize the average wait time of all hall calls, giving no preference to up versus down calls.
- The lobby-peak mode shall optimize elevator dispatching for periods when the hall calls at the lobby(s), in a specific direction, are significantly higher than all other hall call demands in the building. Certain cars shall be designated to service up or down hall calls at the lobby(s). The remaining cars shall be dispatched in balanced mode, to answer all other hall calls in the building. This mode shall give priority service to up or down hall calls at the lobby floor(s) in order to accommodate disproportionately high traffic at the lobby. The cars that are selected for lobby-peak mode shall bypass all other hall calls.
- Demand-up-peak (and down-peak) modes shall also be supported, for periods when the up (down) hall call demand at all floors is significantly higher than the down (up) hall-call demand at all floors and give priority to all up (down) hall calls.

There shall be four ways in which the dispatching mode can be selected:

- Hardware switch
- Software switch
- Timer - software time schedule
- Automatic - software selected

In automatic mode, the dispatching software shall decide which mode to use. It shall evaluate the number of hall calls, car calls, their distribution and frequency as well as additional system inputs, to select the optimal dispatching mode to address the current building demand.

Security Management: Physical hall lock support per floor/riser, independent front/rear opening control per car/floor/riser/direction of travel, car operating panel floor registration control per riser.

Dispatching Penalty and Advantage Assignment: Allows you to set conditions that will favor assignment of calls to cars depending upon real time traffic conditions including car operating modes, car readiness, and call coincidence (floor call at registered car call destination)

Parking Management: Eight user-defined parking schemes, to allow programming of multiple lobby and non-lobby parking configurations, shall be supported. It shall be possible to enable or disable these parking configurations manually or based on a time schedule. Time table choices shall include time of day, day of week, day of month, or day of year, allowing specification by name of day, occurrence of named day in the month, or by date.

The user shall select which cars may be parked at each programmed parking floor. If no cars are selected the system shall assume that all cars are eligible. Zone/Sector parking shall be supported, allowing the user to divide the hoistway into multiple, contiguous floor zones in which idle cars shall be parked according to user-assigned priority.

Parking of cars with front and/or rear doors always closed, always opened, or opened for a programmed number of seconds shall be supported.

Parking logic shall be provided with shuffle delay timers (configurable parameter) to determine the wait time before parking idle cars, and re-parking non-lobby parked cars.

Dynamic-parking, to determine the optimal parking configuration for a building at any given time, shall be supported. Using artificial intelligence and learned historical data, predictions shall be made as to where the next building hall-call demands will most likely occur, and idle elevators shall be parked accordingly. The controller shall review data and refresh dynamic parking factors every fifteen minutes.

All time related configuration parameters used to park cars, including Lobby Parking Delay, Non-Lobby Parking Delay, Shuffle Delay, etc., shall be user programmable.

The user shall be able to specify whether lobby priority cars are to park with doors opened, closed, or opened for a specified amount of time. The user shall also be able to specify whether non-lobby priority cars are to park with doors opened, closed, or opened for a specified amount of time.

Combined dynamic and user-defined parking shall be supported. In this mode, the user shall be able to configure the essential parking floors and leave the rest of the parking floors undefined. Once all the user defined parking floors are served, the dynamic parking scheme shall park the remaining idle elevators automatically.

Emergency Power Operation: Recall (Phase 1) and Service (Phase 2) management per cars in group

## 2.4 Destination Based Dispatching

Dispatching shall be destination based, allowing passengers with the same or efficiency-compatible destination floors to be grouped in specific elevator cars so fewer stops are required per car.

The destination based dispatching system shall be scalable, permitting destination based dispatching to be employed throughout a building, on specified floors, or as lobby boost installations that use destination based dispatching only on the busiest departure floors while allowing other floors to retain traditional dispatching hall call stations.

The destination based dispatching system shall be capable of being returned to a traditional dispatching system at the will of building management. Such return shall be capable of being assigned manually or through automated timers. Should a malfunction seriously impact the destination based dispatching system, dispatching shall be returned to traditional means automatically to avoid disrupting elevator service. Such return to traditional dispatching shall require no additional fixtures to be installed. Instead, destination entry touch screens shall display touch-enabled Up and Down call symbols.

The destination based dispatching system shall use touch screen fixtures at the primary destination entry stations and in place of traditional hall call stations. Should it be desirable or necessary to uninterrupted system operation, touch screens shall revert to traditional up/down hall call functionality.

Destination Based Dispatching shall fully support ADA requirements. Primary destination entry stations, in addition to touch screen controls, shall have a Braille labeled button that, when pressed, initiates a voice-directed means of destination selection using only the Braille labeled button. Such audible direction shall include annunciation of a tone or set of tones that, when repeated by the assigned elevator car, allow that car to be readily identified and located.

Destination Based Dispatching primary entry stations shall support an optional feature allowing a user to enter a number of passengers associated with the call entry to support more efficient and accurate car assignment. Such designation shall be for two passengers, three passengers, or four or more passengers.

### 2.4.1 Elevators shall be dispatched as an automatic group.

- An independent PC running advanced software application to dispatch from 1 to 8 cars shall be supplied.
- Group dispatching algorithm shall minimize system journey time (time between latching a destination call and arriving at destination).
- Group dispatching algorithm shall not put priority on individual passenger wait times over the system journey time.
- Group dispatcher shall take into account separate walk times individually set for each destination input device. Walk times shall be field adjustable.
- Group dispatcher shall take into account field programmable car capacities as number of passengers per car.
- Group dispatcher shall have an option to operate in standard ETA mode based on software input, programmable timer, or hardware switch.
- During ETA mode, destination input devices shall show only up and down call buttons and register regular hall calls.

### 2.4.2 Call Input Devices

- Passengers shall enter destination calls by touch screen destination input devices (DID).
- Each floor shall have at least two destination input devices.
- Destination input device shall optionally request number of passengers to help prevent piggybacking of people going to same floor.
- Destination input device shall have option to show custom image of building or site.
- Destination input devices shall communicate serially via CAN protocol to the group dispatcher.
- Destination Input Device shall respond to call request with a graphical representation of a path from that particular DID to the assigned car.

### 2.4.3 Special Access ADA operation:

- Destination input device shall have a mechanical button with Braille 3 dot equilateral triangle symbol for accessibility.
- When button is pressed, the destination input device shall verbally inform the passenger to press again when the desired floor is spoken.
- Destination input device shall respond to a call request with a graphical representation of the path to the assigned car and a voice announcement of the car letter and unique audible tone for that car.
- Audible tone played at destination input device shall be repeated by hallway fixture above the car.
- Elevator adjuster shall have the ability to select which tone plays for each car as a field programmable option.
- Registration of a call with ADA button shall give preference to an empty car and extend door time set by a field adjustable parameter.

### 2.4.4 Special Operation Features

- Destination input device shall have ability to display special operations screen.
- Special operations screen shall be guarded by 3 to 10 digit password entered on touchscreen.
- Special operations password may be changed on the group dispatcher in the machine room.
- Special operation screen shall allow selected individuals to recall a car to DID floor with doors open so that it may be put in independent service or taken out of service for maintenance.

### 2.4.5 Hallway Fixtures

- Each hallway opening shall have a destination hallway fixture.
- Hallway fixture shall show the car letter when no destinations are displayed.
- When call is registered, the assigned car's hallway fixture at the source floor shall change to show the car label and the destination floor(s) being served.
- Destinations shown on hallway fixture shall be extinguished when car answers the source call.
- Hallway fixtures shall blink the car letter and repeat unique car tone when ADA special operation calls are assigned to the car.

### 2.4.6 In-Car Fixture

- Each car shall be equipped with at least one door jamb fixture.
- Door jamb fixture shall show destinations car is traveling to. Destination floor label shall be added to the list only after car arrives at source floor.
- Door jamb shall flash destination floor label when car arrives at that floor.
- COP call buttons shall be concealed behind a locked panel for use only when the elevator is operating on modes other than destination dispatch.

### 2.4.7 Exposed COP devices shall include:

- Door open/close buttons.
- Alarm button.
- Emergency stop switch.
- Self-dialing hands free phone or intercom with ADA provisions
- Three position fire key operated switch, call cancel button, and illuminated visual/audible signal system with mandated signage engraved per ASME A.17.1 standards.

### 2.4.8 Locked Panel

Provide a locked panel containing key switches required to operate and maintain the elevator, including, but not limited to:

- Independent/Attendant service switch and service indicators.
- Light switch.
- Fan switch.
- G.F.I. duplex receptacle.
- Emergency light test button.
- Inspection Service operation key switch.

## 2.5 Dispatching, General

### 2.5.1 Emergency Power Options

- Automatic selection of power feed from any car in the group
- Building Emergency Generator

### 2.5.2 Monitoring Options

- iMonitor: Local, LAN/WAN, Remote (high-speed Internet) Cars/Groups/Sites
- iReport: System logging, report generation, archiving, automated notification
- BMS-LINK: Monitoring and control through Building Management System software

### 2.5.3 Non-Proprietary Equipment

Only universally "Serviceable and Maintainable," Non-proprietary elevator control equipment shall be accepted. Non-proprietary standards recognize specific owner's rights:

- The right to all information needed for diagnosis, service, and repair.
- The right to access on-board computers, including the information they store and the ability to diagnose, repair, and/or reprogram these systems.
- The right to select from among multiple sources for maintenance and repair in a competitive marketplace.

### 2.5.4 Environmental Considerations

The elevator group control shall be capable of operating within the following environmental conditions:

- Ambient temperature: 32°F to 104°F (0°C degrees to 40°C degrees).
- Humidity: Non-condensing up to 95%
- Altitude: Up to 7500 feet (2286 m)

Motion Control Engineering specializes in control products for adverse environmental conditions. For example, dust-proof, water-proof, corrosion-resistant, or air conditioned controller cabinets can be engineered to meet specific applications. Higher temperature range compatibility is available. Please contact MCE Sales Engineering for details.

### 2.5.5 Status Display

The group shall have a status display screen (iCue default display) that provides group and car status. At a minimum, the display shall provide:

- Group identification
- Group mode of operation (Automatic (dynamic mode assignment by Group), Balanced, Lobby Peak, Demand Down Peak, Demand Up Peak
- LAN and System network IP address, Subnet mask, and Gateway
- Connection status for each car in the group
- Bus status (connection, voltage, Driver VDC, Node Control, Bus Enabled, High Current) for each of up to four serial bus connections if present
- Emergency power status for each of up to two generators

### 2.5.6 User Displays Through iView

The status display described above appears when the system configuration PC is monitoring iCue real-time operating software. When the system configuration PC is connected to the group through iView, configuration-oriented displays including the following are displayed.

### 2.5.7 Building Configuration

The group shall support field configuration or reconfiguration of building-service parameters in the field through iView. Such configurable parameters shall include:

- Floors served per car
- Label assignment per floor up to three characters
- Setting or editing the number of cars in the elevator group
- Label assignment per car up to three characters
- Primary dispatcher designation
- Alternate dispatcher designation

### 2.5.8 Commandeer For Special Services

The group shall provide a screen allowing assignment or editing of special riser hall calls that may be used to recall a car to an enabled floor/opening for service outside group control. Such service may include security, VIP, or other independent control requirements. This screen shall provide:

- Maximum number of cars to operate on selected CFSS mode simultaneously
- Selection of 1 or multiple hall calls permitted per assigned car
- Per car designation of  enabled (front or rear) riser per building floor

### 2.5.9 Dispatching Options

The group shall provide a screen allowing assignment or editing of conditions that will favor assignment of calls to cars depending upon real time traffic conditions including car operating modes, car readiness, current car assignment, and call coincidence (floor call at registered car call destination)

### 2.5.10 Hall Call Eligibility

The group shall provide a screen allowing assignment or editing of up to eight different Hall Call Eligibility sets. For each set, this screen shall provide:

- Selection of eligible hall call risers on a per car, per floor, per opening basis

The user shall be able to assign any of the eight sets to any of four Dispatching Configurations. Each Dispatching Configuration shall be capable of manual assignment by the user or of timer-based assignment by the elevator group control. Each Dispatching Configuration shall be additionally capable of controlling Parking sets, Parking Eligibility sets, and Mode of Operation sets. (See Dispatching Configurations.)

### 2.5.11 Mode of Operation

The group shall provide a screen allowing assignment or editing of up to eight different Mode of Operation sets. For each set, this screen shall provide:

- Selection of the Mode of Operation to be used when this set is active (Automatic [dynamic selection by Group according to user-defined conditions], Balanced, Lobby Peak, Demand Up Peak, Demand Down Peak).

The user shall be able to assign any of the eight sets to any of four Dispatching Configurations. Each Dispatching Configuration shall be capable of manual assignment by the user or of timer-based assignment by the elevator group control. Each Dispatching Configuration shall be additionally capable of controlling Parking sets, Parking Eligibility sets, and Hall Call Eligibility sets. (See Dispatching Configurations.)

### 2.5.12 Parking

The group shall provide a screen allowing assignment or editing of up to eight different Parking sets. For each set, this screen shall provide:

- Selection of the Parking Method to be employed (Per Floor, Sector Parking).
- Parking delay options in seconds for Lobby parking, Lobby shuffle, Non-lobby parking, Non-lobby shuffle
- Door behavior per car when parked
- Parking floor priority if multiple parking floors are assigned to a car

The user shall be able to assign any of the eight sets to any of four Dispatching Configurations. Each Dispatching Configuration shall be capable of manual assignment by the user or of timer-based assignment by the elevator group control. Each Dispatching Configuration shall be additionally capable of controlling Hall Call Eligibility, Parking Eligibility sets, and Mode of Operation sets. (See Dispatching Configurations.)

### 2.5.13 Parking Eligibility

The group shall provide a screen allowing assignment or editing of up to eight different Parking Eligibility sets. For each set, this screen shall provide:

- Parking behavior per car (at a specific floor(s), not at all)
- Door behavior if allowed to park

The user shall be able to assign any of the eight sets to any of four Dispatching Configurations. Each Dispatching Configuration shall be capable of manual assignment by the user or of timer-based assignment by the elevator group control. Each Dispatching Configuration shall be additionally capable of controlling Parking sets, Hall Call Eligibility sets, and Mode of Operation sets. (See Dispatching Configurations.)

### 2.5.14 Dispatching Configurations

The group shall provide a screen allowing assignment or editing of up to eight pre-programmed dispatching configurations. Each configuration shall be capable of incorporating and controlling any one of eight pre-programmed Parking Eligibility, Parking, Hall Call Eligibility, or Mode of Operation sets. This screen shall provide:

- Ability to manually select and manually assign an ad-hoc Configuration incorporating any one of the eight sets previously configured for Parking Eligibility, Parking, Hall Call Eligibility, or Mode of Operation
- Ability to enable or disable timer-based assignment of any of up to eight Dispatching Configurations (Please refer to Timer Tables)

### 2.5.15 Timer Tables

The group shall provide a screen(s) allowing assignment or editing of timer tables used by the Group to enable system features on a timed basis. This screen shall provide:

- The ability to add, edit, remove, or set the priority of system timers
- A display of the attributes of any selected timer
- The ability to enter a logical name for each timer
- The ability to set a recurrence pattern for each timer
- The ability to set starting and ending times for each timer
- The ability to assign Hall Call Eligibility, Parking, Parking Eligibility, Mode of Operating, and Security attributes per timer
- The ability to assign the status (on/off) of any or all of four shared remote outputs per timer

### 2.5.16 Split Bank Operation

The group shall provide a screen(s) allowing assignment or editing of split bank operation (splitting the elevator group into two, separate groups call “banks”). This screen shall provide:

- The ability to enable or disable split bank operation
- The ability to assign hall call risers to each bank

### 2.5.17 Management (Monitoring)

The group shall provide a screen(s) allowing authorization or de-authorization of access to third-party monitoring systems.

## 2.6 Emergency Power

The group shall provide a screen(s) allowing assignment or editing of emergency generator attributes in relation to cars in the elevator group. This screen shall provide:

- Ability to assign or edit assignment of selected cars to one of up to two emergency generators
- Set the active polarity (high/low) of the emergency generator alerting input
- Set a time in seconds which must elapse before cars may be run on emergency power (allowing the generator power to stabilize)
- Determine how or if emergency recall is activated per car and the sequence in which cars are recalled
- Set the number of cars that may be recalled simultaneously
- Set a recall timeout such that, if a car should fail to recall within this period, the group shall move on to the next eligible car
- Determine how or if recalled cars should be run on emergency power and the sequence in which they are to be run
- Set the number of cars that may run simultaneously on emergency power

## 2.7 Legacy Group Interface

*The group shall provide a screen(s) allowing accommodation for a legacy group control (cross-cancellation / cross-registration). This screen shall provide:

- Assignment of accommodation type (cross-cancellation / cross-registration)
- Cars to be cross-registered if that accommodation is selected
- Setting or editing of threshold time (if an iControl car cannot respond within this time, iCentral will assign the call to a legacy car) – cross-registration
- Setting or editing of cross-cancellation output timer – cross-cancellation (first group car to respond causes cancellation of call to other group; timer allows receiving controller time to process the cancellation input and cancel the car assignment)
- Legacy group accommodation requires additional hardware. Not all legacy controllers can be accommodated.

## 2.8 Security

If the elevator group is subject to building security requirements, interface must be provided for elements external to the elevator group. iCentral provides means to configure security requirements pertinent to the elevator group.

### 2.8.1 Security (Status)

The group shall provide a screen(s) allowing current security status to be displayed and to override software security if necessary. This screen shall provide:

- Master security status (Active, Hardware override active, Software override active)
- Software security override capability
- Active security configuration (if multiple configurations have been programmed) and means of activation (hardware, software, timer)
- The ability to assign activation of a security configuration manually or by a timer
- The ability to override or allow override by the Master Security switch
- Manage passwords allowing access to security settings
- The ability to assign security level (no security, basic security with per floor codes, basic security with per floor and passenger codes)

### 2.8.2 Security (Per Floor)

The group shall provide a screen allowing management of security per-floor. This screen shall provide:

- The ability to assign or edit hall call security (unrestricted, locked, or secured (security requirements active) on a per-floor, per riser, per opening, per car direction, per security set basis
- The ability to determine how long the call will accept input after the security requirement has been met
- The ability to allow/disallow a car to park at a secured floor

### 2.8.3 Security (Per Car Hall Call Response))

The group shall provide a screen allowing management of security per-car. This screen shall provide:

- Determination of which cars may respond to a hall call on a per-car, per-floor, per-direction basis.

### 2.8.4 Security (Car Floor Access)

The group shall provide a screen allowing management of car call registration per security configuration. This screen shall provide:

- The ability to edit any one of eight security configurations –
    - Floors/Openings that may be accessed per car when security is active and security requirement are satisfied
- The ability to edit the period of time within which a call must be registered after security requirements are met

### 2.8.5 Security (Car Restriction Override)

The group shall provide a screen allowing a car call security restriction to be overridden when the car is operating in a selected mode or when the call is placed from a selected source. This screen shall provide:

- Selection of the security configuration to be overridden
- Selection or editing of the sources or modes capable of overriding security (All, OBD calls, Remote calls, Attendant service, CFSS 1, CFSS 2, Independent service, Test mode, Shuttle service)

### 2.8.6 Security (Car Operating Panel Passcode Per Floor)

The group shall provide a screen allowing floor access to be restricted unless the correct COP passcode is entered. This screen shall provide:

- Selection of the security configuration to be affected
- The ability to set a required passcode for car access on a per-car, per-floor, per opening basis

### 2.8.7 Security (Car Operating Panel Passcode Per Passenger)

The group shall provide a screen allowing car access to specific floors and openings dependent upon entry of a code unique to a specified passenger. This screen shall provide:

- The ability to add, delete, or edit passenger settings
- The ability to set particular floors and openings available to the passenger
- The ability to assign or edit a COP entered passcode for the passenger
- The ability to determine what operating modes, in addition to normal Passenger mode, in which this passenger code is effective (Attendant, Independent, Sabbath, CFSS 1, CFSS 2)

## 2.9 Diagnostics and Service Related Screens

The group shall provide screens allowing diagnostic and service related parameters to be defined. These screens shall provide:

- Assignment or reassignment of inputs or outputs on the group serial bus (main/auxiliary riser calls, CFSS calls, emergency power, cross-registration, security, security override, remote outputs, user-defined events)
- Viewing of the status of any of the four system busses
- Inventory and functionality test of all bus devices
- System performance graphics per hall call type capable of being printed to a user-provided printer
    - Hourly average wait times for up and down hall calls
    - Number of up and down hall calls answered each hour
    - Average wait time for up and down hall calls for each hour
    - Average wait time for up, down, and all hall calls during last 24 hours

## 2.10 Status Indicators

Every field connection input or output shall have a dedicated LED such that no volt meter or other test equipment is required to see when an input or output is active.

## 2.11 Hoistway Display

The hoistway display shall provide a real-time view of all cars in the group, providing information and capabilities including:

- Traffic mode display (Balanced, Lobby Peak, Demand Up Peak, Demand Down Peak, Automatic)
- ETA in whole seconds in which the group estimates a registered hall call will be serviced per riser
- Ability to register hall and car calls
- Communication status per car
- ID per car
- Hoistway location per car
- Direction of travel per car

- Current floor per car
- Active calls per car
- Real time door operation per car

## 2.12 Monitoring Options

### 2.12.1 MCE iMonitor

A PC-based system monitoring application shall be available. At a minimum, monitoring shall be capable of providing system status, car location and travel direction, operating mode, and door operation indication via Ethernet connection.

The monitoring system shall be capable of remotely registering car and hall calls.

The monitoring system shall be capable of initiating recall of any car in the group to the lobby floor and of placing the car into Independent Service or placing it out of service upon arrival.

**Optional:** A site view, with three-dimensional representations of site buildings, visual indicators of elevator status in buildings so equipped, and the ability to show status details upon indicator selection shall be available. (This option requires additional graphics development as agreed upon by MCE and the customer.)

### 2.12.2 MCE iReport

An Ethernet client/server based report collection and generation application shall be available. Based on historical data collected by the server, the report application shall provide, at a minimum, hall call analysis, traffic analysis, hall call log, car call log, event log, emergency log, maintenance log, and percent in service reports. The report application shall also be capable of emergency notification and report distribution through email service.

### 2.12.3 Building Management System Interface

An interface to a Tridium technology client Building Management System shall be available. At a minimum, this interface shall allow the management system to view car location, call status, and door operation. The interface shall also allow the management system to set any of three levels of demand-response operation, each of which shall specify a set of cars to continue running in response to curtailed energy availability or if the building owner is voluntarily reducing energy demand. The interface shall also allow selected cars to be removed from and/or returned to service as desired through the building management system. (Depending on Building Management System software, modification of system code may be required.)

### 2.12.4 Third Party Monitoring

**Optional:** An interface to an IDS Liftnet monitoring system shall be available.

# SECTION 14 24 10

# HYDRAULIC ELEVATOR – MODERNIZATION

## PART 1 - GENERAL

### 1.1 DESCRIPTION

A. This section specifies the engineering, furnishing and installation of the complete hydraulic elevator system as described herein and as indicated on the contract drawings.

B. Items listed in the singular apply to each elevator in this specification except where noted.

C. Passenger Elevator P1-P2 & P13-P14 must be oil hydraulic, microprocessor control system and power-operated car and hoistway doors. Elevator must be Class "A" loading rated as a minimum.

| ELEVATOR SCHEDULE | |
|---|---|
| Elevator Number | P1-P2 |
| Overall Platform Size | Field verify |
| Clear Inside Platform | Field verify |
| Rated Load – kg (lb) | P1 – 4500 Lbs., P2 -6500 Lbs. |
| Contract Speed - m/s (fpm) | P1 – 100 FPM, P2 – 75 FPM |
| Total Travel – m (ft) | Field verify |
| Floors Served | 1, 2 |
| Number of Openings | 2 |
| Entrance Type & Size | 1 – Front, 2 – F/R |
| Plunger Size | Field verify |

| ELEVATOR SCHEDULE | |
|---|---|
| Elevator Number | P13-P14 |
| Overall Platform Size | Field verify |
| Clear Inside Platform | Field verify |
| Rated Load – kg (lb) | P1 – 1500 Lbs., P2 -4500 Lbs. |
| Contract Speed - m/s (fpm) | 125 FPM |

| ELEVATOR SCHEDULE | |
|---|---|
| Total Travel – m (ft) | Field verify |
| Floors Served | B, 1-3 |
| Number of Openings | 4 |
| Entrance Type & Size | Front |
| Plunger Size | Field verify |

**1.2 RELATED WORK**

A. Section 01 33 23 SPECIFICATIONS AND DRAWINGS FOR CONSTRUCTION (FAR 52.236-21) and, SPECIAL NOTES (VAAR 852.236-91), in GENERAL CONDITIONS.

B. Section 07 84 00, FIRESTOPPING: Sealing around penetrations to maintain the integrity of fire-rated construction.

C. SECTION 09 06 00, SCHEDULE FOR FINISHES: As a master format for construction projects, to identify interior and exterior material finishes for type, texture, patterns, color and placement.

D. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Requirements for seismic restraint of non-structural components.

E. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements that are common to more than one section.

F. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Low Voltage power and lighting wiring.

G. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.

H. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits for cables and wiring.

I. Section 26 05 73, OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY: Requirements for installing the over-current protective devices to ensure proper equipment and personnel protection.

J. Section 26 22 00, LOW-VOLTAGE TRANSFORMERS: Low voltage transformers.

K. Section 26 24 16, PANELBOARDS: Low voltage panelboards.

L. Section 26 43 13, TRANSIENT-VOLTAGE SURGE SUPPRESSION: Surge suppressors installed in panelboards.

M. Section 26 51 00, INTERIOR LIGHTING: Fixture and ballast type for interior lighting

**1.3 QUALIFICATIONS**

A. Approval by the Contracting Officer is required for products and services of proposed manufacturers, suppliers, installers and must be contingent upon submission of certificates by the Contractor stating the following:

1. Elevator contractor is currently and regularly engaged in the installation of elevator equipment as one of his principal products.
2. Elevator contractor must have five (5) years of successful experience, trained supervisory personnel and facilities to install elevator equipment specified herein.

B. Welding at the project site must be performed by certified welders who have previously qualified by test as prescribed in American Welding Society Publications AWS Dl.1 to perform the type of work required. Certificates must be submitted for all workers employed in this capacity. A welding or hot work permit is required for each day and must be obtained from the VAMC safety department. Request permit one day in advance.

C. Electrical work must be performed by a Licensed Master Electrician and Licensed Journeymen Electricians as requirements by NEC. Certificates must be submitted for all workers employed in this capacity.

D. Approval will not be given to elevator contractors and manufacturers who have established on prior projects, either government, municipal, or commercial, a record of unsatisfactory elevator installations, have failed to complete awarded contracts within the contract period and do not have the requisite record of satisfactorily performing elevator installations of similar type and magnitude.

E. Approval of Elevator Contractor’s equipment will be contingent upon their providing factory training, engineering and technical support, including all manuals, wiring diagrams and tools necessary for adjusting, maintenance, repair and testing of equipment to the VA for use by the VA’s designated Elevator Maintenance Service Provider.

F. Identifying an elevator maintenance service provider that must render services within two hours of receipt of notification, together with certification that the quantity and quality of replacement parts stock is enough to warranty continued operation of the elevator installation.

G. Equipment within a group of hydraulic elevators must be the product of the same manufacturer.

H. The Contractor must provide and install safety devices that have been subjected to tests witnessed and certified by an independent professional testing laboratory that is not a subsidiary of the firm that manufactures supplies or installs the equipment.

**1.4 APPLICABLE PUBLICATIONS**

A. The publications listed below form a part of this specification. Elevator installation must meet the requirements of the latest editions published and adopted by the United States Department of Veterans Affairs on the date this contract is signed.

B. Federal Specifications (Fed. Spec.):

J-C-30B - Cable and Wire, Electrical (Power, Fixed Installation)

J-C-580 – Cord, Flexible and Wire, Fixture

W-S-610 – Splice Connectors

W-C-596F - Connector, Plug, Electrical; Connector, Receptacle, Electrical

W-F-406E - Fittings for Cable, Power, Electrical and Conduit, Metal, Flexible

HH-I-558C - Insulation, Blankets, Thermal (Mineral Fiber, Industrial Type)

W-F-408E - Fittings for Conduit, Metal, Rigid (Thick- Wall and Thin-wall (EMT) Type)

RR-W-410 - Wire Rope and Strand

TT-E-489J - Enamel, Alkyd, Gloss, Low VOC Content

QQ-S-766 - Steel, Stainless and Heat Resisting, Alloys, Plate, Sheet and Strip

C. American Society of Mechanical Engineers (ASME):

A17.1 - Safety Code for Elevators and Escalators

A17.2 - Inspectors Manual for Electric Elevators and Escalators

D. National Fire Protection Association:

NFPA 13 - Standard for the Installation of Sprinkler Systems

NFPA 70 - National Electrical Code (NEC)

NFPA 72 - National Fire Alarm and Signaling Code

NFPA 101 - Life Safety Code

NFPA 252 - Fire Test of Door Assemblies

E. International Building Code (IBC)

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

A1008/A1008M-09 - Steel, Sheet, Cold Rolled, Carbon, Structural, High-Strength Low-Alloy and High Strength Low-Alloy with Improved Formability

E1042-02 - Acoustically Absorptive Materials Applied by Trowel or Spray

G. Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS):

SP-58 - Pipe Hangers and Supports

H. Society of Automotive Engineers, Inc. (SAE)

J517-91 - Hydraulic Hose, Standard

I. Gages:

For Sheet and Plate: U.S. Standard (USS)

For Wires: American Wire Gauge (AWG)

J. American Welding Society (AWS):

D1.1 - Structured Welding Code – Steel

K. National Electrical Manufacturers Association (NEMA):

LD-3 - High-Pressure Decorative Laminates

L. Underwriter's Laboratories (UL):

486A - Safety Wire Connectors for Copper Conductors

797 - Safety Electrical Metallic Tubing

M. Institute of Electrical and Electronic Engineers (IEEE)

N. Regulatory Standards:

Uniform Federal Accessibility Standards

Americans with Disabilities Act

VA Barrier Free Design Handbook H-18-13

O. National Elevator Industry, Inc.

NEII-1 Building Transportation Standards and Guidelines

**1.5 SUBMITTALS**

A. Submit in accordance with Specification Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA and SAMPLES.

B. Before execution of work, furnish information to evidence full compliance with contract requirements for proposed items. Such information must include, as required: Manufacturer's Name, Trade Names, Model or Catalog Number, Nameplate Data (size, capacity and rating) and corresponding specification reference (Federal or project specification number and paragraph). All submitted drawings and related elevator material must be forwarded to the Contracting Officer.

C. Shop Drawings:

1. Complete scaled and dimensioned layout in plan and section view showing the arrangement of equipment and all details of each elevator unit specified including:
   a. Complete layout showing location of storage tank/pump assembly, controller, piping layout, outside diameter of cylinder/plunger assembly, size of car platform, car frame members and support assembly.
   b. Car, guide rails, brackets, buffers and other components located in hoistway.
   c. Rail bracket spacing and maximum vertical forces on guide rails in accordance with H-18-8 for Seismic Risk Zone 2 or greater.
   d. Reaction at points of support and buffer impact loads.
   e. Weight of principal parts.
   f. Top and bottom clearances and over travel of the car.
   g. Location of main line switch/shunt trip circuit breaker, switchboard panel, light switch and feeder extension points in the machine room.
2. Drawings of hoistway entrances and doors showing details of construction and method of fastening to the structural members of the building.
   a. If drywall construction is used to enclose hoistway, submit details of interface fastenings between entrance frames and drywall.
   b. Sill details including sill support.

D. Samples:
   1. One each of stainless steel, 75 mm x 125 mm (3 in. x 5 in.).
   2. One each of baked enamel, 75 mm x 125 mm (3 in. x 5 in.).
   3. One each of color floor covering.
   4. One each of protection pads, 75 mm x 125 mm (3 in. x 5 in.) if used.
   5. One each car and hoistway Braille plate sample.
   6. One each car and hall button sample.
   7. One each car and hall lantern/position indicator sample.
   8. One each wall and ceiling material finish sample.
   9. One each car lighting sample.

E. Name of manufacturer, type or style designation and applicable data of the following equipment must be shown on the elevator layouts:
   1. Storage tank/pump assembly.

2. Pump and motor, HP and RPM rating, Voltage, Starting and Full Load Ampere, Number of phases and Gallons per minute.
3. Controller.
4. Starters and Overload Current Protection Devices.
5. Car Safety Device; Rupture Valve and Manual Shut Off Valves.
6. Electric Door Operator; HP, RPM, Voltage and Ampere rating of motor.
7. Hoistway Door Interlocks.
8. Car Buffers; maximum and minimum rated load, maximum rated striking speed and stroke.
9. Cab Ventilation Unit; HP rating and CFM rating.

F. Complete construction drawings of elevator car enclosure, showing dimensioned details of construction, fastenings to platform, car lighting, ventilation, ceiling framing, top exits and location of car equipment.

G. Complete dimensioned detail of vibration isolating foundations for storage tank/pump assembly.

H. Dimensioned drawings showing details of:
1. All signal and operating fixtures.
2. Car slide guides/roller guides.
3. Hoistway door tracks, hangers and sills.
4. Door operator, infrared curtain units.

I. Cut sheets or drawings showing details of controllers and supervisory panels.

J. Furnish certificates as required under: Paragraph "QUALIFICATIONS".

**1.6 WIRING DIAGRAMS**

A. Provide three complete sets of paper and one electronic set of field wiring and straight-line wiring diagrams showing all electrical circuits in the hoistway, machine room and fixtures. Install one set coated with an approved plastic sealer and mounted in the elevator machine room as directed by the Resident Engineer/Contracting Officer or authorized representative.

B. In the event field modifications are necessary during installation, diagrams must be revised to include all corrections made prior to and during the final inspection. Corrected diagrams must be delivered to the Resident Engineer/Contracting Officer within 30 days of final acceptance.

C. Provide the following information relating to the specific type of microprocessor controls installed:

1. Owner's information manual, containing job specific data on major components, maintenance and adjustment.
2. System logic description.
3. Complete wiring diagrams needed for field troubleshooting, adjustment, repair and replacement of components. Diagrams must be base diagrams, containing all changes and additions made to the equipment during the design and construction period.
4. Changes made during the warranty period must be noted on the drawings in adequate time to have the finalized drawings reproduced for mounting in the machine room no later than six months prior to the expiration of the warranty period.

**1.7 PERFORMANCE STANDARDS**

A. The elevators must meet the highest standards of the industry and specifically the following:
   1. Contract speed is high speed in either direction of travel with rated capacity load in the elevator. Speed variation under all load conditions, regardless of direction of travel, must not vary more than five (5) percent.
   2. The controlled rate of change of acceleration and retardation of the car must not exceed 0.1G per ft/s/s and the maximum acceleration and retardation must not exceed 0.2G per ft/s/s.
   3. Starting, stopping and leveling must be smooth and comfortable without appreciable steps of acceleration and deceleration.

B. The door operator must open the car door and hoistway door simultaneously at 2.5-feet per second and close at 1-foot per second.

C. Pressure: Fluid system components must be designed and factory tested for 500 psi operating pressure.

D. Floor level stopping accuracy must be within 3 mm (.125 in.) above or below the floor, regardless of load condition.

E. Noise and Vibration Isolation: All elevator equipment including their supports and fastenings to the building, must be mechanically and electrically isolated from the building structure to minimize objectionable noise and vibration transmission to car, building structure, or adjacent occupied areas of building.

F. Sound Isolation: Noise level relating to elevator equipment operation in machine room must not exceed 80 decibels. All db readings must be taken three (3) feet off the floor and three (3) feet from equipment.

G. Airborne Noise: Measured noise level of elevator equipment during operation must not exceed 50 decibels in elevator lobbies and 60 decibels inside car under any condition including door operation and car ventilation exhaust blower on its highest speed.

**1.8 WARRANTY**

A. Submit all labor and materials furnished regarding elevator system and installation to terms of "Warranty of Construction" articles of FAR clause 52.246-21. The One-Year Warranty and Guarantee Period of Service must commence and run concurrent after final inspection, completion of performance test and upon acceptance of each elevator.

B. During warranty period if a device is not functioning properly in accordance with specification requirements, more maintenance than the contract requires keeping device operational, device must be removed and a new device meeting all requirements must be installed as part of work until satisfactory operation of installation is obtained. Period of warranty must start anew for such parts from date of completion of each new installation performed, in accordance with foregoing requirements.

**1.9 POWER SUPPLY**

A. For power supply in each machine room, see Specification 26 05 19, Electrical specifications and Electrical drawings.

B. Main Line Fused Disconnect Switch/Shunt Trip Circuit Breaker for each controller must be located inside the machine room at the strike side of the machine room door and lockable in the “Off” position.

C. Provide Surge Suppressors to protect the elevator equipment.

**1.10 EMERGENCY POWER SUPPLY**

A. Emergency power supply, its starting means, transfer switch for transfer of elevator supply from normal to emergency power, two pair of conductors in a conduit from an auxiliary contact on the transfer switch (open or close contacts as required by Elevator Controller Manufacturer) to terminals in the group elevator controller and other related work must be provided by the Electrical Contractor.

B. Upon loss of normal power supply there must be a delay before transferring to emergency power of 10 seconds minimum to 45 seconds maximum, the delay must be accomplished through an adjustable timing device.

C. Prior to the return of normal power an adjustable timed circuit must be activated that will cause all cars to remain at a floor if already

there or stop and remain at the next floor if in flight. Actual transfer of power from emergency power to normal building power must take place after all cars are stopped at a floor with their doors open.

D. Car lighting circuits must be connected to the emergency power panel.

**1.11 ELEVATOR MACHINE ROOM**

A. Reuse existing machine room and meet the requirements of ASME A17.1, NFPA 70, NFPA 101 and IBC. The elevator drive machine and elevator controller must be in the same code approved machine room.

B. Locate the shunt trip breakers and machine room light switch to the lock side of the door inside the room.

C. Locate sprinkler pipes to provide seven (7) feet head clearance. Do not locate sprinkler heads, heat detectors and smoke detectors directly over elevator equipment.

**1.12 HOISTWAY LIGHTING**

A. Provide lighting with 3-way switches at the top and bottom of the hoistway accessible from elevator hoistway entrance prior to entering the pit or stepping onto the car top.

B. Lighting must illuminate top of elevator cab when it is at the top floor and the pit when at the bottom floor.

**1.13 TOOL CABINET**

A. Provide a metal parts/tool cabinet, having two shelves and hinged doors. Cabinet must be 1219 mm (48 in.) high, 762 mm (30 in.) wide and 457 mm (18 in.) deep.

**1.14 WORK SCHEDULE**

A. Before starting work submit a detailed work schedule for approval and arrange with COR sequence of procedure, means of access to premises, space for storage, use of approaches, corridors, stairways, elevators, location of temporary partitions, disposal of trash and recyclable materials. The COR must be notified twenty (20) calendar days, in writing, in advance of starting work on elevators. No work may begin on any elevator until all materials for that elevator have been delivered to the site and verified by the Contracting Officer and/or Contracting Officer’s Representative. The phasing of work on the elevators must be coordinated with the Contracting Officer and/or the Contracting Officer’s Representative.

**1.15 SAFETY PRECAUTIONS**

A. Buildings will be occupied during execution of work. Work must be conducted in a manner to afford maximum protection of patients, public,

employees, building and facilities to prevent unreasonable delay or interference with normal functioning of hospital activities.

B. Where an adjacent elevator is in operation, isolate the elevators from each other with suitable barriers between them, extending from the pit floor to bottom of secondary slab at top of hoistway, while work is in progress. Remove partition when work is completed.

C. Provide fire extinguishers that are readily available always.

D. It must be the obligation of the contractor to maintain a free and clear passageway in each elevator lobby. Parts and tools must be kept within the confines of entrance partitions. Trash and debris must be removed daily.

E. Provide fire rated partition during the modernization of elevators. Barrier must extend to the full height of the elevator entrance and must be dust and vapor proof with dust absorbing mats at access points.

**1.16 REMOVAL OF MATERIALS AND EQUIPMENT**

A. Material and equipment that are not specified to be reused or retained under contract must be removed daily from the site at the expense of the contractor. The contractor must receive title to all material and equipment not specified to be reused as of date of withdrawal from service. The government does not warranty condition of the material to which contractor must obtain title, nor must the government be liable for damage before or after title passes to contractor.

**PART 2 - PRODUCTS**

**2.1 MATERIALS**

A. Where stainless steel is specified, it must be corrosion resisting steel complying with Fed. Spec. QQ-S-766, Class 302 or 304, Condition A with Number 4 finish on exposed surfaces. Stainless steel must have the grain of belting in the direction of the longest dimension and surfaces must be smooth and without waves. During installation stainless steel surfaces must be protected with a suitable material.

B. Where cold rolled steel is specified, it must be low-carbon steel rolled to stretcher level standard flatness, complying with ASTM A109.

**2.2 MANUFACTURED PRODUCTS**

A. Materials, devices and equipment furnished must be of current production by manufacturers regularly engaged in the manufacture of such items. The elevator equipment, including controllers, door operators and supervisory system must be the product of manufacturers of established reputation, provided such items are capably engineered

and produced under coordinated specifications to ensure compatibility with the total operating system.

B. Manufacturers of equipment assemblies which include components made by others must assume complete responsibility for the final assembled unit. Components must be compatible with each other and with the total assembly for the intended service.

C. Mixing of manufactures related to a single system or group of components must be identified in the submittals.

D. Key operated switches provide for this elevator modernization, must be provide four (4) keys for each individual switch or lock. Provide different key tumblers for different switch and lock functions. Each key must have a tag bearing a stamped or etched legend identifying its purpose.

**2.3 CONDUIT AND WIREWAY**

A. Remove existing and provide new conduit and wireway. Install electrical conductors, except traveling cable connected to the elevator, in rigid zinc-coated steel or aluminum conduit, electrical metallic tubing or metal wireways. Rigid conduit smaller than .75 inch or electrical metallic tubing smaller than .50-inch electrical trade size must not be used. All raceways completely embedded in concrete slabs, walls, or floor fill must be rigid steel conduit. Wireway (duct) must be installed in the hoistway and to the controller and between similar apparatus in the elevator machine room. Fully protect self-supporting connections, where approved, from abrasion or other mechanical injury. Flexible metal conduit not less than .375-inch electrical trade size may be used, not exceeding 18 inches in length unsupported, for short connections between risers and limit switches, interlocks and for other applications permitted by NEC.

B. All conduits terminating in steel cabinets, junction boxes, wireways, switch boxes, outlet boxes and similar locations must have approved insulation bushings. Install a steel lock nut under the bushings if they are constructed completely of insulating materials. Protect the conductors at ends of conduits not terminating in steel cabinets or boxes by terminal fittings having an insulated opening for the conductors.

C. Rigid conduit and EMT fittings using set screws or indentations as a means of attachment must not be used.

D. Connect motors or other items subject to movement, vibration or removal to the conduit or EMT systems with flexible, steel conduits.

**2.4 CONDUCTORS**

A. Remove existing and provide new. Conductors must be stranded or solid coated annealed copper in accordance with Federal Specification J-C-30B for Type RHW or THW. Where 16 and 18 AWG are permitted by NEC, single conductors or multiple conductor cables in accordance with Federal Specification J-C-580 for Type TF may be used provided the insulation of single conductor cable and outer jacket of multiple conductor cable is flame retardant and moisture resistant. Multiple conductor cable must have color or number coding for each conductor. Conductors for control boards must be in accordance with NEC. Joints or splices are not permitted in wiring except at outlets. Tap connectors may be used in wireways provided they meet all UL requirements.

B. Provide all conduit and wiring between machine room, hoistway and fixtures.

C. All wiring must test free from short circuits or ground faults. Insulation resistance between individual external conductors and between conductors and ground must be a minimum of one megohm.

D. Where size of conductors is not given, voltage and amperes must not exceed limits set by NEC.

E. Provide equipment grounding. Ground the conduits, supports, controller enclosure, motor, platform and car frame and all other non-current conducting metal enclosures for electrical equipment in accordance with NEC. The ground wires must be copper, green insulated and sized as required by NEC. Bond the grounding wires to all junction boxes, cabinets and wire raceways.

F. Terminal connections for all conductors used for external wiring between various items of elevator equipment must be solderless pressure wire connectors in accordance with Federal Specification W-S-610. The Elevator Contractor may, at his option, make these terminal connections on #10 gauge or smaller conductors with approved terminal eyelets set on the conductor with a special setting tool, or with an approved pressure type terminal block. Terminal blocks using pierce-through serrated washers are not acceptable.

**2.5 TRAVELING CABLES**

A. Remove existing and provide new flexible traveling cables conforming to the requirements of NEC. Traveling cables must run from the junction

box on the car directly to the controller. Junction boxes on the car must be equipped with terminal blocks. Terminal blocks having pressure wire connectors of the clamp type that meet UL 486A requirements for stranded wire may be used in lieu of terminal eyelet connections. Terminal blocks must have permanent indelible identifying numbers for each connection. Cables must be securely anchored to avoid strain on individual terminal connections. Flame and moisture resistant outer covering must remain intact between junction boxes. Abrupt bending, twisting and distortion of the cables must not be permitted.

B. Provide spare conductors equal to 10 percent of the total number of conductors furnished, but not less than 5 spare conductors in each traveling cable.

C. Provide shielded wires for the auto dial telephone system within the traveling cable, five (5) pair shielded wires for card reader, one (1) RG-6 Ethernet cable for Wi-FI, two (2) pair 14-gauge wires for 110 Volt power supply and wire for video display monitor if specified.

D. If traveling cables contact the hoistway or elevator due to sway or change in position, provide shields or pads to the elevator and hoistway to prevent damage to the traveling cables.

E. Hardware cloth may be installed from the hoistway suspension point to the elevator pit to prevent traveling cables from rubbing or chafing and securely fastened and tensioned to prevent buckling. Hardware cloth is not required when traveling cable is hung against a flat wall.

**2.6 CONTROLLER AND SUPERVISORY PANEL**

A. Remove existing and provide new UL/CSA Labeled Controller. Mount all assemblies, power supplies, chassis switches and relays on a steel frame in a NEMA Type 1 General Purpose Enclosure. Cabinet must be securely attached to the building structure.

B. Properly identify each device on all panels by name, letter, or standard symbol which must be neatly stencil painted or decaled in an indelible and legible manner. Identification markings must be coordinated with identical markings used on wiring diagrams. The ampere rating must be marked adjacent to all fuse holders. All spare conductors to controller and supervisory panel must be neatly formed, laced and identified.

**2.7 MICROPROCESSOR CONTROL SYSTEM**

A. Provide a microprocessor control system with absolute position/speed feedback to control dispatching, signal functions, door operation and

pump motor control. Complete details of the components and printed circuit boards, together with a complete operational description, must be submitted for approval. Provide closed transition SCR soft start.

B. Controller manufacturer must provide factory training, engineering and technical support, including all manuals, wiring diagrams and tools necessary for adjusting, maintenance, repair and testing of equipment to the VA for use by the VA's designated Elevator Maintenance Service Provider.

C. Microprocessor dispatching system must evaluate building traffic demand including number of elevators in service, hall calls, car calls, elevator position, direction of travel, load in elevator, door status and select an elevator to answer hall calls for least possible passenger wait times.

D. Provide a low oil control feature that must shut off the motor and pump and return the elevator to the lowest landing. Upon reaching the lowest landing, doors will open automatically allowing passengers to leave the elevator and then doors must close. All control buttons, except the door open button, alarm bell button and the call for help button must be made ineffective.

**2.8 MACHINE ROOM MONITOR**

A. Provide a monitor in each machine room, separate monitors for each passenger elevator group and each service elevator group. Provide a separate keyboard for each monitor.

B. The monitor must contain indicators to provide the following information:

1. The floor where each elevator is currently located.
2. The direction that each elevator is currently traveling or is scheduled to travel.
3. The location and direction of currently registered hall calls.
4. Elevators that are currently out of service.
5. Elevators that are currently bypassing hall calls.
6. Elevators that are currently engaged in passenger transfers.
7. Operations program under which entire group is currently operating.
8. Zone divisions of the entire group.
9. Door positions.
10. Status indication for elevators on independent service, car top inspection, fire service, earthquake protection and activated stop switch and alarm bell.

C. The maintenance terminal must be suitable for all troubleshooting procedures related to the specific type of microprocessor installed on this project.

**2.9 EMERGENCY POWER OPERATION**

A. Emergency Rescue Operation:
Provide a power source to send the elevator to the lowest landing. After the elevator has leveled at the lowest landing, provide power to open the car and hoistway doors automatically. After a predetermined time, the doors must close. Power must stay applied to the door open button to reopen the doors from the inside of the elevator. The elevator must remain shut down at the bottom landing until normal power is restored. Install a sign on the controller indicating that power is applied to emergency rescue operator and door operator during loss of normal power.

**2.10 FIREFIGHTER'S SERVICE**

A. Provide Firefighter's Service. All key switches must be barrel-key FEOK1.
   1. Main Floor:
   2. Alternate Floor:
   3. Verify main and alternate floors with RE/CO or authorized representative.

**2.11 INDEPENDENT SERVICE**

A. Provide an INDEPENDENT SERVICE // key switch on the face of the main car operating panel // or a toggle switch in the service operating panel // that must have its positions marked "ON" and "OFF". When the switch is in the "ON" position, the car must respond only to calls registered on its car dispatch buttons and must bypass all calls registered on landing push buttons. The car must start when a car call is registered, car call button or door close button is pressed, car and hoistway doors are closed and interlock circuits are made. When switch is returned to "OFF" position, normal service must be resumed.

**2.12 MEDICAL EMERGENCY SERVICE – PATIENT CARE FACLITIES ONLY**

A. Provisions must be made for calling elevator(s) to floors served by the elevator on an emergency basis, operating independently from the dispatch signals and landing call signals.

B. Install key switches in the floor landing push button fixture above the push buttons.

C. Provide a call registered light indicator adjacent to key switch. The key switch at the landings and in the car, must only be operable by authorized personnel with a key.

D. When key switch is activated at any floor, the call register light indicator must illuminate at the call floor and inside the elevator only. The elevator control system must instantly select an elevator to respond to the medical emergency call. Immediately upon selection, all car calls must be cancelled. If car is traveling away from the medical emergency call, it must slow down and stop at the nearest floor, maintain closed doors, reverse direction and proceed nonstop to the medical emergency call floor. If the car is traveling toward the medical emergency call floor, it must proceed to that floor nonstop. If at the time of selection, it is slowing down for a stop, the car must stop, maintain doors closed and start immediately toward the medical emergency floor.

E. Arriving at the medical emergency floor, the car must remain with doors open for 60 seconds. After this interval has expired and the car has not been placed on medical emergency operation inside the car, the car must automatically return to normal service.

F. Provide an LED illuminated indicator light next to the Medical Emergency key switch the same size as the Fire Service indicator.

   1. Locate a “Medical Emergency” key switch above call buttons in the main car operating panel for selecting medical emergency service. Activation of the key switch will allow the car to accept a car call for any floor, close doors and proceed nonstop to the floor desired.
   2. After medical emergency call has been completed the elevator must return to normal operation after the key is removed.

G. In the center of the rear cab panel provide a back lighted "MEDICAL EMERGENCY" LED illuminated display that must flash on and off continuously when the car is assigned to this operation and until it is restored to normal service. "MEDICAL EMERGENCY" indicator must be a photographic negative type 1828 mm (72 in.) to center above the floor, 152 mm (6 in.) wide X 76 mm (3 in.) high, with 12.5 mm (.50 in.) high letters legible only when illuminated.

H. If the car being operated on “Independent Service”, the medical emergency service indicator lights in the car operating panel and rear

wall must be illuminated, buzzer must sound and the "Audio Voice" system must direct the attendant to return the car to automatic operation.

I. If the car is out of service and unable to answer medical emergency calls, the call register light must not illuminate.

J. Each key switch must have its identity legible and indelible engraved in faceplates. All lettering must be 6 mm (.25 in.) high, filled with black paint.

K. When Phase I fire recall is activated, it must over-ride elevators on medical emergency service and return them to the main or alternate fire service recall floor. When the fire emergency floor has been identified the attendants may complete their medical emergency run on Phase II firefighter's operation if life safety is not affected.

**2.14 PUMP, MOTOR AND VALVE ASSEMBLY**

A. Provide new pump assembly for the control of the elevator self-contained in a unit fabricated of structural steel. The unit must consist of a hydraulic fluid pump, AC motor, oil control valves with down speed regulator, muffler, piping and fittings.

B. Submersible pump with the motor and oil control valve mounted above the tank are preferred to eliminate heat from the motor being transferred to the oil. Submersible motor and pump power units are acceptable but are best suited for lower traffic areas. Enclose V-belt power unit on four open sides with not less than 16-gauge steel removable panel sections. Provide a 50 mm (2 in.) minimum, 100mm (4 in.) maximum air space between the top of the panels and bottom of tank. Line panels on the interior side with one-inch rigid acoustical insulation board. Install metal belt guard that can be removed with hand tools for servicing and inspection.

C. Control valves must be electronically controlled. Hydraulic fluid flow must be controlled to insure speed variation of not more than five (5) percent under all load conditions in either direction of travel. Locate the manual lowering valve, easily accessible, properly identified and not concealed within the storage tank. Mark the operating handle in red.

D. Pump must be designed for hydraulic elevator service, having a steady discharge without pulsation to give smooth and quiet operation. Pump output must be capable of lifting elevator car with rated capacity, with a speed variation of no more than five (5) percent between no load

and full load. Hydraulic fluid by-pass must discharge directly into storage tank.

E. Provide motor specifically designed for elevator service, synchronous speed of 1800 RPM, not to exceed nameplate full load current by more than 10% and rated 120 starts per hour without exceeding a rise of 40 degrees C.

F. Provide isolation pads to prevent transmission of pump and motor vibration to the building.

G. Install blowout-proof, non-hammering, oil-hydraulic muffler in the hydraulic fluid supply pressure line near power unit in machine room. Design muffler to reduce to a minimum any pulsation or noises that may be transmitted through the hydraulic fluid into the hoistway.

**2.15 HYDRAULIC SYSTEM**

A. Construct the storage tank of sheet steel, welded construction and a steel cover with means for filling, a minimum one-inch protected vent opening and a valve drain connection. Tank must be sized to pass through machine room door as shown on drawings. Provide marked gauge to monitor hydraulic fluid level. Tank must be sized to hold volume of hydraulic fluid required to lift elevator to stop ring, plus a reserve of not less than ten gallons. Provide a baffle in the bottom of the tank to prevent entry of any sediment or foreign particles into hydraulic system. Baffle must also minimize aeration of hydraulic fluid. Permissible minimum hydraulic fluid level must be clearly indicated. Hydraulic fluid must be of good grade to assure free flow when cool and have minimum flash point of 380-400 degrees F. Provide initial supply of hydraulic fluid for operation of elevator.

1. Provide a means to maintain the fluid viscosity in the reservoir, pump and control valve at the manufacturer’s recommended operating temperature.
2. Provide a data plate on the tank frame indicating the characteristics of the hydraulic fluid used.

B. Provide and install connections between the storage tank, pump, muffler, operating valves and cylinder complete with necessary valves, pipe supports and fittings. Pipe must be minimum schedule 40 steel with threaded, flanged, or welded mechanical couplings. Size of pipe and couplings between cylinder and pumping unit must be such that fluid pressure loss is limited to 10 percent.

C. Hydraulic system working pressure must not exceed 500 psi under any load condition. Do not subject valves, piping and fittings to working pressure greater than those recommended by the manufacturer.

D. Support all horizontal piping. Place hangers or supports within 300 mm (12 in.) on each side of every change of direction of pipeline and space supports not over 304.8 cm (10 ft) apart. Secure vertical runs properly with iron clamps at sufficiently close intervals to carry weight of pipe and contents. Provide supports under pipe to floor.

1. Provide all piping from machine room to hoistway, including necessary supports or hangers. If remote piping is underground or in damp inaccessible areas, install hydraulic piping thru PVC sleeve.

E. Install pipe sleeves where pipes pass through walls or floors. After installation of piping, equip the sleeves with snug fitting inner liner of fire rated insulation.

F. Provide an automatic shut-off valve in the oil supply line at the cylinder inlet. Activate the automatic shut-off valve when there is more than a ten percent increase in high speed in the down direction. When activated, this device must immediately stop the descent of the elevator and hold the elevator. The exposed adjustments of the automatic shut-off valve must have their means of adjustment sealed after being set to their correct position.

G. Provide external tank shut-off valve to isolate hydraulic fluid during maintenance operations.

H. Provide shut-off valves in the pit near the cylinder and in the machine room capable of withstanding 150 percent of design operating pressure. Each manual valve must have an attached handle.

I. Provide oil-tight drip pan for assembled pumping unit, including storage tank. Pan must be not less than 16-gauge sheet steel, with one-inch sides.

J. Components of the hydraulic system must be factory certified to withstand pressure equal to twice the calculated working pressure.

**2.16 HYDRAULIC PLUNGER ASSEMBLY**

A. Reuse existing plunger assembly or provide new.

**2.18 CAR BUFFERS**

A. Provide two new spring buffers for the elevator. Securely fasten buffers and supports to the pit channels and in the alignment with striker plates on elevator. Buffers must have a permanently attached

metal plate indicating its stroke and load rating. Buffer anchorage must not puncture pit waterproofing. Reuse existing if possible.

B. Provide pipe stanchions and struts as required to properly support the buffer.

**2.19 GUIDE RAILS, SUPPORTS AND FASTENINGS**

A. Reuse existing. Clean, replace missing bolts and tighten as needed.

**2.20 NORMAL AND FINAL TERMINAL STOPPING DEVICES**

A. Mount new terminal slowdown switches and direction limit switches on the elevator or in hoistway to reduce speed and bring car to an automatic stop at the terminal landings.

1. Switches must function with any load up to and including 100 percent of rated elevator capacity at any speed obtained in normal operation.
2. Switches, when opened, must permit operation of elevator in reverse direction of travel.

B. Mount final terminal stopping switches in the hoistway.

1. Switches must be positively opened should the car travel beyond the terminal direction limit switches.
2. Switches must be independent of other stopping devices.
3. Switches, when opened, must remove power from pump motor and control valves preventing operation of car in either direction.

**2.21 CROSSHEAD DATA PLATE AND CODE DATA PLATE**

A. Permanently attach a non-corrosive metal Data Plate to car crosshead.

B. Permanently attach a Code Data Plate, in plain view, to the controller.

**2.22 WORKMAN'S LIGHTS AND OUTLETS**

A. Provide duplex GFCI protected type receptacles and lamp, with guards on top of elevator car and beneath platform.

B. The receptacles must be in accordance with Fed. Spec. W-C-596 for Type D7, 2-pole, 3-wire grounded type rated for 15 amperes and 125 volts.

**2.23 CARTOP OPERATING DEVICE**

A. Provide a new cartop operating device.

B. The device must be activated by a toggle switch mounted in the device. The switch must be clearly marked "INSPECTION" and "NORMAL" on the faceplate, with 6 mm (.25 in.) letters.

C. Movement of the elevator must be accomplished by the continuous pressure on a direction button and a safety button.

D. Provide an emergency stop switch, push to stop/pull to run.

E. Provide permanent identification for the operation of all components in the device.

F. The device must be permanently attached to the elevator crosshead on the side of the elevator nearest to the hoistway doors used for accessing the top of the car.

**2.24 LEVELING DEVICE**

A. Car must be equipped with a new two-way leveling device to automatically bring the car to within 3 mm (.125 in.) of exact level with the landing for which a stop is initiated regardless of load in car or direction of travel.

B. If the car stops short or travels beyond the floor, the leveling device, within its zone must automatically correct this condition and maintain the car within 3 mm (.125 in.) of level with the floor landing regardless of the load carried.

**2.25 EMERGENCY STOP SWITCHES**

A. Provide an emergency stop switch, push to stop/pull to run, for the top-of-car device, pit, machine spaces, service panel and firefighter's control panel inside the elevator. Mount stop switches in the pit adjacent to pit access door, at top of the pit ladder 1219 mm (48 in.) above the bottom landing sill and 1219 mm (48 in.) above the pit floor adjacent to the pit ladder.

B. Each stop switch must be red in color and must have "STOP" and "RUN" positions legibly and indelibly identified.

**2.26 MAIN CAR OPERATING PANEL**

A. Provide new main car operating panel in the car enclosure on the front return panel for passenger/service elevators. The top floor car call push button must not be more than 1219 mm (48 in.) above the finished floor. "Vandal Resistant" car push buttons and indicator lights must be LED illuminated, round with a minimum diameter of 25 mm (1 in.). Each button must contain an integral registration LED white light which must illuminate upon registration of a call and must extinguish when that call is answered.

B. One-piece hinged front faceplate with edges beveled 15 degrees must have the firefighter's service panel recessed into the upper section and the service operation panel recessed into the lower section fitted with hinged doors. Doors must have concealed hinges, be in the same front plane as the faceplate and fitted with cylinder type key operated locks. Secure the faceplate with stainless steel tamperproof screws.

C. All terminology and tactile symbols on the faceplate must be on square or rectangular plates recessed into the faceplate with its surface flush with the surface of the faceplate. Use 6 mm (.25 in.) letters to identify all devices in the faceplate. The handicapped markings with contrasting background must be 12.5 mm (.50 in.) high raised .075 mm (.030 in.) on the plate. Surface mounted plates are not acceptable.

D. The upper section must contain the following items in order listed from top to bottom:

1. Elevator number, 12.5 mm (.50 in.) high with black paint for contrast.
2. Capacity plate information with black paint for contrast with freight loading class and number of passengers allowed.
3. LED illuminated digital car position indicator with direction arrows.
4. Emergency car lighting system consisting of a rechargeable battery, charger, controls and LED illuminated light fixture. The system must automatically provide emergency light in the car upon failure or interruption of the normal car lighting service and function irrespective of the position of the light control switch in the car. The system must maintain a minimum illumination of 1.0 foot-candle when measured 1219 mm (48 in.) above the car floor and approximately 305 mm (12 in.) in front of the car operating panel, for not less than four (4) hours.
5. Firefighter’s Emergency Operation Panel must be 1650 mm (66 in.) minimum to 1828 mm (72 in.) maximum to the top of the panel above finished floor.
6. Firefighter’s Emergency Indicator Light must be round with a minimum diameter of 25 mm (1 in.).
7. Medical Emergency key switch marked “MEDICAL EMERGENCY” with two positions labeled “ON” and “OFF” and Medical Emergency Indicator Light located next to the key switch must be round with a minimum diameter of 25 mm (1 in.). Instruction for Medical Emergency operation must be adjacent to the key switch and light.
8. Key operated Independent Service Switch on the face of panel.
9. Provide a Door Hold Button on the faceplate above the call buttons. It must have “DOOR HOLD” indelibly marked on the button. Button must light when activated. When activated, the door must stay open for a

maximum of one minute. To override hold timer, push a car call button or door close button.

10. Provide round “Vandal Resistant” car push buttons and indicator lights, minimum diameter of 25 mm (1 in.) and LED illuminated, corresponding to the floors served. Car call buttons must be legibly and indelibly identified by a floor number, letter or symbol not less than 12.5 mm (.50 in.) high in the face of the button or indicator.
11. Door Open and Door Close buttons must be located below the car call buttons. They must have “OPEN” and “CLOSE” legibly and indelibly identified by letters in the face of the respective button. The Door Open button must be located closest to the door jamb.
    a. Rear Door Open and Rear Door Close buttons must be located below the Front Door Open and Front Door Close buttons. They must have “REAR OPEN” and “REAR CLOSE” legibly and indelibly identified by letters in the face of the respective button.
12. Red Emergency Alarm button that must be located below the car operating buttons. Mount the emergency alarm button not lower than 875 mm (35 in.) above the finished floor. It must be connected to audible signaling devices. Provide audible signaling devices including the necessary wiring.
13. Emergency Help push button must activate two-way communications by Auto Dial telephone system that is compatible with the VAMC’s telephone system. Help button must be LED white light illuminated and flash when call is acknowledged. Legibly and indelibly label the button “HELP” in the face of the button with 12.5 mm (.50 in.) high letters.

E. The service operation panel, in the lower section must contain the following items:
    1. Light switch labeled “LIGHTS” for controlling interior car lighting with its two positions marked “ON” and “OFF”.
    2. Inspection switch that will disconnect normal operation and activate hoistway access switches at terminal landings. Switch must be labeled “ACCESS ENABLE” with its two positions marked “ON” and “OFF”.
    3. Three position switch labeled “FAN” with its positions marked “HIGH”, “LOW” and “OFF” for controlling car ventilating blower.

4. Two position, spring return, toggle switch or push button to test the emergency light and alarm device. It must be labeled “TEST EMERGENCY LIGHT AND ALARM”.
5. Independent service switch labeled “ON” AND “OFF”. (Delete if key switch on face of panel).
6. Two-position emergency stop switch, when operated, must interrupt power supply and stop the elevator independently of regular operating devices. Emergency stop switch must be marked “PUSH TO STOP” and “PULL TO RUN”.

**2.27 AUXILIARY CAR OPERATING PANEL**

A. Provide an auxiliary car operating panel in the // front return panel opposite the main car operating panel. The auxiliary car operating panel must contain only those controls essential to passenger (public) operation. The auxiliary car operating panel faceplate must match the main car operating panel faceplate in material and general design. Secure the faceplate with stainless steel tamperproof screws.

1. Provide round “Vandal Resistant” car push buttons and indicator lights, minimum diameter 25 mm (1 in.) and LED illuminated corresponding to the floors served. Car buttons and indicator lights must be legibly and indelibly identified by a floor number, letter, or symbol not less than 12.5 mm (.50 in.) high in the face of the button or indicator light corresponding to the main car operating panel buttons or indicator light.
2. Door "OPEN" and door "CLOSE" buttons closest to the door jamb and mount the alarm button no lower than 889 mm (35 in.) above the finished floor. The Door Open button must be located closest to the door.
3. Cross-connect all buttons in the auxiliary car operating panels to their corresponding buttons in the main car operating panel. Registration of a car call must cause the corresponding button to illuminate in the main and auxiliary car operating panel.
4. Emergency Help push button must activate two-way communications by auto dial telephone that is compatible with the VAMC’s telephone system. Help button must be LED white light illuminated and flash when call is acknowledged. Legibly and indelibly label the button “HELP” in the face of the button with 12.5 mm (.50 in.) high letters.

B. All terminology and tactile symbols on the faceplate must be on square or rectangular plates recessed into the faceplate with its surface flush with the surface of the faceplate. Use 6 mm (.25 in.) letters to identify all devices in the faceplate. The tactile symbols with contrasting background must be 12.5 mm (0.5 in.) high raised .075 mm (.030 in.) on the plate. Surface mounted plates are not acceptable.

**2.28 CAR POSITION INDICATOR**

A. Provide an alpha-numeric digital car position indicator in the main car operating panel, consisting of numerals and arrows 63 mm (2.5 in.) high, to indicate position of car and direction of car travel. Locate position indicator at the top of the main car operating panel, illuminated by light emitting diodes.

**2.29 AUDIO VOICE SYSTEM**

A. Provide digitized audio voice system activated by stopping at a floor. Audio voice must announce floor designations, direction of travel and special announcements. The voice announcement system must be a natural sounding human voice that receives messages and must comply with ADA requirements for audible car position indicators. The voice announcer must have two separate volume controls, one for the floor designations and direction of travel and another for special announcements. The voice announcer must have a full range loudspeaker, located on top of the cab. The audio voice unit must contain the number of ports necessary to accommodate the number of floors, direction messages and special announcements. Install voice announcer per manufacturer’s recommendations and instructions. The voice system must be the product of a manufacturer of established reputation. Provide manufacturer literature and list of voice messages.

1. Fire Service Message.
2. “Please do not block doors”.
3. Provide special messages as directed by COR.

**2.30 AUTO DIAL TELEPHONE SYSTEM**

A. Provide a complete, ADA compliant, auto dial communication system that is compatible with the VAMC’s telephone system.

B. Two-way communication device shall be in full compliance with ASME A17.1 Rule 2.27.1.1 (2019) or later editions.

**2.31 CORRIDOR OPERATING DEVICES**

A. Provide new corridor operating device faceplates from not less than 3 mm (.125 in.) thick flat stainless steel with all edges beveled 15 degrees.

B. Corridor push button faceplates must be sized to cover existing openings in the walls. The centerline of the landing push buttons must be 1067 mm (42 in.) above the corridor floor.

C. Elevator Corridor Call Station Pictograph must be engraved in the faceplate.

D. Fasten all car and corridor operating device and signal device faceplates with stainless steel tamperproof screws.

E. All terminology and tactile symbols on the faceplate must be raised .030 inch with contrasting background, on square or rectangular plates recessed into the faceplate with its surface flush with the surface of the faceplate. The handicapped markings with contrasting background must be 12.5 mm (0.5 in.) high raised .075 mm (.030 in.) on the plate, square or rectangular. Use 6 mm (.25 in.) letters to identify all other devices in the faceplate. Surface mounted plates are not acceptable.

F. Provide one riser of landing call buttons for each elevator or group of elevators as shown on contract drawings.

G. “Vandal Resistant” hall buttons and indicator lights must be LED illuminated upon registration of a call and shall extinguish when that call is answered.

H. The direction of each button must be legibly and indelibly identified by arrows not less than 12.5 mm (.50 in.) high in the face of each button. Provide a corresponding Braille plate on the left side of each button.

I. Hall call buttons must not re-open the doors while the car and hoistway doors are closing at that floor, the call must be registered for the next available elevator. Calls registered must be canceled if closing doors are re-opened by means of "DOOR OPEN" button or infrared curtain unit.

J. Provide emergency power indicator light, fire service recall key switch and indicator light, fire recall instruction, communication failure light, audible enunciator and reset key switch in the fixture at the designated main floor.

K. Remove old fixtures, repair and refinish walls.

L. Submit design of hall pushbutton fixtures for approval.

**2.32 CORRIDOR ARRIVAL LANTERN/POSITION INDICATOR**

A. Provide new combination corridor lantern/position indicator digital display mounted over the hoistway entrances at each floor in healthcare facilities. For non-healthcare facilities provide combination fixtures only at main and alternate fire recall floors. Provide each terminal landing with "UP" or "DOWN", minimum 63 mm (2.5 in.) high digital arrow lanterns and each intermediate landing with "UP" and "DOWN" digital arrow lanterns. Each lens must be LED illuminated of proper intensity, so shielded to illuminate individual lens only. The lenses in each lantern must be illuminated green to indicate "UP" travel and red to indicate "DOWN" travel. Lanterns must signal in advance of car arrival at the landing indicating the direction of travel. Corridor lanterns must not be illuminated when a car passes a floor without stopping. Each lantern must be equipped with an audible electronic chime which must sound once for "UPWARD" bound car and twice for "DOWNWARD" bound car. Audible signal must not sound when a car passes the floor without stopping. Provide adjustable sound level on audible signal. Car riding lanterns are not acceptable.

B. Install alpha-numeric digital position indicator between the arrival lanterns. Indicator faceplate must be stainless steel. Numerals must be not less than 63 mm (2.5 in.) high with direction arrows. Cover plates must be readily removable for re-lamping. The appropriate direction arrow must be illuminated during entire travel of car in corresponding direction.

C. Remove old fixtures, repair and refinish walls.

**2.33 HOISTWAY ACCESS**

A. Provide new n hoistway access switches for elevator at top terminal landing to permit access to top of car and at bottom terminal landing to permit access to pit. Elevators with side slide doors, mount the access key switch 182.9 cm (6 ft) above the corridor floor in the wall next to the strike jamb.

B. Exposed portion of each access switch or its faceplate must have legible, indelible legends to indicate "UP", "DOWN" and "OFF" positions.

C. Each access switch must be a constant pressure cylinder type lock having not less than five pins or five stainless steel disc combination with key removable only when switch is in the "OFF" position.

D. Lock must not be operable by any other key which will operate any other lock or device used for any other purpose at the VA Medical Center.

E. Arrange the hoistway switch to initiate and maintain movement of the car. When the elevator is operated in the down direction from the top terminal landing, limit the zone of travel to a distance not greater than the top of the car crosshead level with the top floor. Submit design and location of access switches for approval.

F. Provide emergency access for all hoistway entrances, keyways for passenger and service elevators.

**2.34 HOISTWAY ENTRANCES: PASSENGER/SERVICE ELEVATORS**

A. Clad existing entrance frames in stainless steel.

B. Clean and reuse existing hoistway sills, hanger supports, strut angles, fascia plates and toe guards.

C. Replace all damaged or missing dust covers.

D. Provide new stainless steel hoistway doors. Door panels must be flush hollow metal construction, not less than 32 mm (1.25 in.) thick, consisting of one continuous piece 16-gauge stainless steel on corridor side wrapped around the leading edge. Separate two plates by a sound-deadening material and reinforce by steel shapes welded to the plates at frequent intervals. Reinforce panels as required for installation of hangers, power-operating and door-opening devices. Top and bottom of door panels must have continuous stiffener channels welded in place. Reinforcement of the door panels must be a minimum of 1.0 mm (0.04 in.) in thickness and of the hat section type.

E. Hang doors on two-point suspension hangers having sealed ball-bearing sheaves not less than 76 mm (3 in.) in diameter, with non-metallic sound-reducing tires. Equip hangers with adjustable ball-bearing rollers to take upward thrust of panels. Provide two removable non-metallic door gibs of approved material and a separate fire gib at the bottom of each door panel. Gibs must be replaceable without removing of door panel. One door panel for each entrance must bear a BOCA label, Underwriters' label, or other labels may be furnished provided they are based on fire test reports and factory inspection procedures acceptable to the COR. Fasten stainless steel sight guard of 14-gauge metal, extending full height of panel, to leading edge of fast speed panel of two-speed doors.

F. Provide new hardware, tracks, gibs, separate fire gibs, door rollers, door locks, drive roller assemblies and sill mounted closers or spirators.

G. Reuse Braille plates on both sides of door frame entrances located 1523 mm (60 in.) to center above finished floor. Replace damaged or missing Braille plates.

H. Provide unique car number on every elevator entrance at designated main fire service floor level, minimum 76 mm (3 in.) in height.

I. Equip each hoistway entrance with new electrical/mechanical interlock, functioning as hoistway unit system, to prevent operation of elevator until all hoistway doors are locked in the closed position unless car is operating in the leveling zone or hoistway access switch is used.

J. Wiring installed from the hoistway riser to each door interlock must be NEC type SF-2 or equivalent.

**2.35 CAR GUIDES**

A. Provide new adjustable roller guides, each assembled on a substantial metal base, to permit individual alignment to the guide rails.

B. Each guide must consisting of not less than three (3) wheels, each with a durable, resilient oil-resistant material tire rotating on ball bearings having sealed-in lubrication. Assemble rollers on a substantial metal base and mount to provide continuous spring pressure contact of all wheels with the corresponding rail surfaces under all conditions of loading and operation. Secure the roller guides at top and bottom on each side of car frame and counterweight frame. All mounting bolts must be fitted with nuts, flat washers, split lock washers and if required, beveled washers.

C. Provide sheet metal guards to protect rollers on top of car and counterweight.

D. Minimum diameter of car rollers must be 150 mm (6 in.). The entire elevator car must be properly balanced to equalize pressure on all guide rollers. Cars must be balanced in post-wise and front-to-back directions. Test for this balanced condition must be witnessed at time of final inspection.

E. Equip car with an auxiliary guiding device for each guide that must prevent the car from leaving the rails if the normal guides fail. These auxiliary guides must not, during normal operation, touch the guiding surfaces of the rails. Fabricate the auxiliary guides from hot rolled steel plate and mount between the normal guide shoes and the car

frames. The auxiliary guides may be an extension of the normal guide shoe mounting plate if that plate is fabricated from hot rolled steel. The portion of the auxiliary guide which must contacts the rail guiding surfaces in the event of loss of the normal guides must be lined with an approved bearing material to minimize damage to the rail guiding surfaces.

**2.36 CAR FRAME: PASSENGER/SERVICE ELEVATORS**

A. Reuse existing car frame. Tighten bolts and replace missing bolts.

**2.37 CAR PLATFORM: PASSENGER/SERVICE ELEVATORS**

A. The platform must be designed to withstand the forces developed under the loading class specified. Provide car entrance with new stainless-steel sill with machined or extruded door guide grooves and recessed for platform guard. Cover underside and all exposed edges of wood filled platform with sheet metal of not less than 26-gauge, with all exposed joints and edges folded under. Fire resistant paint is not acceptable. Platform must have flexible composition flooring not less than 3 mm (.125 in.) thick. For color, see Section 09 06 00, SCHEDULE FOR FINISHES. Adhesive material must be type recommended by manufacturer of flooring. Lay flooring flush with threshold plate and base.

B. Provide a platform guard (toe guard) of not less than 12-guage sheet-steel on the entrance side, extend 76 mm (3 in.) beyond each side of entrance jamb. Securely brace platform guard to car platform and bevel bottom edge at a 60-75-degree angle from horizontal. Square platform sill with the hoistway sills to provide clearance that must not exceed 32 mm (1.25 in.).

C. Provide new isolation pads between the platform and car frame where needed. Use approved rubber pads or other approved material.

D. Provide new or reuse existing adjustable diagonal brace rods to hold platform firmly within car suspension frame.

E. Balance car front to back and side to side. Provide balancing frame and weights, properly located, to achieve the required true balance.

F. Provide a bonding wire between frame and platform.

**2.44 CAR ENCLOSURE: PASSENGER/SERVICE ELEVATORS**

A. Reuse existing car enclosure. Refinish or replace damaged stainless-steel entrance panels.

B. Front return wall panel, entrance columns, entrance head-jamb and transom must be 14-gauge stainless steel. Transom must be full width of

cab. Side and rear walls must be constructed of 14-gauge cold rolled steel. Coat exterior of walls with mastic sound insulation material approximately 2.5 mm (.10 in.) thick followed by a prime coat of paint.

D. Side and rear walls of passenger elevators may have raised panels covered in fire rated materials approved for use in elevator interior.

E. Side and rear walls of service elevators, up to the center line of the top handrail, must be covered with stainless steel. Side and rear walls to the ceiling must be covered with high pressure plastic laminate panels. Submit a method of fastening panels to steel walls.

F. Provide car top railings.

G. Provide an exit switch to prevent operation of the elevator when the emergency exit is open.

H. Provide duplex, GFCI protected receptacle in car. Locate flush-mounted receptacle on the centerline of the main car operating panel, 152 mm (6 in.) above the car floor.

I. Lighting for passenger/service elevators:

1. Provide stainless steel hanging ceiling frame. Construct frame of 3.125 mm (.125 in.) thick x 38 mm (1.50 in.) wide x 38 mm (1.50 in.) high “T” and “L” sections, divide ceiling into six panels.

2. Provide LED illuminated car light fixtures above the ceiling panels. Maintain a minimum light level of 50-foot candles at 914 mm (36 in.) above the finished floor.

J. Provide a blower unit arranged to exhaust through an opening in the canopy. Provide a stainless or chrome plated fan grill on the interior side of the opening. Provide screening over intake and exhaust end of blower. Provide 2-speed fan, with rated air displacement of 250 cfm and 400 cfm at respective speeds. Mount fan on top of car with rubber isolation to prevent transmission of vibration to car structure. Provide a 3-position switch to control the unit in the service panel.

K. Provide two sets of handrails with centerlines 762 mm and 1067 mm (30 in. and 42 in.) above the car floor, circumference not to exceed 15.2 cm (6 in.).

1. Locate handrails 38 mm (1.50 in.) from cab wall. Install handrails on side and rear walls. Conceal all handrail fastenings. Handrails must be removable from inside the car enclosure

L. Provide passenger and service cars with new horizontal sliding doors constructed the same as hoistway doors.

M. Provide new hardware, tracks, gibs, separate fire gibs, gate switch, door drive clutch assemblies and door restrictor.

N. Provide passenger car with single speed center opening horizontal sliding doors and service car with two-speed side opening horizontal sliding doors constructed the same as hoistway doors. Door panels must be not less than 16-gauge sheet steel and not less than 32 mm (1.25 in.) thick flush type construction with the hall side and leading edge wrapped in one continuous piece of 16-gauge stainless steel. Top and bottom of door panels must have continuous stiffener channels welded in place. Reinforcement of the door panels must be approximately 1.0 mm (0.04 in.) in thickness and of the hat section type. Reinforce each door panel for hangers, interlock mechanism, opening and closing devices. Do not use hangers that are constructed integrally with the door panels.

O. Hang doors on two-point suspension hangers having sealed ball-bearing sheaves not less than 76 mm (3 in.) in diameter, with non-metallic sound-reducing tires. Equip hangers with adjustable ball-bearing rollers to take upward thrust of panels. Provide two non-metallic door gibs on each door panel and a separate fire gib. Gibs must be replaceable without removing of door panel. One door panel for each entrance must bear a BOCA label, Underwriters' label, or other labels may be furnished provided they are based on fire test reports and factory inspection procedures acceptable to the COR. Fasten stainless steel sight guard of 14-gauge metal, extending full height of panel, to leading edge of fast speed panel of two-speed doors.

**2.39 POWER DOOR OPERATORS: PASSENGER/SERVICE ELEVATORS**

A. Provide a new high-speed heavy-duty door operator to automatically open the car and hoistway doors simultaneously when the car is level with the floor and automatically close the doors simultaneously at the expiration of the door-open time. Provide solid-state door control with closed loop circuitry to constantly monitor and automatically adjust door operation based upon velocity, position and motor current. Motor must be of the high-internal resistance type, capable of withstanding high currents resulting from stall without damage to the motor. The door operator must open the car door and hoistway door simultaneously, at a speed of 76.2 cm (2.5 ft) per second. The closing speed of the doors must be 30.5 cm (1 ft) per second. A reversal of direction of the doors from the closing to opening operation, whether initiated by

obstruction of the infrared curtain or the door "OPEN" button, must be accomplished within 38 mm (1.5 in.) maximum of door movement. Emphasis is placed on obtaining quiet interlock and door operation; smooth, fast, dynamic braking for door reversals, stopping of the door reversal and stopping of the doors at extremes of travel. Construct all levers and drive arms operating the doors, of heavy steel members and all pivot points must have ball or roller bearings.

B. Car and hoistway doors must be manually operable (open only) in an emergency without disconnecting the power door operating equipment unless the car is outside the unlocking zone.
   1. It must not be possible for the doors to open by power unless the elevator is within the leveling zone.
   2. Provide infrared curtain unit. The device must cause the car and hoistway doors to reverse automatically to the fully open position should the unit be actuated while the doors are closing. Unit must function when the doors are not closed, irrespective of all other operating features except firefighter’s service.

C. Should the doors be prevented from closing for more than a predetermined adjustable interval of 20 to 60 seconds by operation of the curtain unit, the doors must stay open, the audio voice message and a buzzer located on the car must sound only on automatic operation. Do not provide door nudging.
   1. If an obstruction of the doors should not activate the photo-electric door control device and prevent the doors from closing for more than a predetermined adjustable interval of 15 to 30 seconds, the doors must reverse to the fully open position and remain open until the “Door Close” button re-establishes the closing cycle.

D. Provide door "OPEN" and "CLOSE" buttons. When the door "OPEN" button is pressed and held, the doors, if in the open position, must remain open and if the doors are closing, they must stop, reverse and re-open. Momentary pressure of the door "CLOSE" button must initiate the closing of the doors prior to the expiration of the normal door open time.

**PART 3 - EXECUTION**

**3.1 PREPARATION**

A. Examine work of other trades on which the work of this section depends. Report defects to the COR in writing which may affect the work of the elevator contractor.

B. Examine elevator hoistway openings for plumb, level, in line and that elevator pit is proper size, waterproofed and drained with necessary access door and ladder.

C. Examine machine room for proper illumination, heating, ventilation, electrical equipment and beams are correctly located complete with access stairs and door.

D. Before fabrication, take necessary job site measurements and verify where work is governed by other trades. Check measurement of space for equipment and means of access for installation and operation. Obtain dimensions from site for preparation of shop drawings.

E. Work required prior to the completion of the elevator installation:
   1. Supply of electric feeder wires to the terminals of the elevator control panel, including circuit breaker.
   2. Provide light and GFCI outlets in the elevator pit and machine room.
   3. Furnish electric power for testing and adjusting elevator equipment.
   4. Furnish circuit breaker panel in machine room for car and hoistway lights and receptacles.
   5. Supply power for cab lighting and ventilation from an emergency power panel specified in Division 26, ELECTRICAL.
   6. Machine room enclosed and protected from moisture, with self-closing, self-locking door and access stairs.
   7. Provide fire extinguisher in machine room.

**3.2 ARRANGEMENT OF EQUIPMENT**

A. Arrange equipment in machine room so that major equipment components can be removed for repair or replacement without dismantling or removing other equipment in the same machine room. Locate controller near and visible to its respective hoisting machine.

**3.3 WORKMANSHIP AND PROTECTION**

A. Installations must be performed by Certified Elevator Mechanics and Apprentices to best possible industry standards. Details of the installation must be mechanically and electrically correct. Materials and equipment must be new and without imperfections.

B. Recesses, cutouts, slots, holes, patching, grouting, refinishing to accommodate installation of equipment must be included in the Contractor's work. All new holes in concrete must be core drilled.

C. Structural members must not be cut or altered. Work in place that is damaged or defaced must be restored equal to original new condition.

D. Finished work must be straight, plumb, level and square with smooth surfaces and lines. All machinery and equipment must be protected against dirt, water, or mechanical injury. At completion, all work must be thoroughly cleaned and delivered in perfect unblemished condition.

E. Sleeves for conduit and other small holes must project 51 mm (2 in.) above concrete slabs.

F. Exposed gears, sprockets and sheaves must be guarded from accidental contact.

**3.4 CLEANING**

A. After completion of installation and prior to final inspection, all equipment must be thoroughly cleaned of grease, oil, cement, plaster, dust and other debris.

B. Clean machine room and equipment.

C. Perform hoistway clean down.

D. Prior to final acceptance remove protective coverings from finished or ornamental surfaces. Clean and polish as required for type of material.

**3.5 PAINTING AND FINISHING**

A. All equipment, except specified as architectural finish, must be painted one coat of approved color, conforming to manufacturer's standard.

B. Pump Unit Assembly must be factory painted with manufacturer's standard finish and color.

C. Controller, sheave, car frame and platform, counterweight, beams, rails and buffers except their machined surfaces, cams, brackets and all other uncoated ferrous metal items must be painted one factory primer coat or approved equal.

D. Stencil or apply decal floor designations not less than 100 mm (4 in.) high on hoistway doors, fascia or walls within door restrictor areas. The color of paint used must contrast with the color of the surfaces to which it is applied.

E. Elevator pump/motor machine, controller, main line switch/shunt trip circuit breaker, bolster channel and cross head of car must be identified by 100 mm (4 in.) high numerals and letters located as directed. Numerals must contrast with surrounding color and must be stenciled or decaled.

F. Hoistway Entrances of Passenger and Service Elevators:

1. Door panels must be given rust resistant treatment and a factory finish of one coat of baked-on primer and one factory finish coat of baked-on enamel.
2. Fascia plates, top and bottom shear guards, dust covers, hanger covers and other metalwork, including built-in or hidden work and structural metal, (except stainless steel entrance frames and surfaces to receive baked enamel finish) must be given one approved prime coat in the shop and one field coat of paint of approved color.

G. Elevator Cabs for Passenger and Service Elevators:
1. Interior and exterior steel surfaces must be given rust resistant treatment before finish is applied.
2. Interior steel surfaces must be factory finished with one coat of paint of approved color.
3. Give exterior faces of car doors one finish coat of paint of approved color.

**3.6 PRE-TESTS AND TESTS**

A. Pre-test the elevators and related equipment in the presence of the Contracting Officer or his authorized representative for proper operation before requesting final inspection. Conduct final inspection at other than normal working hours, if required by Contracting Officer.
1. The VA must obtain the services of an Independent Qualified Elevator Inspector, ANSI/ASME QEI-1 Certified, that must witness all tests. The QEI must utilize an Elevator Acceptance Inspection Form to record the results of inspection and all testing and to identify safety code and contract deficiencies. Specific values must be provided for all tests required by ASME A17.1, ASME A17.2 and contract documents. After completion of inspection and testing, the QEI must sign a copy of the completed form and provide it to the Contracting Officer. Within 14 days of the inspection, the QEI must also prepare a formal inspection report, including all test results and deficiencies. After successful completion of inspection and testing, the QEI will complete, sign and provide a certificate of compliance provide by the VA.
2. Government must furnish electric power including necessary current for starting, testing and operating machinery of each elevator.
3. Contractor must furnish the following test instruments and materials on-site and at the designated time of inspection: properly marked

certified test weights, voltmeter, amp probe, thermometers, direct reading tachometer, megohm meter, vibration meter, sound meter, light meter, stopwatch and a means of two-way communication.

B. Inspection of workmanship, equipment furnished and installation for compliance with specification.

C. Full-Load Run Test: Elevators must be tested for a period of one-hour continuous run with full contract load in the car. The test run must consist of the elevator stopping at all floors, in either direction of travel, for not less than five or more than ten seconds per floor.

D. Speed Test: The actual speed of the elevator must be determined in both directions of travel with full contract load and no load in the elevator. Speed must be determined by certified tachometer. The actual measured speed of the elevator with all loads in either direction must be within five (5) percent of specified rated speed. Full speed runs must be quiet and free from vibration and sway.

E. Temperature Rise Test: The temperature rise of the pump motor must be determined during the full load test run. Temperatures must be measured using thermometers. Under these conditions, the temperature rise of the equipment must not exceed 50 degrees Centigrade above ambient temperature. Test must start when all machine room equipment is within 5 degrees Centigrade of the ambient temperature. Other tests for heat runs on motors must be performed as prescribed by the Institute of Electrical and Electronic Engineers.

F. Car Leveling Test: Elevator car leveling devices must be tested for accuracy of leveling at all floors with no load in car and with contract load in car in both directions of travel. Accuracy of floor level must be within plus or minus 3 mm (.125 in.) of level with any landing floor for which the stop has been initiated regardless of load in car or direction of travel. The car leveling device must automatically correct over travel as well as under travel and must maintain the car floor within plus or minus 3 mm (.125 in.) of level with the landing floor regardless of change in load.

G. Insulation Resistance Test: The elevator's complete wiring system must be free from short circuits and ground faults and the insulation resistance of the system must be determined by use of megohm meter, at the discretion of the Elevator Inspector conducting the test.

H. Overload Devices: Test all overload current protection devices in the system at final inspection.

I. Limit Stops:
   1. The position of the car when stopped by each of the normal limit stops with no load and with contract load in the car must be accurately measured.
   2. Final position of the elevator relative to the terminal landings must be determined when the elevator has been stopped by the final limits. The lower limit stop must be made with contract load in the elevator. Elevator must be operated at inspection speed for both tests. Normal limit stopping devices must be inoperative for the tests.

J. Working Pressure: Verify working pressure of the hydraulic system by pressure gauge placed in the system line. Take readings with no load and full load in car.

K. Test automatic shut-off valve for proper operation.

L. Operating and Signal System: The elevator must be operated by the operating devices provided and the operation signals and automatic floor leveling must function in accordance with requirements specified. Starting, stopping and leveling must be smooth and comfortable without appreciable steps of acceleration or deceleration.

M. Performance of the Elevator supervisory system must be witnessed and approved by the COR.

N. Evidence of malfunction in any tested system or parts of equipment that occurs during the testing must be corrected, repaired, or replaced at no additional cost to the Government and the test repeated.

O. If equipment fails test requirements and a re-inspection is required, the Contractor must be responsible for the cost of re-inspection; salaries, transportation expenses and per-diem expenses incurred by the representative of the Contracting Officer.

**3.7 INSTRUCTION TO VA PERSONNEL**

A. Provide competent instruction to VA personnel regarding the operation of equipment and accessories installed under this contract, for a period equal to one eight-hour workday. Instruction must commence after completion of all work and at the time and place directed by the Resident Engineer/Contract Officer or authorized representative.

B. Written instructions in triplicate relative to care, adjustments and operation of all equipment and accessories must be furnished and delivered to the RE/CO or authorized representative in independently bound folders. DVD recordings will also be acceptable. Written

instructions must include correct and legible wiring diagrams, nomenclature sheet of all electrical apparatus including location of each device, complete and comprehensive sequence of operation, complete replacement parts list with descriptive literature and identification and diagrammatic cuts of equipment and parts. Information must also include electrical operation characteristics of all circuits, relays, timers and electronic devices, as well as rpm values and related characteristics for all rotating equipment.

C. Provide supplementary instruction for any new equipment that may become necessary because of changes, modifications or replacement of equipment or operation under requirements of paragraph entitled "Warranty of Construction".

**3.8 ELEVATOR GUARANTEE PERIOD OF SERVICE: MAINTENANCE SERVICE AND INSPECTIONS**

A. Provide complete maintenance service and inspections during the modernization period for all elevators and on each elevator for one (1) year after completion and acceptance of each elevator in this specification by the Resident Engineer or Contracting Officer. This maintenance service must run concurrently with the warranty. Maintenance work must be performed by Certified Elevator Mechanics and Apprentices.

B. This contract will cover full maintenance including emergency call back service, inspections and servicing the elevators listed in the schedule of elevator. The Elevator Contractor must be required to perform the following:

1. Monthly systematic examination of equipment.
2. During each maintenance visit the Elevator Contractor must clean, lubricate, adjust, repair and replace all parts as necessary to keep the equipment in first class condition and proper working order.
3. Furnishing all lubricant, cleaning materials, parts and tools necessary to perform the work required. Lubricants must be only those products recommended by the manufacturer of the equipment.
4. As required, motors, controllers, selectors, leveling devices, operating devices, switches on cars and in hoistways, hoistway doors and car doors or gate operating device, interlock contacts, guide shoes, guide rails, car door sills, hangers for doors, car doors or gates and signal system must be cleaned, lubricated and adjusted.
5. Guide rails and bottom of platforms must be cleaned every three months. Car tops and machine room floors must be cleaned monthly.

Accumulated rubbish must be removed from the pits monthly. A general cleaning of the entire installation including all machine room equipment and hoistway equipment must be accomplished quarterly. Cleaning supplies and vacuum cleaner must be furnished by the Contractor.

6. Maintain the performance standards set forth in this specification.
7. The operational system must be maintained to the standards specified hereinafter including any changes or adjustments required to meet varying conditions of hospital occupancy.
8. Maintain smooth starting and stopping and accurate leveling always.

C. Maintenance service must not include the performance of work required because of improper use, accidents and negligence for which the Elevator Contractor is not directly responsible.

D. Provide 24-hour emergency call-back service that must consist of promptly responding to calls within two hours for emergency service should a shutdown or emergency develop between regular examinations. Overtime emergency call-back service must be limited to minor adjustments and repairs required to protect the immediate safety of the equipment and persons in and about the elevator.

E. Service and emergency personnel must report to the Contracting Officer or his authorized representative upon arrival at the hospital and again upon completion of the required work. A copy of the work ticket containing a complete description of the work performed must be given to the COR.

F. The Elevator Contractor must maintain a logbook in the machine room. The log must list the date and time of all bi-weekly examinations and all trouble calls. Each trouble call must be fully described including the nature of the call, necessary correction performed, or parts replaced.

G. Written “Maintenance Control Program” must be in place to maintain the equipment in compliance with ASME A17.1.

- - - E N D - - -

Specification Document SD001 A3, 1/15

# MOTION 2000 Hydraulic Elevator Control

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This specification is for the MCE Motion 2000 Hydraulic Elevator Controller and includes:

- Product photograph
- Product specifications table
- Compliance
- Motion Control Engineering corporate information
- Controller standard features
- Controller optional features
- Motor starter features
- Landing/positioning system information
- Monitoring options
- Building Management System interface
- Service Enhancements

## Product Photograph

## Product Specifications Table

| | |
|---|---|
| Maximum car speed | 200 fpm, 1.0 m/s |
| Configuration | Simplex, Duplex, Group up to 6 cars |
| Landings | 32 landings, 64 openings maximum |
| Motor control | Solid State, Wye/Delta or Across The Line |
| Landing system, solid tape/magnets | MCE LS-QUTE |
| Landing system, perforated tape/magnets/virtual switches | MCE LS-EDGE with distance feedback |
| Landing system, vanes/switches | MCE LS-STAN |
| Power requirement | 208 – 600 VAC, 50/60 Hz, Single or 3-phase |
| Environment | 32 - 104º F, 0 - 40º C; Humidity 95% non-condensing |
| Standard enclosure | 34” w x 31.5” h x 11” d (864 x 800 x 280 mm) with knock-outs |
| Optional enclosures | 36” w x 42” h x 12” d (914 x 1067 x 305 mm)<br>36” w x 48” h x 12” d (914 x 1219 x 305 mm)<br>48” w x 36” h x 12” d (1219 x 914 x 305 mm) (dual motor) |
| Available NEMA enclosures | NEMA 1, 4, 4X, 12 |

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## Elevator Safety Code Compliance

- ASME A17.1/CSA B44
- NYC Appendix K
- Massachusetts 524 CMR
- Australia AS 1735
- New Zealand NZS 4332
- EN 81-72 for Firefighters Lifts

## Other Applicable Standards

- NFPA 70/CSA C22.1 Electrical Codes (U.S. & Canada)
- CSA B44.1/ASME A17.5 Elevator and Escalator Electrical Equipment Standards
- EN 12016 EMC Immunity Standards
- ADA & ICC/ANSI A117.1 Accessibility Standards

## MCE Corporate Information

MCE, Motion Control Engineering, is an established provider of elevator controls and peripheral equipment, boasting a track record of steady growth and industry-leading innovation for nearly thirty years. MCE's primary manufacturing facility in Rancho Cordova, California, service and sales offices, and contract manufacturing facilities around the world provide a time-tested, global presence.

MCE is part of a family of companies operating under the Nidec corporate banner. Nidec companies are major players in many industrial arenas, stretching from elevator controls and lift machines to door operators and small industrial motors and controls to electric vehicle and consumer product components. Nidec's manufacturing strength and global presence help ensure the long term durability of the MCE brand.

MCE is the largest manufacturer of non-proprietary elevator controls, with an installed base of over 150,000 worldwide. Non-proprietary means that building owners are not locked into a specific service provider by long-term contracts and special, proprietary tools. Our non-proprietary philosophy ensures building owners the freedom to choose the installer and service provider of their choice, without constraint. MCE controls never require special, proprietary tools and MCE technical support is available to all service providers, without regard to their corporate affiliation. Over the life of a building, our non-proprietary approach to elevator controls by itself can save a large building owner hundreds of thousands of dollars but MCE quality and MCE controls provide many other important benefits as well.

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## Controller Standard Features

- Code Compliant
- ADA Compliant
- Field-programmable Logic
- Non-Proprietary
- On-board diagnostics
- CAN Bus connectivity
- Universal I/O, 24, 48, 110/120 V, AC or DC, electrically protected
- Easily visible Status Indicators for critical processes
- Individual LED indicators for all field inputs and outputs
- Out of Service Timer
- Motor Limit Timer
- Valve Limit Timer
- High or Low Speed Inspection selection
- Programmable Door Operation
- Door Pre-opening
- Call registration through on-board LCD and keypad
- Fire Service Operation with multiple code presets
- Independent Service
- Simplex Selective Collective Operation
- Simplex Home Landing Operation
- Accurate Leveling
- Test Switch disables doors and calls during system test
- Machine room inspection
- Car top inspection
- Uncanceled Call Bypass
- Anti-nuisance (Photo Eye)
- Inspection and Automatic operation Fault Bypass capabilities

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## ADA Requirements

The elevator shall comply with ICC/ANSI A117.1, the American National Standard for Accessible and Usable Buildings and Facilities.

Leveling Accuracy: The controller shall have a self-leveling feature that shall automatically bring the car to floor landings within a tolerance of 0.25" (6.35 mm) or better under all loading conditions up to the rated load.

Hall Lanterns: The controller shall have outputs to drive the visible and audible signals that are required at each hoistway entrance to indicate which elevator car is answering a call. Audible signals shall sound once for up, twice for down. (In-car lanterns located in cars, visible from the vicinity of hall call buttons, and conforming to the above requirements, shall be acceptable.)

Car Position Indicators: The controller shall have a position indicator output to drive the required position indicator which shall indicate the corresponding floor numbers as the car passes or stops at a floor. An audible signal shall sound as the position indicator changes floors.

Optional: The controller shall have a voice annunciator output to facilitate announcement of car direction and floor number. (Voice annunciator is required for destination-based dispatching elevators or for elevators with speeds greater than 200 fpm).

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## Programmable Logic

All available programming options (consult your MCE Sales Representative) or parameters shall be field programmable, without need for any external device or knowledge of any programming languages. Programmable options and parameters shall be stored in nonvolatile memory. At a minimum, there shall be a 32-character alphanumeric display for programming and diagnostics. Programmable parameters and options shall include, but are not limited to, the following:

- Number of Stops/Openings Served (Each Car)
- Simplex/Duplex/Group
- Single Automatic Pushbutton /Selective Collective/Single Button Collective
- Programmable Fire Code Options/Fire Floors (Main, Alternates)
- Serial Car Operating Panel Selection
- Floor Encoding (Absolute PI)
- Digital Position Indicators/Single Wire Position Indicators
- Programmable CE Microcom floor labels
- Programmable Door Timers
- Programmable Motor Limit Timer
- Programmable Car Fan and Light Timer
- Programmable timer for Wye to Delta transitions
- Door Nudging, Automatic and Fire Operation
- External Car Shutdown Input (e.g., battery lowering device)
- External Low Oil Sensor Input
- External Viscosity Control Input
- Parking Floors
- Lobby Floor
- Hall or Car Gong Selections
- Retiring Cam Option for Freight Doors
- Independent Rear Doors
- MCE Standard Security
- Emergency Hospital Service
- Attendant Service
- Anti-nuisance - Light Load Weighing and Photo Eye
- High Speed Inspection Enable
- Door behavior selections
- Door type selection
- Door pre-opening
- Fault Bypass – Inspection operation
- Fault Bypass – Automatic operation

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Field selectable, preprogrammed Fire Service operations compliant with the following Fire Codes:

- ASME A17.1
- California
- Hawaii
- Massachusetts
- 34 PA Code CH7
- Chicago 2001
- Chicago Old
- City of Denver
- City of Detroit
- City of Houston
- New York City
- Veterans Administration
- Washington DC
- Australia
- British Standard
- Canadian B44

## Non-Proprietary Equipment

Only universally “Serviceable and Maintainable,” Non-proprietary elevator control equipment shall be accepted. Non-proprietary standards recognize specific owner’s rights:

- The right to all information needed for diagnosis, service, and repair.
- The right to access on-board computers, including the information they store and the ability to diagnose, repair, and/or reprogram these systems.
- The right to select from among multiple sources for maintenance and repair in a competitive marketplace.

## Environmental Considerations

The elevator control shall be capable of operating within the following environmental conditions:

- Ambient temperature: 32° F to 104° F, 0° C to 40° C.
- Humidity: Non-condensing up to 95%
- Altitude: Up to 7500 feet (2286 m)

Motion Control Engineering specializes in control products for adverse environmental conditions. For example, dust-proof, water-proof, corrosion-resistant, or air conditioned controller cabinets can be engineered to meet specific applications. Higher temperature range compatibility is available. Please contact MCE Sales Engineering for details.

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## Building and System Configuration

The elevator controller shall be microprocessor based and designed specifically for elevator applications. Elevator and drive logic shall be implemented independently of safety functions.

Elevator logic shall be implemented to facilitate tight coordination between subsystems and enhance reliability. The implementation shall utilize a real-time, multi-tasking operating system to allow the processors to simultaneously execute elevator control logic, drive control logic, operator interface logic, and communication support.

The elevator controller shall have an independent safety system in order to implement safety features required by code. The safety system shall incorporate check redundant, multi-processor, multi-path, solid-state, ASME compliant implementation that meets CSA and CE standards.

The elevator controller shall be configured and packaged in such a way that external “jumpers” cannot be used (intentionally or unintentionally) while the elevator is running in any passenger mode of operation. Non-passenger modes of operation shall be provided, along with means to bypass safety functionality, to allow inspection testing and other setup and/or troubleshooting operations.

The elevator control logic configuration shall be fully field programmable. Changes in number of floors, I/O configuration, starter setup, eligibility etc. shall not require the replacement/reprogramming of EEPROMs or other storage devices. Further, changes in the controller configuration shall be user adjustable in the field.

## Diagnostics

The control system shall provide comprehensive means of accessing the computer memory for elevator diagnostic purposes. It shall have permanent indicators for important elevator status conditions as an integral part of the controller.

The microprocessor boards shall be equipped with on-board diagnostics for ease of troubleshooting and field programmability of specific control variables. Field changes shall be stored permanently, using nonvolatile memory. The microprocessor board shall provide the features listed below:

- On-board diagnostic switches and an alphanumeric display to provide user friendly interaction between the mechanic and the controller.
- An on-board event log shall store and display time-stamped events for diagnostic purposes.
- An on-board real time clock shall display the time and date and be adjustable by means of on-board switches.
- Field programmability of specific timer values (i.e., door times, valve limit times, etc.) may be viewed and/or altered through on-board switches and pushbuttons.
- The elevator controller shall have extensive diagnostic capability. A built-in LCD display or equivalent shall allow access to major user functions and diagnostic features. The display shall be a multi-character, multi-line type with associated keypad to allow users to enter information. The display shall show data and menus in readily understood character format. No numeric, hexadecimal, or binary codes are acceptable.

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- Dedicated indicators shall be provided in a conspicuous location on the elevator controller to indicate important system statuses, such as when the safety string is made, when the door locks are made, when the elevator is on Inspection or Access, etc. In addition, other special or error conditions detected by the main processor or safety subsystem shall be displayed.

### CAN Bus Connectivity

Circuit boards within the controller shall communicate through CAN Bus connections for reliable performance and simplified board replacement. Power for individual circuit boards shall also be distributed through the CAN Bus connection. Communication and power connection shall radiate from a central, multi-connection point such that single-point board failure shall not affect operation of other boards.

### Universal I/O

Field I/O boards shall be universal in that 24V to 120V AC or DC connections shall be accepted without requirement for unique circuit boards for each. I/O boards shall provide built-in current limiting protection.

### Intended Operation of Critical Components

Failure of any single magnetically operated switch, contactor, or relay to release in the intended manner; the failure of any static control device, speed measuring circuit, or speed pattern generating circuit to operate as intended; the occurrence of a single accidental ground or short circuit shall not permit the car to start or run if any hoistway door or gate interlock is unlocked or if any hoistway door or car door or gate contact is not in the made position. Furthermore, while on car top inspection or hoistway access operation, failure of any single magnetically operated switch, contactor or relay to release in the intended manner, failure of any static control device to operate as intended or the occurrence of a single accidental ground, shall not permit the car to move even with the hoistway door locks and car door contacts in the closed or made position.

### Status Indicators

Dedicated permanent status indicators shall be provided on the controller to indicate when the safety string is made, when the door locks are made, when the elevator is operating at high speed, when the elevator is on independent service, when the elevator is on Inspection or Access, when the elevator is on fire service, when the elevator out of service timer has elapsed, and when the elevator has failed to successfully complete its intended movement. A means shall be provided to display other special or error conditions detected by the microprocessor.

Every field connection input or output shall have a dedicated LED such that no volt meter or other test equipment is required to see when and input or output is active.

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### Out of Service Timer

An out of service timer (T. O. S.) shall be provided to take the car out of service if the car is delayed in leaving the landing while calls exist in the system.

### Motor Limit Timer

Motor limit timer function shall be provided which, in case of the pump motor being energized longer than a predetermined time, shall cause the car to descend to the lowest landing and park, open the doors automatically, and then close them. Calls shall be appropriately canceled and the car taken out of service automatically. Operation may be restored by cycling the main line disconnect, putting the car on inspection operation, or pressing the Fault Reset button. Door reopening devices shall remain operative.

### Valve Limit Timer

A valve limit timer shall be provided which shall automatically cut off current to the down valve solenoids if they have been energized longer than a predetermined time. Calls shall be appropriately canceled and the car taken out of service automatically. Operation may be restored by cycling the main line disconnect, putting the car on inspection operation, or pressing the Fault Reset button. Door reopening devices shall remain operative.

### High or Low Speed Inspection

A selection shall be provided on the controller to select high or low speed during access or inspection operation as long as contract speed does not exceed 150 feet per minute.

### Door Operation

Door protection timers shall be provided for both opening and closing directions to protect the door motor and help prevent the car from getting stuck at a landing. The door open protection timer shall cease attempting to open the door after a predetermined time if the doors are prevented from reaching the open position. In the event that the door closing attempt fails to make up the door locks after a predetermined time, the door close protection timer shall reopen the doors for a short time. If, after a predetermined number of attempts, the doors cannot successfully be closed, the doors shall be opened and the car removed from service.

A minimum of four different door standing open times shall be provided. A car call time value shall predominate when only a car call is canceled. A hall call time value shall predominate whenever a hall call is canceled. In the event of a door reopen caused by the safety edge, photo eye, etc., a separate short door time value shall predominate. A separate door standing open time shall be available for lobby return.

If the doors are prevented from closing for longer than a predetermined time, door nudging operation shall cause the doors to move at slow speed in the closed direction. A buzzer shall sound during nudging operation.

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### Door Pre-opening

When selected, this option shall start to open the doors when the car is in final leveling, 3" (76.2 mm) from the floor. If pre-opening is not selected, the doors shall remain closed until the car is at the floor, at which time the doors shall commence opening.

### Car and Hall Call Registration

Car and hall call registration and lamp acknowledgment shall be by means of a single wire per call, in addition to the ground and the power bus. Systems that register the call with one wire, and light the call acknowledgment lamp with a separate wire can be accommodated.

The user shall be able to register car calls via the on-board LCD display and keypad.

### Fire Service Operation

Fire Phase I emergency recall operation, alternate level Phase I emergency recall operation and Phase II emergency in-car operation shall be provided according to applicable local codes.

### Independent Service

Independent service operation shall be provided in such a way that actuation of a key switch in the car operating panel will cancel any existing car calls, and hold the doors open at the landing. The car will then respond only to car calls. Car and hoistway doors will only close with constant pressure on a car call pushbutton or door close button. While on independent service, hall arrival lanterns or jamb mounted arrival lanterns shall be inoperative.

### Simplex Selective Collective Operation

Simplex selective collective automatic operation shall be provided for all single car installations. Operation of one or more car or hall call pushbuttons shall cause the car to start and run automatically, provided the hoistway door interlocks and car door contacts are made. The car shall stop at the first car or hall call set for the direction of travel. Stops shall be made in the order in which car or hall calls set for the direction of travel are reached, regardless of the order in which they were registered. If only hall calls set for the opposite direction of travel of the elevator exist ahead of the car, the car shall proceed to the most distant hall call, reverse direction, and start collecting the calls.

### Single Automatic Pushbutton Operation

Single automatic pushbutton operation shall be user selectable if desired.

### Single Button Collective Operation

Single button collective operation shall be user selectable if desired.

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### Simplex Home Landing Operation

**Optional:** If no calls are registered, this operation shall cause the car to travel to a predetermined home landing floor and stop without door operation. If the car is traveling to the home landing and a call appears from the opposite direction, the car shall slow down, stop, and then proceed in the opposite direction, toward the call. The home landing function shall cease instantly upon the appearance of a normal call and the car shall proceed nonstop in response to any normal call.

### Duplex Operation

For duplex configurations, each elevator shall have its own computer and dispatching algorithm. Should one computer lose power or become inoperative, the other shall be capable of accepting and answering all hall calls. When both computers are in operation, only one shall assume the role of dispatching hall calls to both elevators.

### Leveling

The car shall be equipped with two-way leveling to automatically bring the car level at any landing, within the required range of leveling accuracy, with any load up to full load.

### Test Switch

A controller test switch shall be provided. In the test position, this switch shall allow independent operation of the elevator with the door open function deactivated for purposes of adjusting or testing the elevator. The elevator shall not respond to hall calls and shall not interfere with any other car in a duplex or group installation.

### Inspection

To enhance safety, an inspection switch, enable switch, and an up/down toggle switch shall be provided in the controller and on the car top to place the elevator on inspection operation and allow the user to move the car. Activation of the car top inspection switch shall render the controller inspection switch inoperative.

### Uncanceled Call Bypass

A timer shall be provided to limit the amount of time a car is held at a floor due to a defective hall call or car call, including stuck pushbuttons. Call demand at another floor shall cause the car, after a predetermined time, to ignore the defective call and continue to provide service in the building.

### Anti-nuisance (Photo Eye)

The controller shall cancel all remaining car calls, if a user-determined number of car calls are answered without the computer detecting a change in the photo eye input (indicating that no one is passing through the car door).

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### Absolute Floor Encoding

The controller shall include absolute floor encoding, which upon power up, shall move the car to the closest floor to identify the position of the elevator.

## Controller Optional Features

### Hand-held User Interface

A hand-held user interface with all the functionality of the on-board LCD display and keypad shall be available. The hand-held interface shall allow the user system access via any system CAN Bus connection in the controller, from the car top, or in the car (if a CAN connection has been made available here).

The hand-held interface shall connect to a standard PC, allowing system software updates to be delivered to the PC via Internet download or email attachment, transferred to the hand-held and uploaded to the elevator or group controller.

### Fan Light Timer

A programmable car fan and light timer shall be available. When the set time expires, the fan and light of an idle car shall be shut off to conserve energy. Demand shall immediate cause the fan and light to activate.

### Peripherals

As an integral part of the controller, the capability shall be provided to connect onsite or remote computer peripherals via Ethernet for additional adjustment, diagnostic, monitoring, or control capabilities.

### Viscosity Control (must be allowed by valve design)

Viscosity control (valve design must allow the use of this option) shall cause the car to accomplish the following operation. If a temperature sensor determines the oil is too cold, and if there are no calls registered, the car shall go to the bottom landing and, as long as the doors are closed, the pump motor shall run without the valve coils energized to circulate and heat the oil to the desired temperature. In the event that the temperature sensor fails, a timer shall prevent continuous running of the pump motor.

### Battery Lowering Device

MCE Hydraulic Controllers are available with a battery lowering device pre-wired, pre-tested and integrated into the standard enclosure. For freight doors, 3-phase powered doors, or 3-phase retiring cam applications, a standalone battery lowering device can be provided.

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## Motor Starter Features

### Starter Location

MCE offers both solid state and mechanical starters for three, six, nine, or twelve lead motors (Solid State, Y-Delta, ATL). MCE-supplied starters will be mounted within the controller enclosure unless a remote starter enclosure is specified.

### Solid State

Motor starting shall not be initiated by mechanical contacts. The starter shall provide a current limit adjustment range. The starter shall limit current inrush during starting and provide gradual acceleration of the motor. The starter shall provide an internal fault detection system. If the internal fault detection system detects a failure, power shall be removed from the motor.

### Motor/Valve Combinations

Controller shall be expandable to four motor/valve combinations using additional interface boards.

## Landing/Positioning System Information

### LS-QUTE, Steel Tape and Magnetic Strips

The advantage of the LS-QUTE system is ease of installation and the fact that it can be used in a brightly lighted area. Corrosion may result if the steel tape is installed in an environment that is high in moisture, salt or chemical vapors (stainless steel tape optional). Consult your MCE Sales Representative for additional information.

The landing system shall provide high speed stepping signals, one floor run stepping signals, leveling and door zone signals and optional floor encoding signals. Each output signal shall be electrically isolated and shall be capable of reliably operating at 120 VAC.

The system shall consist of a steel tape with mounting hardware to accommodate the complete travel of the elevator, a car top assembly with tape guides and sensors and magnetic strips for stepping, leveling and floor encoding.

### LS-STAN, Vane-actuated VS1 Proximity Switch

The LS-STAN landing system uses MCE's model VS 1 proximity switches actuated by vanes located in the hoistway. This landing system should not be used outdoors or in brightly lighted areas. The hoistway landing system shall use model VS 1 vane operated infrared optical switches to sense the position of the elevator in the hoistway. It shall provide stepping, leveling, door zone and floor encoding signals.

The vane switches shall be installed on a 14 gauge steel enclosure with adequate adjustment capability, and shall include labeled terminals for electrical interconnection.

The landing system shall include vanes and mounting hardware for vane mounting in the hoistway.

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Switches shall be accurate to 0.0625" (1.59 mm) and the accuracy shall be the same regardless of direction of travel.

Switches shall not exhibit any interaction when arranged in any compact configuration.

Switch size shall allow horizontal spacing of lanes as close as 2" (50.8 mm), center to center.

### LS-EDGE Landing/Positioning System

The LS-EDGE positioning system uses hall-effect sensors and perforated steel tape to accurately report position and speed as the car moves through the hoistway. 5.5-inch magnets are used at each door zone.
The system uses capacitor-stored power and non-volatile memory to retain position information in the event of a power failure, continuing to capture information for 10 seconds after power loss and storing the final reading for use after power restoration.

The LS-EDGE system allows slowdown switches and access limits to exist virtually in software reducing installation and adjustment time. Stepping distances, floor height offsets, and inspection access limits are adjustable from the machine room.

### NEMA Landing/Positioning System

NEMA rated landing/positioning systems are available for harsh hoistway conditions (NEMA 1, 4X, 12).

## Monitoring Options

### MCE iMonitor

A PC-based system monitoring application shall be available. At a minimum, monitoring shall be capable of providing system status, car location and travel direction, operating mode, and door operation indication via Ethernet connection.

The monitoring system shall be capable of remotely registering car and hall calls.

The monitoring system shall be capable of initiating recall of any car in the group to the lobby floor and of placing the car into Independent Service or placing it out of service upon arrival.

(Optional) A site view, with three-dimensional representations of site buildings, visual indicators of elevator status in buildings so equipped, and the ability to show status details upon indicator selection shall be available. (This option requires additional graphics development as agreed upon by MCE and the customer.)

### MCE iReport

A client/server based report collection and generation application shall be available via Ethernet connection. Based on historical data collected by the server, the report application shall provide, at a minimum, hall call analysis, traffic analysis, hall call log, car call log, event log, emergency log, maintenance log, and percent in service reports. The report application shall also be capable of emergency notification and report distribution through email service.

Motion Control Engineering
11380 White Rock Road
Rancho Cordova, CA 95742
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## Building Management System Interface

An interface to a capable Building Management System shall be available. At a minimum, this interface shall allow the management system to view car location, call status, and door operation. The interface shall also allow the management system to set any of three levels of demand-response operation, each of which shall specify a set of cars to continue running in response to curtailed energy availability or if the building owner is voluntarily reducing energy demand. The interface shall also allow selected cars to be removed from and/or returned to service as desired through the building management system. (Depending on Building Management System software, modification of system code may be required.)

### Third Party Monitoring

**Optional:** An interface to an IDS Liftnet monitoring system is available.

## Service Enhancements

The manufacturer shall reduce requirements for service agency spare board stocks by using common major circuit assemblies in both Traction and Hydraulic controls of the same design series.

The manufacturer shall make software updates for controller and/or group control available via Internet download, email attachment, or physical EEPROM shipment. Internet download and email attachment deliveries require an optional, hand-held user interface to facilitate software transfer from the user's PC to the elevator or group.

# ASECTION 21 13 13
# WET-PIPE SPRINKLER SYSTEMS

## PART 1 - GENERAL

### 1.1 DESCRIPTION

A. Design, installation and testing shall be in accordance with NFPA 13.

B. The design and installation of a hydraulically calculated automatic wet-pipe system complete and ready for operation.

### 1.2 RELATED WORK

A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Section 07 84 00, FIRESTOPPING.

C. Section 09 91 00, PAINTING.

D. Section 28 31 00, FIRE DETECTION AND ALARM.

### 1.3 DESIGN CRITERIA

A. Design Basis Information: Provide design, materials, equipment, installation, inspection, and testing of the automatic sprinkler system in accordance with the requirements of NFPA 13.

1. Perform hydraulic calculations in accordance with NFPA 13 utilizing the Area/Density method. Do not restrict design area reductions permitted for using quick response sprinklers throughout by the required use of standard response sprinklers in the areas identified in this section.

2. Sprinkler Protection: Sprinkler hazard classifications shall be in accordance with NFPA 13. The hazard classification examples of uses and conditions identified in the Annex of NFPA 13 shall be mandatory for areas not listed below. Request clarification from the Government for any hazard classification not identified. To determining spacing and sizing, apply the following coverage classifications:

   a. Light Hazard Occupancies: Patient care, treatment, and customary access areas.

   b. Ordinary Hazard Group 1 Occupancies: Laboratories, Mechanical Equipment Rooms, Transformer Rooms, Electrical Switchgear Rooms, Electric Closets, and Repair Shops.

c. Ordinary Hazard Group 2 Occupancies: Storage rooms, trash rooms, clean and soiled linen rooms, pharmacy and associated storage, laundry, kitchens, kitchen storage areas, retail stores, retail store storage rooms, storage areas, building management storage, boiler plants, energy centers, warehouse spaces, file storage areas for the entire area of the space up to 140 square meters (1500 square feet) and Supply Processing and Distribution (SPD).

3. Hydraulic Calculations: Calculated demand including hose stream requirements shall fall no less than 10 percent below the available water supply curve.

5. Zoning:

a. For each sprinkler zone provide a control valve, flow switch, and a test and drain assembly with pressure gauge. For buildings greater than two stories, provide a check valve at each control valve.

b. Sprinkler zones shall conform to the smoke barrier zones shown on the drawings.

**1.4 SUBMITTALS**

A. Submit as one package in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. Prepare detailed working drawings that are signed by a NICET Level III or Level IV Sprinkler Technician or stamped by a Registered Professional Engineer licensed in the field of Fire Protection Engineering. As the Government review is for technical adequacy only, the installer remains responsible for correcting any conflicts with other trades and building construction that arise during installation. Partial submittals will not be accepted. Material submittals shall be approved prior to the purchase or delivery to the job site. Suitably bind submittals in notebooks or binders and provide an index referencing the appropriate specification section. In addition to the hard copies, provide submittal items in Paragraphs 1.4(A)1 through 1.4(A)5 electronically in pdf format on a compact disc or as directed by the COR. Submittals shall include, but not be limited to, the following:

1. Qualifications:

a. Provide a copy of the installing contractors state fire sprinkler contractor’s license.

b. Provide a copy of the NICET certification for the NICET Level III or Level IV Sprinkler Technician who prepared and signed the detailed working drawings unless the drawings are stamped by a Registered Professional Engineer licensed in the field of Fire Protection Engineering.

c. Provide documentation showing that the installer has been actively and successfully engaged in the installation of commercial automatic sprinkler systems for the past ten years.

2. Drawings: Submit detailed 1:100 (1/8 inch) scale (minimum) working drawings conforming to the Plans and Calculations chapter of NFPA 13. Drawings shall include graphical scales that allow the user to determine lengths when the drawings are reduced in size. Include a plan showing the piping to the water supply test location.

3. Manufacturer’s Data Sheets: Provide data sheets for all materials and equipment proposed for use on the system. Include listing information and installation instructions in data sheets. Where data sheets describe items in addition to those proposed to be used for the system, clearly identify the proposed items on the sheet.

4. Calculation Sheets:

a. Submit hydraulic calculation sheets in tabular form conforming to the requirements and recommendations of the Plans and Calculations chapter of NFPA 13.

5. Valve Charts: Provide a valve chart that identifies the location of each control valve. Coordinate nomenclature and identification of control valves with COR. Where existing nomenclature does not exist, the chart shall include no less than the following: Tag ID No., Valve Size, Service (control valve, main drain, aux. drain, inspectors test valve, etc.), and Location.

6. Final Document Submittals: Provide as-built drawings, testing and maintenance instructions in accordance with the requirements in Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. In addition, submittals shall include, but not be limited to, the following:

a. A complete set of as-built drawings showing the installed system with the specific interconnections between the system switches and the fire alarm equipment. Provide a complete set in the

formats as follows. Submit items 2 and 3 below on a compact disc or as directed by the COR.

1) One full size (or size as directed by the COR) printed copy.
2) One complete set in electronic pdf format.
3) One complete set in AutoCAD format or a format as directed by the COR.

b. Material and Testing Certificate: Upon completion of the sprinkler system installation or any partial section of the system, including testing and flushing, provide a copy of a completed Material and Testing Certificate as indicated in NFPA 13. Certificates shall be provided to document all parts of the installation.

c. Operations and Maintenance Manuals that include step-by-step procedures required for system startup, operation, shutdown, and routine maintenance and testing. The manuals shall include the manufacturer's name, model number, parts list, and tools that should be kept in stock by the owner for routine maintenance, including the name of a local supplier, simplified wiring and controls diagrams, troubleshooting guide, and recommended service organization, including address and telephone number, for each item of equipment.

d. One paper copy of the Material and Testing Certificates and the Operations and Maintenance Manuals above shall be provided in a binder. In addition, these materials shall be provided in pdf format on a compact disc or as directed by the COR.

e. Provide one additional copy of the Operations and Maintenance Manual covering the system in a flexible protective cover and mount in an accessible location adjacent to the riser or as directed by the COR.

**1.5 QUALITY ASSURANCE**

A. Installer Reliability: The installer shall possess a valid State of Texas fire sprinkler contractor's license. The installer shall have been actively and successfully engaged in the installation of commercial automatic sprinkler systems for the past ten years.

B. Materials and Equipment: All equipment and devices shall be of a make and type listed by UL or 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. All materials and equipment shall be free from defect. All materials and equipment shall be new unless specifically indicated otherwise on the contract drawings.

**1.6 APPLICABLE PUBLICATIONS**

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. National Fire Protection Association (NFPA):

13-19 .....Installation of Sprinkler Systems

25-20 .....Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems

101-18 .....Life Safety Code

170-18 .....Fire Safety Symbols

C. Underwriters Laboratories, Inc. (UL):

Fire Protection Equipment Directory (2011)

D. Factory Mutual Engineering Corporation (FM):

Approval Guide

**PART 2 - PRODUCTS**

**2.1 PIPING & FITTINGS**

A. Piping and fittings for private underground water mains shall be in accordance with NFPA 13.

1. Pipe and fittings from inside face of building 300 mm (12 in.) above finished floor to a distance of approximately 1500 mm (5 ft.) outside building: Ductile Iron, flanged fittings and 316 stainless steel bolting.

B. Piping and fittings for sprinkler systems shall be in accordance with NFPA 13.

1. Plain-end pipe fittings with locking lugs or shear bolts are not permitted.
2. Piping sizes 50 mm (2 inches) and smaller shall be black steel Schedule 40 with threaded end connections.
3. Piping sizes 65 mm (2 ½ inches) and larger shall be black steel Schedule 10 with grooved connections. Grooves in Schedule 10 piping shall be rolled grooved only.

4. Use nonferrous piping in MRI Scanning Rooms.
5. Plastic piping shall not be permitted except for drain piping.
6. Flexible sprinkler hose shall be FM Approved and limited to hose with threaded end fittings with a minimum inside diameter or 1-inch and a maximum length of 6-feet.

**2.2 VALVES**

A. General:
1. Valves shall be in accordance with NFPA 13.
2. Do not use quarter turn ball valves for 50 mm (2 inch) or larger drain valves.

B. Control Valve: The control valves shall be a listed indicating type. Control valves shall be UL Listed or FM Approved for fire protection installations. System control valve shall be rated for normal system pressure but in no case less than 175 PSI.

C. Check Valve: Shall be of the swing type with a flanged cast iron body and flanged inspection plate.

D. Automatic Ball Drips: Cast brass 20 mm (3/4 inch) in-line automatic ball drip with both ends threaded with iron pipe threads.

E. Riser Check Valve: Alarm check valve shall be UL Listed and Factory Mutual Approved. The alarm check valve shall be listed for installation in the vertical or horizontal position. The alarm check valve shall be equipped with a removable cover assembly, gauge connections on the system side and supply side of the valve clapper, variable pressure trim, and an external bypass to eliminate false water flow alarms. The alarm check valve trim piping shall be galvanized. Maximum water working pressure to 250 PSI.

F. Backflow Preventer: Provide backflow preventer in accordance with Section 22 05 23, GENERAL-DUTY VALVES FOR PLUMBING PIPING. Provide means to forward flow test the backflow preventer in accordance with NFPA 13.

**2.3 FIRE DEPARTMENT SIAMESE CONNECTION**

A. Brass, flush wall type, exterior fire department connection with brass escutcheon plate, and 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 shall be FM approved quick response except "institutional" type sprinklers shall be permitted to be UL Listed quick response. Provide FM approved quick response sprinklers in all areas, except that standard response sprinklers shall be provided in freezers, refrigerators, elevator hoistways, elevator machine rooms, and generator rooms.

B. Temperature Ratings: In accordance with NFPA 13 except that sprinklers in elevator shafts and elevator machine rooms shall be no less than intermediate temperature rated and sprinklers in generator rooms shall be no less than high temperature rated.

C. Provide sprinkler guards in accordance with NFPA 13 and when the elevation of the sprinkler head is less than 7 feet 6 inches above finished floor. The sprinkler guard shall be UL listed or FM approved for use with the corresponding sprinkler.

**2.5 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 type of sprinkler in accordance with NFPA 13. Locate adjacent to the riser.

B. Provide a list of sprinklers installed in the property in the cabinet. The list shall include the following:

1. Manufacturer, model, orifice, deflector type, thermal sensitivity, and pressure for each type of sprinkler in the cabinet.
2. General description of where each sprinkler is used.
3. Quantity of each type present in the cabinet.
4. Issue or revision date of list.

**2.6 SPRINKLER SYSTEM SIGNAGE**

Rigid plastic, steel or aluminum signs with white lettering on a red background with holes for easy attachment. Sprinkler system signage shall be attached to the valve or piping with chain.

**2.7 SWITCHES:**

A. OS&Y Valve Supervisory Switches shall be in a weatherproof die cast/red baked enamel, oil resistant, aluminum housing with tamper resistant screws, 13 mm (1/2 inch) conduit entrance and necessary facilities for attachment to the valves. Provide two SPDT switches rated at 2.5 amps at 24 VDC.

B. Water flow Alarm Switches: Mechanical, non-coded, non-accumulative retard and adjustable from 0 to 60 seconds minimum. Set flow switches at an initial setting between 20 and 30 seconds.

D. Valve Supervisory Switches for Ball and Butterfly Valves: May be integral with the valve.

**2.8 GAUGES**

Provide gauges as required by NFPA 13. Provide gauges where the normal pressure of the system is at the midrange of the gauge.

**2.9 PIPE HANGERS, SUPPORTS AND RESTRAINT OF SYSTEM PIPING**

Pipe hangers, supports, and restraint of system piping shall be in accordance with NFPA 13.

**2.10 WALL, FLOOR AND CEILING PLATES**

Provide chrome plated steel escutcheon plates.

**2.11 ANTIFREEZE SOLUTION**

Antifreeze solution shall be in accordance with NFPA 13 and shall be compatible with use in a potable water supply.

**2.12 VALVE TAGS**

Engraved black filled numbers and letters not less than 15 mm (1/2 inch) high for number designation, and not less than 8 mm (1/4 inch) for service designation on 19 gage, 40 mm (1-1/2 inches) round brass disc, attached with brass "S" hook, brass chain, or nylon twist tie.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

A. Installation shall be accomplished by the licensed contractor. Provide a qualified technician, experienced in the installation and operation of the type of system being installed, to supervise the installation and testing of the system.

B. Installation of Piping: Accurately cut pipe to measurements established by the installer and work into place without springing or forcing. In any situation where bending of the pipe is required, use a standard

pipe-bending template. Concealed piping in spaces that have finished ceilings. Where ceiling mounted equipment exists, such as in operating and radiology rooms, install sprinklers so as not to obstruct the movement or operation of the equipment. Sidewall heads may need to be utilized. In stairways, locate piping as near to the ceiling as possible to prevent tampering by unauthorized personnel and to provide a minimum headroom clearance of 2250 mm (seven feet six inches). Piping shall not obstruct the minimum means of egress clearances required by NFPA 101. Pipe hangers, supports, and restraint of system piping, shall be installed accordance with NFPA 13.

C. Welding: Conform to the requirements and recommendations of NFPA 13.

D. Drains: Provide drips and drains, including low point drains, in accordance with NFPA 13. Pipe drains to discharge at safe points outside of the building or to sight cones attached to drains of adequate size to readily carry the full flow from each drain under maximum pressure. Do not provide a direct drain connection to sewer system or discharge into sinks. Install drips and drains where necessary and required by NFPA 13. The drain piping shall not be restricted or reduced and shall be of the same diameter as the drain collector.

E. Supervisory Switches: Provide supervisory switches for sprinkler control valves.

F. Waterflow Alarm Switches: Install waterflow alarm switches and valves in stairwells or other easily accessible locations.

G. Inspector's Test Connection: Install and supply in accordance with NFPA 13, locate in a secured area, and discharge to the exterior of the building.

H. Affix cutout disks, which are created by cutting holes in the walls of pipe for flow switches and non-threaded pipe connections to the respective waterflow switch or pipe connection near to the pipe from where they were cut.

I. Provide escutcheon plates for exposed piping passing through walls, floors or ceilings.

J. Clearances: For systems requiring seismic protection, piping that passes through floors or walls shall have penetrations sized 50 mm (2 inches) nominally larger than the penetrating pipe for pipe sizes 25 mm

(1 inch) to 90 mm (3 ½ inches) and 100 mm (4 inches) nominally larger for penetrating pipe sizes 100 mm (4 inches) and larger.

K. Sleeves: Provide for pipes passing through masonry or concrete. Provide space between the pipe and the sleeve in accordance with NFPA 13. Seal this space with a UL Listed through penetration fire stop material in accordance with Section 07 84 00, FIRESTOPPING. Where core drilling is used in lieu of sleeves, also seal space. Seal penetrations of walls, floors and ceilings of other types of construction, in accordance with Section 07 84 00, FIRESTOPPING.

L. Where dry pendent sprinklers are used for freezers or similar spaces and they are connected to the wet pipe system, provide an EPDM boot around the dry pendent sprinkler on the heated side and securely seal to the pipe and freezer to prevent condensation from entering the freezer.

M. Provide pressure gauges at each water flow alarm switch location and at each main drain connection.

N. 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).

O. Firestopping shall be provided for all penetrations of fire resistance rated construction. Firestopping shall comply with Section 07 84 00, FIRESTOPPING.

P. MRI Suite: Provide no more than one penetration of the MRI shield enclosure.

Q. Painting of Pipe: In finished areas where walls and ceilings have been painted, paint primed surfaces with two coats of paint to match adjacent surfaces, except paint valves and operating accessories with two coats of gloss red enamel. Exercise care to avoid painting sprinklers. Painting of sprinkler systems above suspended ceilings and in crawl spaces is not required. Painting shall comply with Section 09 91 00, PAINTING. Any painted sprinkler shall be replaced with a new sprinkler.

R. Sprinkler System Signage: Provide rigid sprinkler system signage in accordance with NFPA 13 and NFPA 25. Sprinkler system signage shall include, but not limited to, the following:

1. Identification Signs:
   a. Provide signage for each control valve, drain valve, sprinkler cabinet, and inspector's test.
   b. Provide valve tags for each operable valve. Coordinate nomenclature and identification of operable valves with COR. Where existing nomenclature does not exist, the Tag Identification shall include no less than the following: (FP-B-F/SZ-#) Fire Protection, Building Number, Floor Number/Smoke Zone (if applicable), and Valve Number. (E.g., FP-500-1E-001) Fire Protection, Building 500, First Floor East, Number 001.)
2. Instruction/Information Signs:
   a. Provide signage for each control valve to indicate valve function and to indicate what system is being controlled.
   b. Provide signage indicating the number and location of low point drains.
3. Hydraulic Placards:
   a. Provide signage indicating hydraulic design information. The placard shall include location of the design area, discharge densities, required flow and residual pressure at the base of riser, occupancy classification, hose stream allowance, flow test information, and installing contractor. Locate hydraulic placard information signs at each alarm check valve.

S. 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 Representative (COR) or his designated representative. Test and flush underground water line prior to performing these hydrostatic tests.

B. Final Inspection and Testing: Subject system to tests in accordance with NFPA 13, and when all necessary corrections have been accomplished, advise COR to schedule a final inspection and test.

Connection to the fire alarm system shall have been in service for at least ten days prior to the final inspection, with adjustments made to prevent false alarms. Furnish all instruments, labor and materials required for the tests and provide the services of the installation foreman or other competent representative of the installer to perform the tests. Correct deficiencies and retest system as necessary, prior to the final acceptance. Include the operation of all features of the systems under normal operations in test

**3.3 INSTRUCTIONS**

Furnish the services of a competent instructor for not less than two hours for instructing personnel in the operation and maintenance of the system, on the dates requested by the COR.

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**SECTION 22 05 11**
**COMMON WORK RESULTS FOR PLUMBING**

## PART 1 - GENERAL

### 1.1 DESCRIPTION

A. The requirements of this Section shall apply to all sections of Division 22.

B. Definitions:

1. Exposed: Piping and equipment exposed to view in finished rooms.
2. Exterior: Piping and equipment exposed to weather be it temperature, humidity, precipitation, wind or solar radiation.

C. Abbreviations/Acronyms:

1. ABS: Acrylonitrile Butadiene Styrene
2. AC: Alternating Current
3. ACR: Air Conditioning and Refrigeration
4. A/E: Architect/Engineer
5. AFF: Above Finish Floor
6. AFG: Above Finish Grade
7. AI: Analog Input
8. AISI: American Iron and Steel Institute
9. AO: Analog Output
10. ASHRAE: American Society of Heating Refrigeration, Air Conditioning Engineers
11. ASJ: All Service Jacket
12. ASME: American Society of Mechanical Engineers
13. ASPE: American Society of Plumbing Engineers
14. AWG: American Wire Gauge
15. BACnet: Building Automation and Control Network
16. BAg: Silver-Copper-Zinc Brazing Alloy
17. BAS: Building Automation System
18. BCuP: Silver-Copper-Phosphorus Brazing Alloy
19. bhp: Brake Horsepower
20. Btu: British Thermal Unit
21. Btu/h: British Thermal Unit per Hour
22. BSG: Borosilicate Glass Pipe
23. C: Celsius
24. CA: Compressed Air

25. CD: Compact Disk
26. CDA: Copper Development Association
27. CGA: Compressed Gas Association
28. CFM: Cubic Feet per Minute
29. CI: Cast Iron
30. CLR: Color
31. CO: Contracting Officer
32. COR: Contracting Officer’s Representative
33. CPVC: Chlorinated Polyvinyl Chloride
34. CR: Chloroprene
35. CRS: Corrosion Resistant Steel
36. CWP: Cold Working Pressure
37. CxA: Commissioning Agent
38. dB: Decibels
39. db(A): Decibels (A weighted)
40. DCW: Domestic Cold Water
41. DDC: Direct Digital Control
42. DFU: Drainage Fixture Units
43. DHW: Domestic Hot Water
44. DHWR: Domestic Hot Water Return
45. DHWS: Domestic How Water Supply
46. DI: Digital Input
47. DI: Deionized Water
48. DISS: Diameter Index Safety System
49. DN: Diameter Nominal
50. DO: Digital Output
51. DOE: Department of Energy
52. DVD: Digital Video Disc
53. DWG: Drawing
54. DWH: Domestic Water Heater
55. DWS: Domestic Water Supply
56. DWV: Drainage, Waste and Vent
57. ECC: Engineering Control Center
58. EL: Elevation
59. EMCS: Energy Monitoring and Control System
60. EPA: Environmental Protection Agency
61. EPACT: Energy Policy Act

62. EPDM: Ethylene Propylene Diene Monomer
63. EPT: Ethylene Propylene Terpolymer
64. ETO: Ethylene Oxide
65. F: Fahrenheit
66. FAR: Federal Acquisition Regulations
67. FD: Floor Drain
68. FDC: Fire Department (Hose) Connection
69. FED: Federal
70. FG: Fiberglass
71. FNPT: Female National Pipe Thread
72. FOR: Fuel Oil Return
73. FOS: Fuel Oil Supply
74. FOV: Fuel Oil Vent
75. FPM: Fluoroelastomer Polymer
76. FSK: Foil-Scrim-Kraft Facing
77. FSS: VA Construction & Facilities Management, Facility Standards Service
78. FU: Fixture Units
79. GAL: Gallon
80. GCO: Grade Cleanouts
81. GPD: Gallons per Day
82. GPH: Gallons per Hour
83. GPM: Gallons per Minute
84. HDPE: High Density Polyethylene
85. HEFP: Healthcare Environment and Facilities Program (replacement for OCAMES)
86. HEX: Heat Exchanger
87. Hg: Mercury
88. HOA: Hands-Off-Automatic
89. HP: Horsepower
90. HVE: High Volume Evacuation
91. Hz: Hertz
92. ID: Inside Diameter
93. IE: Invert Elevation
94. INV: Invert
95. IPC: International Plumbing Code
96. IPS: Iron Pipe Size

97. IW: Indirect Waste
98. IWH: Instantaneous Water Heater
99. Kg: Kilogram
100. kPa: Kilopascal
101. KW: Kilowatt
102. KWH: Kilowatt Hour
103. lb: Pound
104. lbs/hr: Pounds per Hour
105. LNG: Liquid Natural Gas
106. L/min: Liters per Minute
107. LOX: Liquid Oxygen
108. L/s: Liters per Second
109. m: Meter
110. MA: Medical Air
111. MAWP: Maximum Allowable Working Pressure
112. MAX: Maximum
113. MBH: 1000 Btu per Hour
114. MED: Medical
115. MER: Mechanical Equipment Room
116. MFG: Manufacturer
117. mg: Milligram
118. mg/L: Milligrams per Liter
119. ml: Milliliter
120. mm: Millimeter
121. MIN: Minimum
122. MV: Medical Vacuum
123. N2: Nitrogen
124. N20: Nitrogen Oxide
125. NC: Normally Closed
126. NF: Oil Free Dry (Nitrogen)
127. NG: Natural Gas
128. NIC: Not in Contract
129. NO: Normally Open
130. NOM: Nominal
131. NPTF: National Pipe Thread Female
132. NPS: Nominal Pipe Size
133. NPT: Nominal Pipe Thread

134. NTS: Not to Scale
135. O2: Oxygen
136. OC: On Center
137. OD: Outside Diameter
138. OSD: Open Sight Drain
139. OS&Y: Outside Stem and Yoke
140. PA: Pascal
141. PBPU: Prefabricated Bedside Patient Units
142. PD: Pressure Drop or Difference
143. PDI: Plumbing and Drainage Institute
144. PH: Power of Hydrogen
145. PID: Proportional-Integral-Differential
146. PLC: Programmable Logic Controllers
147. PP: Polypropylene
148. ppb: Parts per Billion
149. ppm: Parts per Million
150. PSI: Pounds per Square Inch
151. PSIA: Pounds per Square Inch Atmosphere
152. PSIG: Pounds per Square Inch Gauge
153. PTFE: Polytetrafluoroethylene
154. PVC: Polyvinyl Chloride
155. PVDF: Polyvinylidene Fluoride
156. RAD: Radians
157. RO: Reverse Osmosis
158. RPM: Revolutions Per Minute
159. RTD: Resistance Temperature Detectors
160. RTRP: Reinforced Thermosetting Resin Pipe
161. SAN: Sanitary Sewer
162. SCFM: Standard Cubic Feet per Minute
163. SDI: Silt Density Index
164. SMACNA: Sheet Metal and Air Conditioning Contractors National Association
165. SPEC: Specification
166. SPS: Sterile Processing Services
167. SQFT/SF: Square Feet
168. SS: Stainless Steel
169. STD: Standard

170. SUS: Saybolt Universal Second
171. SWP: Steam Working Pressure
172. TD: Temperature Difference
173. TDH: Total Dynamic Head
174. TEFC: Totally Enclosed Fan-Cooled
175. TEMP: Temperature
176. TFE: Tetrafluoroethylene
177. THERM: 100,000 Btu
178. THHN: Thermoplastic High-Heat Resistant Nylon Coated Wire
179. THWN: Thermoplastic Heat & Water Resistant Nylon Coated Wire
180. TIL: Technical Information Library httpwww.cfm.va.gov/til/indes.asp
181. T/P: Temperature and Pressure
182. TYP: Typical
183. USDA: U.S. Department of Agriculture
184. V: Vent
185. V: Volt
186. VA: Veterans Administration
187. VA CFM: VA Construction & Facilities Management
188. VA CFM CSS: VA Construction & Facilities Management, Consulting Support Service
189. VAC: Vacuum
190. VAC: Voltage in Alternating Current
191. VAMC: Veterans Administration Medical Center
192. VHA OCAMES: This has been replaced by HEFP.
193. VSD: Variable Speed Drive
194. VTR: Vent through Roof
195. W: Waste
196. WAGD: Waste Anesthesia Gas Disposal
197. WC: Water Closet
198. WG: Water Gauge
199. WOG: Water, Oil, Gas
200. WPD: Water Pressure Drop
201. WSFU: Water Supply Fixture Units

**1.2 RELATED WORK**

A. Section 01 00 00, GENERAL REQUIREMENTS.

B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT.

D. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

E. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

F. Section 07 84 00, FIRESTOPPING.

G. Section 07 92 00, JOINT SEALANTS.

H. Section 09 91 00, PAINTING.

I. Section 22 07 11, PLUMBING INSULATION.

J. Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

**1.3 APPLICABLE PUBLICATIONS**

A. The publications listed below shall form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Where conflicts occur these specifications and the VHA standard will govern.

B. American Society of Mechanical Engineers (ASME):

B31.1-2013.....Power Piping

ASME Boiler and Pressure Vessel Code -

BPVC Section IX-2019.... Welding, Brazing, and Fusing Qualifications

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

A36/A36M-2019.....Standard Specification for Carbon Structural Steel

A575-96(2013)e1.....Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades

E84-2013a.....Standard Test Method for Surface Burning Characteristics of Building Materials

E119-2012a.....Standard Test Methods for Fire Tests of Building Construction and Materials

D. International Code Council, (ICC):

IBC-2018.....International Building Code

IPC-2018.....International Plumbing Code

E. Manufacturers Standardization Society (MSS) of the Valve and Fittings Industry, Inc:

SP-58-2018.....Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application and Installation

F. Military Specifications (MIL):

P-21035B.....Paint High Zinc Dust Content, Galvanizing Repair (Metric)

G. National Electrical Manufacturers Association (NEMA):

MG 1-2016.....Motors and Generators

H. National Fire Protection Association (NFPA):

51B-2019.....Standard for Fire Prevention During Welding, Cutting and Other Hot Work

54-2018.....National Fuel Gas Code

70-2020.....National Electrical Code (NEC)

99-2018.....Healthcare Facilities Code

I. NSF International (NSF):

5-2019.....Water Heaters, Hot Water Supply Boilers, and Heat Recovery Equipment

14-2019.....Plastic Piping System Components and Related Materials

61-2019.....Drinking Water System Components – Health Effects

372-2016.....Drinking Water System Components – Lead Content

J. Department of Veterans Affairs (VA):

PG-18-102014(R18).....Plumbing Design Manual

PG-18-13-2017(R18).....Barrier Free Design Guide

**1.4 SUBMITTALS**

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 22 05 11, COMMON WORK RESULTS FOR PLUMBING", with applicable paragraph identification.

C.

D. Contractor shall make all necessary field measurements and investigations to assure that the equipment and assemblies will meet contract requirements, and all equipment that requires regular maintenance, calibration, etc are accessable from the floor or permanent work platform. It is the Contractor’s responsibility to ensure all submittals meet the VA specifications and requirements and it is assumed by the VA that all submittals do meet the VA specifications unless the Contractor has requested a variance in

writing and approved by COR prior to the submittal. If at any time during the project it is found that any item does not meet the VA specifications and there was no variance approval the Contractor shall correct at no additional cost or time to the Government even if a submittal was approved.

E. If equipment is submitted which differs in arrangement from that shown, provide documentation proving equivalent performance, design standards and drawings that show the rearrangement of all associated systems. Additionally, any impacts on ancillary equipment or services such as foundations, piping, and electrical shall be the Contractor’s responsibility to design, supply, and install at no additional cost or time to the Government. VA approval will be given only if all features of the equipment and associated systems, including accessibility, are equivalent to that required by the contract.

F. 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.

G. 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.

H. Manufacturer's Literature and Data including: Manufacturer’s literature shall be submitted under the pertinent section rather than under this section.

   1. Electric motor data and variable speed drive data shall be submitted with the driven equipment.
   2. Equipment and materials identification.
   3. Firestopping materials.

I. Coordination/Shop Drawings:

   1. Submit complete consolidated and coordinated shop drawings for all new systems, and for existing systems that are in the same areas.
   2. The coordination/shop 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 1 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 coordination/shop drawings of all piping and duct systems. The drawings should include all lockout/tagout points for all energy/hazard sources for each piece of equipment. Coordinate lockout/tagout procedures and practices with local VA requirements.

3. Do not install equipment foundations, equipment or piping until coordination/shop drawings have been approved.
4. In addition, for plumbing systems, provide details of the following:
   a. Mechanical equipment rooms.
   b. Interstitial space.
   c. Hangers, inserts, supports, and bracing.
   d. Pipe sleeves.
   e. Duct or equipment penetrations of floors, walls, ceilings, or roofs.

J. Plumbing 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. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replacement parts, and troubleshooting guide:
   a. Include complete list indicating all components of the systems.
   b. Include complete diagrams of the internal wiring for each item of equipment.
   c. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

K. Provide copies of approved plumbing equipment submittals to the TAB and Commissioning Subcontractor.

L. Completed System Readiness Checklist provided by the CxA and completed by the Contractor, signed by a qualified technician and dated on the

date of completion, in accordance with the requirements of Section 22 08 00 COMMISSIONING OF PLUMBING SYSTEMS.

M. Submit training plans, trainer qualifications and instructor qualifications in accordance with the requirements of Section 22 08 00 COMMISSIONING OF PLUMBING SYSTEMS.

**1.5 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 plumbing.

B. Products Criteria:

1. Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture, supply and servicing of the specified products for at least 5 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 5 years.
2. Equipment Service: There shall be permanent service organizations, authorized and trained by manufacturers of the equipment supplied, located within 160 km (100 miles) of the project. These organizations shall come to the site and provide acceptable service to restore operations within 4 hours of receipt of notification by phone, e-mail or fax in event of an emergency, such as the shut-down of equipment; or within 24 hours in a non-emergency. Names, mail and e-mail addresses and phone numbers of service organizations providing service under these conditions for (as applicable to the project): pumps, compressors, water heaters, critical instrumentation, computer workstation and programming shall be submitted for project record and inserted into the operations and maintenance manual.

3. All items furnished shall be free from defects that would adversely affect the performance, maintainability and appearance of individual components and overall assembly.
4. The products and execution of work specified in Division 22 shall conform to the referenced codes and standards as required by the specifications. Local codes and amendments enforced by the local code official shall be enforced, if required by local authorities such as the natural gas supplier. If the local codes are more stringent, then the local code shall apply. Any conflicts shall be brought to the attention of the Contracting Officers Representative (COR).
5. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be of the same manufacturer and model number, or if different models are required they shall be of the same manufacturer and identical to the greatest extent possible (i.e., same model series).
6. Assembled Units: Performance and warranty of all components that make up an assembled unit shall be the responsibility of the manufacturer of the completed assembly.
7. 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.
8. Asbestos products or equipment or materials containing asbestos is prohibited.
9. Bio-Based Materials: For products designated by the USDA’s bio-based Bio-Preferred Program, provide products that meet or exceed USDA recommendations for bio-based content, so long as products meet all performance requirements in this specifications section. For more information regarding the product categories covered by the Bio-Preferred Program, visit http:www.biopreferred.gov.

C. 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 BPVC, Section IX, "Welding and Brazing Qualifications". Provide proof of current certification to CO.

2. Comply with provisions of ASME B31 series "Code for Pressure Piping".
3. Certify that each welder and welding operator has passed American Welding Society (AWS) qualification tests for the welding processes involved, and that certification is current.
4. All welds shall be stamped according to the provisions of the AWS or ASME as required herein and by the association code.

D. 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 COR 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.

E. Execution (Installation, Construction) Quality:
1. All items shall be applied and installed in accordance with manufacturer's written instructions. Conflicts between the manufacturer's instructions and the contract documents shall be referred to the COR for resolution. Printed copies or electronic files of manufacturer’s installation instructions shall be provided to the COR at least 10 working days prior to commencing installation of any item.
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, and control devices. Prior to commencing installation work, refer conflicts between this requirement and contract documents to COR for resolution. Failure of the Contractor to resolve or call attention to any discrepancies or deficiencies to the COR will result in the Contractor correcting at no additional cost or time to the Government.
3. Complete layout drawings shall be required by Paragraph, SUBMITTALS. Construction work shall not start on any system until the layout drawings have been approved by VA.

4. Installer Qualifications: Installer shall be licensed and shall provide evidence of the successful completion of at least five projects of equal or greater size and complexity. Provide tradesmen skilled in the appropriate trade.
5. Workmanship/craftsmanship will be of the highest quality and standards. The VA reserves the right to reject any work based on poor quality of workmanship this work shall be removed and done again at no additional cost or time to the Government.

F. Upon request by Government, provide lists of previous installations for selected items of equipment. Include contact persons who will serve as references, with current telephone numbers and e-mail addresses.

G. Guaranty: Warranty of Construction, FAR clause 52.246-21.

H. Plumbing Systems: IPC, International Plumbing Code. Unless otherwise required herein, perform plumbing work in accordance with the latest version of the IPC. For IPC codes referenced in the contract documents, advisory provisions shall be considered mandatory, the word “should” shall be interpreted as “shall”. Reference to the “code official” or “owner” shall be interpreted to mean the COR.

I. Cleanliness of Piping and Equipment Systems:
1. Care shall be exercised in the storage and handling of equipment and piping material to be incorporated in the work. Debris arising from cutting, threading and welding of piping shall be removed.
2. Piping systems shall be flushed, blown or pigged as necessary to deliver clean systems.
3. The interior of all tanks shall be cleaned prior to delivery and beneficial use by the Government. All piping shall be tested in accordance with the specifications and the International Plumbing Code (IPC). All filters, strainers, fixture faucets shall be flushed of debris prior to final acceptance.
4. Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems.

**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 or theft.

2. Damaged equipment shall be replaced with an identical unit as determined and directed by the COR. Such replacement shall be at no additional cost or additional time to the Government.
3. Interiors of new equipment and piping systems shall be protected against entry of foreign matter. Both inside and outside shall be cleaned 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.
5. Protect plastic piping and tanks from ultraviolet light (sunlight) while in pre-construction. Plastic piping and tanks shall not be installed exposed to sunlight without metal jacketing to block ultraviolet rays.

**1.7 AS-BUILT DOCUMENTATION**

A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.

B. Submit operation and maintenance data updated to include submittal review comments, VA approved substitutions and construction revisions shall be in electronic version on CD or DVD inserted into a three—ring binder. All aspects of system operation and maintenance procedures, including applicable piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices shall be included. A List of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.

C. The installing Contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. Should the installing Contractor engage the testing company to provide as-built or

any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement. Provide record drawings as follows:

1. As-built drawings are to be provided, with a copy of them on AutoCAD version provided on CD or DVD. The CAD drawings shall use multiple line layers with a separate individual layer for each system.

D. The as-built drawings shall indicate the location and type of all lockout/tagout points for all energy sources for all equipment and pumps to include breaker location and numbers, valve tag numbers, etc. Coordinate lockout/tagout procedures and practices with local VA requirements.

E. Certification documentation shall be provided to COR 21 working days prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and provide documentation/certification that all results of tests were within limits specified. Test results shall contain written sequence of test procedure with written test results annotated at each step along with the expected outcome or setpoint. The results shall include all readings, including but not limited to data on device (make, model and performance characteristics_), normal pressures, switch ranges, trip points, amp readings, and calibration data to include equipment serial numbers or individual identifications, etc.

**1.8 JOB CONDITIONS – WORK IN EXISTING BUILDING**

A. Building Operation: Government employees will be continuously operating and managing all facilities, including temporary facilities that serve the VAMC.

B. Maintenance of Service: Schedule all work to permit continuous service as required by the VAMC.

C. Building Working Environment: Maintain the architectural and structural integrity of the building and the working environment at all times. Maintain the interior of building at 18 degrees C (65 degrees F) minimum. Limit the opening of doors, windows or other access openings to brief periods as necessary for rigging purposes. Storm water or ground water leakage is prohibited. Provide daily clean-up of

construction and demolition debris on all floor surfaces and on all equipment being operated by VA. Maintain all egress routes and safety systems/devices.

D. Acceptance of Work for Government Operation: As new equipment, systems and facilities are made available for operation and these items are deemed of beneficial use to the Government, inspections and tests will be performed. Based on the inspections, a list of contract deficiencies will be issued to the Contractor. After correction of deficiencies as necessary for beneficial use, the Contracting Officer will process necessary acceptance and the equipment will then be under the control and operation of Government personnel.

**PART 2 - PRODUCTS**

**2.1 MATERIALS FOR VARIOUS SERVICES**

A. Material or equipment containing a weighted average of greater than 0.25 percent lead shall not be used in any potable water system intended for human consumption and shall be certified in accordance with NSF 61 or NSF 372.

B. In-line devices such as water meters, building valves, check valves, stops, valves, fittings, tanks and backflow preventers shall comply with NSF 61 and NSF 372.

C. End point devices such as drinking fountains, lavatory faucets, kitchen and bar faucets, ice makers supply stops, and end-point control valves used to dispense drinking water must meet requirements of NSF 61 and NSF 372.

**2.2 FACTORY-ASSEMBLED PRODUCTS**

A. Standardization of components shall be maximized 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 at no additional cost or time to the Government.

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, shall be the same make and model.

**2.3 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 system that conforms to contract requirements.

**2.4 EQUIPMENT AND MATERIALS IDENTIFICATION**

A. Use symbols, nomenclature and equipment numbers specified, shown in the drawings, or shown in the maintenance manuals. Coordinate equipment and valve identification with local VAMC shops. In addition, 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.

B. Interior (Indoor) Equipment: Engraved nameplates, with letters not less than 7 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 shall be permanently fastened to the equipment. Unit components such as water heaters, tanks, coils, filters, etc. shall be identified.

C. Control Items: All temperature, pressure, and controllers shall be labeled and the component’s function identified. Identify and label each item as they appear on the control diagrams.

D. Valve Tags and Lists:

1. Plumbing: All valves shall be provided with valve tags and listed on a valve list (Fixture stops not included).

2. Valve tags: Engraved black filled numbers and letters not less than 15 mm (1/2 inch) high for number designation, and not less than 8 mm

(1/4 inch) for service designation on 19 gauge, 40 mm (1-1/2 inches) round brass disc, attached with brass "S" hook or brass chain.

3. Valve lists: Valve lists shall be created using a word processing program and printed on plastic coated cards. The plastic-coated valve list card(s), sized 215 mm (8-1/2 inches) by 275 mm (11 inches) shall show valve tag number, valve function and area of control for each service or system. The valve list shall be in a punched 3-ring binder notebook. An additional copy of the valve list shall be mounted in picture frames for mounting to a wall. COR shall instruct Contractor where frames shall be mounted.
4. A detailed plan for each floor of the building indicating the location and valve number for each valve shall be provided in the 3-ring binder notebook. Each valve location shall be identified with a color-coded sticker or thumb tack in ceiling or access door.

**2.5 FIRESTOPPING**

A. Section 07 84 00, FIRESTOPPING specifies an effective barrier against the spread of fire, smoke and gases where penetrations occur for piping. Refer to Section 22 07 11, PLUMBING INSULATION, for pipe insulation.

**2.6 PIPE AND EQUIPMENT SUPPORTS AND RESTRAINTS**

A. In lieu of the paragraph which follows, suspended equipment support and restraints may be designed and installed in accordance with the International Building Code (IBC) Submittals based on the International Building Code (IBC) requirements, or the following paragraphs of this Section shall be stamped and signed by a professional engineer registered in the state where the project is located. The Support system of suspended equipment over 227 kg (500 pounds) shall be submitted for approval of the COR in all cases.

B. For Attachment to Concrete Construction:
   1. Concrete insert: Type 18, MSS SP-58.
   2. Self-drilling expansion shields and machine bolt expansion anchors: Permitted in concrete not less than 100 mm (4 inches) thick when approved by the COR for each job condition.
   3. Power-driven fasteners: Permitted in existing concrete or masonry not less than 100 mm (4 inches) thick when approved by the COR for each job condition.

C. For Attachment to Steel Construction: MSS SP-58.
   1. Welded attachment: Type 22.
   2. Beam clamps: Types 20, 21, 28 or 29. Type 23 C-clamp may be used for individual copper tubing up to 23 mm (7/8 inch) outside diameter.
D. Attachment to Metal Pan or Deck: As required for materials specified in Section 05 31 00, STEEL DECKING. Section 05 36 00, COMPOSITE METAL DECKING.
E. bolts.
F. Hanger Rods: Hot-rolled steel, ASTM A36/A36M or ASTM 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 40 mm (1-1/2 inches) minimum of adjustment and incorporate locknuts. All-thread rods are acceptable.
G. Multiple (Trapeze) Hangers: Galvanized, cold formed, lipped steel channel horizontal member, not less than 43 mm by 43 mm (1-5/8 inches by 1-5/8 inches), 2.7 mm (No. 12 gauge), 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 8 mm (1/4 inch) U-bolt fabricated from steel rod. Provide Type 40 insulation shield, secured by two 15 mm (1/2 inch) galvanized steel bands, or insulated calcium silicate shield for insulated piping at each hanger.
H. Pipe Hangers and Supports: (MSS SP-58), use hangers sized to encircle insulation on insulated piping. Refer to Section 22 07 11, PLUMBING INSULATION for insulation thickness. To protect insulation, provide Type 39 saddles for roller type supports or insulated calcium silicate shields. Provide Type 40 insulation shield or insulated calcium silicate shield at all other types of supports and hangers including those for insulated piping.
   1. General Types (MSS SP-58):
      a. Standard clevis hanger: Type 1; provide locknut.
      b. Riser clamps: Type 8.
      c. Wall brackets: Types 31, 32 or 33.
      d. Roller supports: Type 41, 43, 44 and 46.
      e. Saddle support: Type 36, 37 or 38.
      f. Turnbuckle: Types 13 or 15.

g. U-bolt clamp: Type 24.

h. Copper Tube:

1) Hangers, clamps and other support material in contact with tubing shall be painted with copper colored epoxy paint, copper-coated, plastic coated or taped with isolation tape to prevent electrolysis.

2) For vertical runs use epoxy painted, copper-coated 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.

**2.7 PIPE PENETRATIONS**

A. Pipe penetration sleeves shall be installed for all pipe other than rectangular blocked out floor openings for risers in mechanical bays.

B. Pipe penetration sleeve materials shall comply with all firestopping requirements for each penetration.

C. To prevent accidental liquid spills from passing to a lower level, provide the following:

1. For sleeves: Extend sleeve 25 mm (1 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.

D. Penetrations are prohibited through beams or ribs, but may be installed in concrete beam flanges, with structural engineer prior approval. Any deviation from these requirements must receive prior approval of COR.

E. Sheet metal, plastic, or moisture resistant fiber sleeves shall be provided for pipe passing through floors, interior walls, and partitions, unless brass or steel pipe sleeves are specifically called for below.

F. Cast iron or zinc coated pipe sleeves shall be provided for pipe passing through exterior walls below grade. The space between the sleeve and pipe shall be made watertight with a modular or link rubber seal. The link seal shall be applied at both ends of the sleeve.

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G. Galvanized steel or an alternate black iron pipe with asphalt coating sleeves shall be for pipe passing through concrete beam flanges, except where brass pipe sleeves are called for. A galvanized steel sleeve shall be provided for pipe passing through floor of mechanical rooms, laundry work rooms, and animal rooms above basement. Except in mechanical rooms, sleeves shall be connected with a floor plate.

H. Brass Pipe Sleeves shall be provided for pipe passing through quarry tile, terrazzo or ceramic tile floors. The sleeve shall be connected with a floor plate.

I. Sleeve clearance through floors, walls, partitions, and beam flanges shall be 25 mm (1 inch) greater in diameter than external diameter of pipe. Sleeve for pipe with insulation shall be large enough to accommodate the insulation plus 25 mm (1 inch) in diameter. Interior openings shall be caulked tight with firestopping material and sealant to prevent the spread of fire, smoke, water and gases.

J. Sealant and Adhesives: Shall be as specified in Section 07 92 00, JOINT SEALANTS. Bio-based materials shall be utilized when possible.

**2.8 ASBESTOS**

A. Materials containing asbestos are prohibited.

**PART 3 - EXECUTION**

**3.1 ARRANGEMENT AND INSTALLATION OF EQUIPMENT AND PIPING**

A. Location of piping, sleeves, inserts, hangers, and equipment, access provisions shall be coordinated with the work of all trades. Piping, sleeves, inserts, hangers, and equipment shall be located clear of windows, doors, openings, light outlets, and other services and utilities. Equipment layout drawings shall be prepared to coordinate proper location and personnel access of all facilities. The drawings shall be submitted for review.

B. Manufacturer's published recommendations shall be followed for installation methods not otherwise specified.

C. Operating Personnel Access and Observation Provisions: All equipment and systems shall be arranged to provide clear view and easy access, without use of portable ladders, for maintenance, testing and operation of all devices including, but not limited to: all equipment items,

valves, backflow preventers, filters, strainers, transmitters, sensors, meters and control devices. All gauges and indicators shall be clearly visible by personnel standing on the floor or on permanent platforms. Maintenance and operating space and access provisions that are shown in the drawings shall not be changed nor reduced.

D. Structural systems necessary for pipe and equipment support shall be coordinated to permit proper installation.

E. Location of pipe sleeves, trenches and chases shall be accurately coordinated with equipment and piping locations.

F. Cutting Holes:

1. Holes shall be located to avoid interference with structural members such as beams or grade beams. Holes shall be laid out in advance and drilling done only after approval by COR. If the Contractor considers it necessary to drill through structural members, this matter shall be referred to COR for approval.
2. Waterproof membrane shall not be penetrated. Pipe floor penetration block outs shall be provided outside the extents of the waterproof membrane.
3. Holes through concrete and masonry shall be cut by rotary core drill. Pneumatic hammer, impact electric, and hand or manual hammer type drill will not be allowed, except as permitted by COR where working area space is limited.

G. Minor Piping: Generally, small diameter pipe runs from drips and drains, water cooling, and other services are not shown but must be provided.

H. Protection and Cleaning:

1. Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations and as approved by the COR. Damaged or defective items in the opinion of the COR, shall be replaced at no additional cost or time to the Government.
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. Pipe openings, equipment, and plumbing fixtures shall be tightly covered against dirt or

mechanical injury. At completion of all work thoroughly clean fixtures, exposed materials and equipment.

I. Concrete and Grout: Concrete and shrink compensating grout 25 MPa (3000 psig) minimum, specified in Section 03 30 00, CAST-IN-PLACE CONCRETE, shall be used for all pad or floor mounted equipment.

J. Gauges, thermometers, valves and other devices shall be installed with due regard for ease in reading or operating and maintaining said devices. Thermometers and gauges shall be located and positioned to be easily read by operator or staff standing on floor or walkway provided. Servicing shall not require dismantling adjacent equipment or pipe work.

K. Interconnection of Controls and Instruments: Electrical interconnection is generally not shown but shall be provided. This includes interconnections of sensors, transmitters, transducers, control devices, control and instrumentation panels, alarms, instruments and computer workstations. Comply with NFPA 70.

L. Domestic cold and hot water systems interface with the HVAC control system for the temperature, pressure and flow monitoring requirements to mitigate legionella. See the HVAC control points list and Section 23 09 23, DIRECT DIGITAL CONTROL SYSTEM FOR HVAC and Section 23 09 24, WATER QUALITY MONITORING.

M. Work in Existing Building:

1. As specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, OPERATIONS AND STORAGE AREAS, make alterations to existing service piping at times that will cause the least interfere with normal operation of the facility.

N. Work in bathrooms, restrooms, housekeeping closets: All pipe penetrations behind escutcheons shall be sealed with plumbers’ putty.

O. Switchgear Drip Protection: Every effort shall be made to eliminate the installation of pipe above data equipment, and electrical and telephone switchgear. If this is not possible, encase pipe in a second pipe with a minimum of joints. Drain valve shall be provided in low point of casement pipe.

P. 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 or additional time 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 electrical conduit, motors, fans, pumps, belt guards, transformers, high voltage lines, piping, and ductwork.

**3.2 TEMPORARY PIPING AND EQUIPMENT**

A. Continuity of operation of existing facilities may require temporary installation or relocation of equipment and piping. Temporary equipment or pipe installation or relocation shall be provided to maintain continuity of operation of existing facilities.

B. The Contractor shall provide all required facilities in accordance with the requirements of phased construction and maintenance of service. All piping and equipment shall be properly supported, sloped to drain, operate without excessive stress, and shall be insulated where injury can occur to personnel by contact with operating facilities. The requirements of paragraph 3.1 shall apply.

C. Temporary facilities and piping shall be completely removed back to the nearest active distribution branch or main pipe line and any openings in structures sealed. Dead legs are prohibited in potable water systems. Necessary blind flanges and caps shall be provided to seal open piping remaining in service.

**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. Holes shall be drilled or burned in structural steel ONLY with the prior written approval of the COR.

B. The use of chain pipe supports, wire or strap hangers; wood for blocking, stays and bracing, or hangers suspended from piping above shall not be permitted. Rusty products shall be replaced.

C. Hanger rods shall be used that are straight and vertical. Turnbuckles for vertical adjustments may be omitted where limited space prevents use. A minimum of 15 mm (1/2 inch) clearance between pipe or piping covering and adjacent work shall be provided.

D. For horizontal and vertical plumbing pipe supports, refer to the International Plumbing Code (IPC) and these specifications.

E. 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.

**3.4 PLUMBING SYSTEMS DEMOLITION**

A. Unless specified otherwise, all piping, wiring, conduit, and other devices associated with the equipment not re-used in the new work shall be completely removed from Government property per Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT. This includes all concrete equipment pads, pipe, valves, fittings, insulation, and all hangers including the top connection and any fastenings to building structural systems. All openings shall be sealed after removal of equipment, pipes, ducts, and other penetrations in roof, walls, floors, in an approved manner and in accordance with plans and specifications where specifically covered. Structural integrity of the building system shall be maintained. Reference shall also be made to the drawings and specifications of the other disciplines in the project for additional facilities to be demolished or handled.

B. All valves including gate, globe, ball, butterfly and check, all pressure gauges and thermometers with wells shall remain Government property and shall be removed and delivered to COR and stored as directed. The Contractor shall remove all other material and equipment, devices and demolition debris under these plans and specifications. Such material shall be removed from Government property expeditiously and shall not be allowed to accumulate. Coordinate with the COR and Infection Control.

C. Asbestos Insulation Removal: Conform to Section 02 82 11, TRADITIONAL ASBESTOS ABATEMENT.

## 3.5 CLEANING AND PAINTING

A. In addition, the following special conditions apply:

1. Cleaning shall be thorough. Solvents, cleaning materials and methods recommended by the manufacturers shall be used for the specific tasks. All rust shall be removed prior to painting and from surfaces to remain unpainted. Scratches, scuffs, and abrasions shall be repaired prior to applying prime and finish coats.
2. The following Material and Equipment shall NOT be painted:
   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 and damaged surfaces repaired. Touch-up painting shall be made with matching paint type and color obtained from manufacturer or computer matched.
4. Pumps, motors, steel and cast-iron bases, and coupling guards shall be cleaned, and shall be touched-up with the same paint type and color as utilized by the pump manufacturer.
5. The final result shall be a smooth, even-colored, even-textured factory finish on all items. The entire piece of equipment shall be repainted, if necessary, to achieve this. Lead based paints shall not be used.

## 3.6 IDENTIFICATION SIGNS

A. Laminated plastic signs, with engraved lettering not less than 7 mm (3/16 inch) high, shall be provided that designates equipment function, 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, and performance data shall be placed on factory-built equipment.

C. Pipe Identification: Refer to Section 09 91 00, PAINTING.

**3.7 STARTUP AND TEMPORARY OPERATION**

A. Startup of equipment shall be performed as described in the equipment specifications. Vibration within specified tolerance shall be verified 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.

B. The CxA will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the Contracting Officer's Representative and CxA. Provide a minimum of 1 week prior notice.

**3.8 OPERATING AND PERFORMANCE TESTS**

A. Prior to the final inspection, all required tests shall be performed as specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, TESTS and submit the test reports and records to the COR.

B. Should evidence of malfunction in any tested system, or piece of equipment or component part thereof, occur during or as a result of tests, make proper corrections, repairs or replacements, and repeat tests at no additional cost to the Government.

C. When completion of certain work or systems occurs at a time when final control settings and adjustments cannot be properly made to make performance tests, then conduct such performance tests and finalize control settings during the first actual seasonal use of the respective systems following completion of work. Rescheduling of these tests shall be requested in writing to COR for approval.

D. Perform tests as required for commissioning provisions in accordance with Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS and Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

**3.9 OPERATION AND MAINTENANCE MANUALS**

A. All new and temporary equipment and all elements of each assembly shall be included.

B. Data sheet on each device listing model, size, capacity, pressure, speed, horsepower, impeller size, and other information shall be included.

C. Manufacturer’s installation, maintenance, repair, and operation instructions for each device shall be included. Assembly drawings and parts lists shall also be included. A summary of operating precautions and reasons for precautions shall be included in the Operations and Maintenance Manual.

D. Lubrication instructions, type and quantity of lubricant shall be included.

E. Schematic diagrams and wiring diagrams of all control systems corrected to include all field modifications shall be included.

F. Set points of all interlock devices shall be listed.

G. Trouble-shooting guide for the control system troubleshooting shall be inserted into the Operations and Maintenance Manual.

H. The control system sequence of operation corrected with submittal review comments shall be inserted into the Operations and Maintenance Manual.

I. Emergency procedures for shutdown and startup of equipment and systems.

**3.10 COMMISSIONING**

A. Provide commissioning documentation in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

B. Components provided under this section of the specification will be tested as part of a larger system.

**3.11 DEMONSTRATION AND TRAINING**

A. Provide services of manufacturer’s technical representative for 4 hours to instruct each VA personnel responsible in operation and maintenance of the system.

B. Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

- - - E N D - -

**SECTION 22 05 19**
**METERS AND GAUGES FOR PLUMBING PIPING**

## PART 1 - GENERAL

### 1.1 DESCRIPTION

A. This section describes the requirements for water meters and gauges primarily used for troubleshooting the system and to indicate system performance.

B. A complete listing of common acronyms and abbreviations are included in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

C. .

### 1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.

B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.

C. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

D. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

E. Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS. Requirements for commissioning, systems readiness checklist, and training.

F. .

### 1.3 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. Where conflicts occur these specifications and the VHA standard will govern.

B. American Society of Mechanical Engineers (ASME):

B40.100-2013 .....Pressure Gauges and Gauge Attachments

B40.200-2008 .....Thermometers, Direct Reading and Remote Reading

C. American Water Works Association (AWWA):

C700-2015 .....Cold Water Meters, Displacement Type, Bronze Main Case

C701-2015 .....Cold Water Meters-Turbine Type, for Customer Service

C702-20115 .....Cold Water Meters – Compound Type

C707-2010 (R2016) .....Encoder-Type Remote-Registration Systems for Cold-Water Meters

D. Institute of Electrical and Electronics Engineers (IEEE):

C2-2017 .....National Electrical Safety Code (NESC)

E. International Code Council (ICC):

IPC-2018 .....International Plumbing Code

F. National Fire Protection Association (NFPA):

70-2020 .....National Electrical Code (NEC)

G. NSF International (NSF):

61-2019 .....Drinking Water System Components - Health Effects

372-2016 .....Drinking Water System Components - Lead Content

**1.4 SUBMITTALS**

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 22 05 19, METERS AND GAUGES FOR PLUMBING PIPING", with applicable paragraph identification.

C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.

1. Pressure Gauges.
2. Thermometers.
3. Product certificates for each type of gauge.

D. Complete operating and maintenance manual shall including wiring diagrams, technical data sheets, information for ordering replaceable parts, and troubleshooting guide:

1. Include complete list indicating all components of the system.
2. Include complete diagrams of the internal wiring for each item of equipment.
3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

E. Completed System Readiness Checklist provided by the CxA and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

F. Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

**1.5 AS-BUILT DOCUMENTATION**

A. Comply with requirements in Paragraph "AS-BUILT DOCUMENTATION" of Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

**PART 2 - PRODUCTS**

**2.1 THERMOMETERS**

A. Thermometers shall be straight stem, metal case, red liquid-filled thermometer, approximately 175 mm (7 inches) high, 4 degrees C to 100 degrees C (40 degrees F to 212 degrees F). Thermometers shall comply with ASME B40.200.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

A. Direct mounted pressure gauges shall be installed in piping tees with pressure gauge located on pipe at the most readable position.

B. Valves and snubbers shall be installed in piping for each pressure gauge.

C. Test plugs shall be installed on the inlet and outlet pipes of all heat exchangers or water heaters serving more than one plumbing fixture.

D. Pressure gauges shall be installed where indicated in the drawings and at the following locations:

1. .
2. Inlet and outlet of each pressure reducing valve.
3. Suction and discharge of each domestic water pump or re-circulating hot water return pump.

E.

F. Thermometers shall be installed on the water heater inlet and outlet piping, thermostatic mixing valve outlet piping, and the hot water circulation pump inlet piping.

G. If an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no additional cost or time to the Government.

**3.2 STARTUP AND TESTING**

A. Perform tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.

B. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.

C. The CxA will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and CxA. Provide a minimum notice of 10 working days prior to startup and testing.

**3.3 COMMISSIONING**

A. Provide commissioning documentation in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

B. Components provided under this section of the specification will be tested as part of a larger system.

**3.4 DEMONSTRATION AND TRAINING**

A. Provide services of manufacturer’s technical representative for 4 hours to instruct each VA personnel responsible in operation and maintenance of the system.

B. Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

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**SECTION 22 05 23**
**GENERAL-DUTY VALVES FOR PLUMBING PIPING**

## PART 1 - GENERAL

### 1.1 DESCRIPTION

A. This section describes the requirements for general-duty valves for domestic water and sewer systems.

B. A complete listing of common acronyms and abbreviations are included in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

### 1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.

B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.

C. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

D. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

E. Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

### 1.3 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. Where conflicts occur these specifications and the VHA standard will govern.

B. American Society of Mechanical Engineers (ASME):
A112.14.1-2003 .....Backwater Valves

C. American Society of Sanitary Engineering (ASSE):
1001-2017 .....Performance Requirements for Atmospheric Type Vacuum Breakers
1003-2009 .....Performance Requirements for Water Pressure Reducing Valves for Domestic Water Distribution Systems
1011-2017 .....Performance Requirements for Hose Connection Vacuum Breakers
1013-2011 .....Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Principle Fire Protection Backflow Preventers

1015-2011 .....Performance Requirements for Double Check Backflow Prevention Assemblies and Double Check Fire Protection Backflow Prevention Assemblies

1017-2009 .....Performance Requirements for Temperature Actuated Mixing Valves for Hot Water Distribution Systems

1020-2004 .....Performance Requirements for Pressure Vacuum Breaker Assembly

1035-2008 .....Performance Requirements for Laboratory Faucet Backflow Preventers

1069-2005 .....Performance Requirements for Automatic Temperature Control Mixing Valves

1070-2015 .....Performance Requirements for Water Temperature Limiting Devices

1071-2012 .....Performance Requirements for Temperature Actuated Mixing Valves for Plumbed Emergency Equipment

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

A126-2004(R2019) .....Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings

A276/A276M-2017 .....Standard Specification for Stainless Steel Bars and Shapes

A536-1984(R2019e) .....Standard Specification for Ductile Iron Castings

B62-2017 .....Standard Specification for Composition Bronze or Ounce Metal Castings

B584-2014 .....Standard Specification for Copper Alloy Sand Castings for General Applications

E. International Code Council (ICC):

IPC-2018 .....International Plumbing Code

F. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS):

SP-25-2018 .....Standard Marking Systems for Valves, Fittings, Flanges and Unions

SP-67-2017 .....Butterfly Valves

SP-70-2011 .....Gray Iron Gate Valves, Flanged and Threaded Ends

SP-71-2018 .....Gray Iron Swing Check Valves, Flanged and Threaded Ends

SP-80-2019 .....Bronze Gate, Globe, Angle, and Check Valves

SP-85-2011 .....Gray Iron Globe & Angle Valves, Flanged and Threaded Ends

SP-110-2010 .....Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

G. National Environmental Balancing Bureau (NEBB):

8th Edition 2015 Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems

H. NSF International (NSF):

61-2019 .....Drinking Water System Components – Health Effects

372-2016 .....Drinking Water System Components – Lead Content

I. University of Southern California Foundation for Cross Connection Control and Hydraulic Research (USC FCCCHR):

10th Edition .....Manual of Cross-Connection Control

**1.4 SUBMITTALS**

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 22 05 23, GENERAL-DUTY VALVES FOR PLUMBING PIPING", with applicable paragraph identification.

C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.

1. Ball Valves.
2. Balancing Valves.
3. Check Valves.
4. Thermostatic Mixing Valves.

D. Test and Balance reports for balancing valves.

E. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replaceable parts and troubleshooting guide:
   1. Include complete list indicating all components of the systems.
   2. Include complete diagrams of the internal wiring for each item of equipment.
   3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.
   4. Piping diagrams of thermostatic mixing valves to be installed.

F. Completed System Readiness Checklist provided by the CxA and completed by the Contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

G. Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

**1.5 DELIVERY, STORAGE, AND HANDLING**

A. Valves shall be prepared for shipping as follows:
   1. Protect internal parts against rust and corrosion.
   2. Protect threads, flange faces, grooves, and weld ends.
   3. Set angle, gate, and globe valves closed to prevent rattling.
   4. Set ball and plug valves open to minimize exposure of functional surfaces.
   5. Set butterfly valves closed or slightly open.
   6. Block check valves in either closed or open position.

B. Valves shall be prepared for storage as follows:
   1. Maintain valve end protection.
   2. Store valves indoors and maintain at higher than ambient dew point temperature.

C. A sling shall be used for large valves. The sling shall be rigged to avoid damage to exposed parts. Hand wheels or stems shall not be used as lifting or rigging points.

**1.6 AS BUILT DOCUMENTATION**

A. Comply with requirements in Paragraph “AS-BUILT DOCUMENTATION” of Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

## PART 2 - PRODUCTS

### 2.1 VALVES, GENERAL

A. Asbestos packing and gaskets are prohibited.

B. Bronze valves shall be made with dezincification resistant materials. Bronze valves made with copper alloy (brass) containing greater than 15 percent zinc shall not be permitted.

C. Valves in insulated piping shall have 50 mm or DN50 (2 inch) stem extensions and extended handles of non-thermal conductive material that allows operating the valve without breaking the vapor seal or disturbing the insulation. Memory stops shall be fully adjustable after insulation is applied.

D. Exposed Valves over 65 mm or DN65 (2-1/2 inches) installed at an elevation over 3.6 m (12 feet) shall have a chain-wheel attachment to valve hand-wheel, stem, or other actuator.

E. All valves used to supply potable water shall meet the requirements of NSF 61 and NSF 372.

F. Bio-Based Materials: For products designated by the USDA's bio-based Bio-Preferred Program, provide products that meet or exceed USDA recommendations for bio-based content, so long as products meet all performance requirements in this specifications section. For more information regarding the product categories covered by the Bio-Preferred Program, visit http:www.biopreferred.gov.

### 2.2 SHUT-OFF VALVES

A. Cold, Hot and Re-circulating Hot Water:

1. 50 mm or DN50 (2 inches) and smaller: Ball, MSS SP-110, Ball valve shall be full port three piece or two piece with a union design with adjustable stem package. Threaded stem designs are not allowed. The ball valve shall have a SWP rating of 1035 kPa (150 psig) and a CWP rating of 4138 kPa (600 psig). The body material shall be Bronze ASTM B584, Alloy C844. The ends shall be non-lead solder.

B. Reagent Grade Water: Valves for reagent grade, reverse osmosis, or deionized water service shall be ball type of same material as used for pipe.

### 2.3 MANUAL BALANCING VALVES

A. Hot Water Re-circulating, 75 mm or DN75 (3 inches) and smaller manual balancing valve shall be of bronze body, brass ball construction with

glass and carbon filled TFE seat rings and designed for positive shutoff. The manual balancing valve shall have differential pressure read-out ports across the valve seat area. The read out ports shall be fitted with internal EPT inserts and check valves. The valve body shall have 8 mm or DN8 NPT (1/4 inch NPT) tapped drain and purge port. The valves shall have memory stops that allow the valve to close for service and then reopened to set point without disturbing the balance position. All valves shall have calibrated nameplates to assure specific valve settings.

**2.4 THERMOSTATIC BALANCING VALVES**

A. Thermostatic recirculation balancing valves for domestic hot water and domestic cold water application. Thermostatically controlled, spring actuated automatic balancing valve to very recirculation flow to maintain constant return temperatures. Stainless steel body, spring and brass or stainless steel thermal actuator and actuator carrier. Provide with threaded inlet, integral outlet union and stainless steel check valve. Direct acting to maintain return hot water temperature at degrees C ( 100 degrees F).

**2.5 CHECK VALVES**

A. 75 mm or DN75 (3 inches) and smaller shall be Class 125, bronze swing check valves with non-metallic disc suitable for type of service. The check valve shall meet MSS SP-80 Type 4 standard. The check valve shall have a CWP rating of 1380 kPa (200 psig). The check valve shall have a Y pattern horizontal body design with bronze body material conforming to ASTM B62, solder joints, and PTFE or TFE disc.

**2.6 BACKFLOW PREVENTERS**

A. A backflow prevention assembly shall be installed at any point in the plumbing system where the potable water supply comes in contact with a potential source of contamination. The backflow prevention assembly shall be approved by the University of Southern California Foundation for Cross Connection Control and Hydraulic Research (USCFCCC).

B. The reduced pressure principle backflow prevention assembly shall be ASSE listed 1013 with full port OS&Y positive-seal resilient gate valves and an integral relief monitor switch. The main body and access cover shall be epoxy coated ductile iron conforming to ASTM A536 grade 4. The seat ring and check valve shall be the thermoplastic type suited

for water service. The stem shall be stainless steel conforming to ASTM A276/A276M. The seat disc shall be the elastomer type suited for water service. The checks and the relief valve shall be accessible for maintenance without removing the device from the line. An epoxy coated wye type strainer with flanged connections shall be installed on the inlet. Reduced pressure backflow preventers shall be installed in the following applications.

1. Deionizers.
2. Sterilizers.
3. Dialysis, Deionized or Reverse Osmosis Water Systems.
4. Water make up to heating systems, cooling tower, chilled water system, generators, and similar equipment consuming water.
5. Water service entrance from loop system.
6. Dental equipment.
7. Power washer.
8. Medical equipment.
9. Process equipment.
10. Autopsy, on each hot and cold water outlet at each table or sink.
11. Reclaimed water systems.

C. The pipe applied or integral atmospheric vacuum breaker shall be ASSE listed 1001. The main body shall be cast bronze. The seat disc shall be the elastomer type suited for water service. The device shall be accessible for maintenance without removing the device from the service line. The installation shall not be in a concealed or inaccessible location or where the venting of water from the device during normal operation is deemed objectionable. Atmospheric vacuum breakers shall be installed in the following applications.

1. Hose bibs and sinks with threaded outlets.
2. Disposers.
3. Showers (telephone/handheld type).
4. Hydrotherapy units.
5. All kitchen equipment, if not protected by air gap.
6. Ventilating hoods with wash down system.
7. Film processor.
8. Detergent system.
9. Fume hoods.
10. Glassware washers.

11. Service sinks (integral with faucet only).
12. Laundry tubs (integral with faucet only).
13. Sitz baths.

D. The hose connection vacuum breaker shall be ASSE listed 1011. The main body shall be cast brass with stainless steel working parts. The diaphragm and disc shall be the elastomer type suited for water service. The device shall permit the attachment of portable hoses to hose thread outlets. Hose connection vacuum breakers shall be installed in the following locations requiring non-continuous pressure:
   1. Hose bibbs and wall hydrants.

E. The laboratory faucet vacuum breaker shall be ASSE listed 1035. The main body shall be cast brass. Dual check valves with stainless steel working parts. The diaphragm and disc shall be the elastomer type suited for water service. The device shall permit the attachment of portable hoses to laboratory faucets for non-continuous pressure applications.

**2.7 THERMOSTATIC MIXING VALVES**

A. Thermostatic Mixing Valves shall comply with the following general performance requirements:
   1. Shall meet ASSE requirements for water temperature control.
   2. The body shall be cast bronze or brass with corrosion resistant internal parts preventing scale and biofilm build-up. Provide chrome-plated finish in exposed areas.
   3. No special tool shall be required for temperature adjustment, maintenance, replacing parts and disinfecting operations.
   4. Valve shall be able to be placed in various positions without making temperature adjustment or reading difficult.
   5. Valve finish shall be chrome plated in exposed areas.
   6. Valve shall allow easy temperature adjustments to allow hot water circulation. Internal parts shall be able to withstand disinfecting operations of chemical and thermal treatment of water temperatures up to 82°C (180°F) for 30 minutes or 50 mg/L (50 ppm) chlorine residual concentration for 24 hours.
   7. Parts shall be easily removed or replaced without dismantling the valves, for easy scale removal and disinfecting of parts.

8. Valve shall have a manual adjustable temperature control with locking mechanism to prevent tampering by end user. Outlet temperature shall be visible to ensure outlet temperature does not exceed specified limits, particularly after thermal eradication procedures.
9. Provide mixing valves with integral check valves with screens and stop valves.

B. Water Temperature Limiting Devices:
1. Application: Single plumbing fixture point-of-use such as sinks or lavatories.
2. Standard: ASSE 1070.
3. Pressure Rating: 861 kPa (125 psig).
4. Type: Thermostatically controlled water mixing valve set at 43 degrees C (110 degrees F).
5. Connections: Threaded union, compression or soldered inlets and outlet.
6. Upon cold water supply failure the hot water flow shall automatically be reduced to 0.2 gpm maximum.

C. Temperature Activated Mixing Valves:
1. Application: Emergency eye/face/drench shower equipment.
2. Standard: ASSE 1071.
3. Pressure Rating: 861 kPa (125 psig).
4. Type: Thermostatically controlled water mixing valve set at 24-30 degrees C (75-85 degrees F).
5. Connections: Soldered or threaded union inlets and outlet.
6. Cabinet: Factory-fabricated, stainless steel, for recessed or surface mounting and with hinged, stainless-steel door.
7. Thermometers shall be provided to indicate mixed water temperature.
8. Upon cold water supply failure the hot water flow shall automatically be reduced to 0.5 gpm maximum.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

A. Valve interior shall be examined for cleanliness, freedom from foreign matter, and corrosion. Special packing materials shall be removed, such as blocks, used to prevent disc movement during shipping and handling.

B. Valves shall be operated in positions from fully open to fully closed. Guides and seats shall be examined and made accessible by such operations.

C. Threads on valve and mating pipe shall be examined for form and cleanliness.

D. Mating flange faces shall be examined for conditions that might cause leakage. Bolting shall be checked for proper size, length, and material. Gaskets shall be verified for proper size and that its material composition is suitable for service and free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

**3.2 INSTALLATION**

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Valves shall be located for easy access and shall be provide with separate support. Valves shall be accessible with access doors when installed inside partitions or above hard ceilings.

C. Valves shall be installed in horizontal piping with stem at or above center of pipe.

D. Valves shall be installed in a position to allow full stem movement.

E. Install chain wheels on operators for ball butterfly gate and globe valves NPS 100 mm or DN100 (4 inches) and greater and installed greater than 3.0 m (10 feet) above floor. Chains shall be extended to 1524 mm (60 inches) above finished floor.

F. Check valves shall be installed for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level and on top of valve.

G. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that shall be sources of contamination. Comply with authorities having jurisdiction. Locate backflow preventers in same room as connected equipment or system.

1. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters

in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are prohibited for this application.

H. Install pressure gauges on outlet of backflow preventers.

I. Do not install bypass piping around backflow preventers.

J. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets.

1. Install thermometers if specified.
2. Install cabinet-type units recessed in or surface mounted on wall as specified.

K. If an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no additional cost or time to the Government.

L. Install thermostatic balancing valves with inlet strainer and inlet and outlet isolation valves.

**3.3 LABELING AND IDENTIFYING**

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Calibrated balancing valves.
2. Master, thermostatic, water mixing valves.
3. Manifold, thermostatic, water-mixing-valve assemblies.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit.

**3.4 ADJUSTING**

A. Valve packing shall be adjusted or replaced after piping systems have been tested and put into service but before final adjusting and balancing. Valves shall be replaced if persistent leaking occurs.

B. Set field-adjustable flow set points of balancing valves and record data. Ensure recorded data represents actual measured or observed conditions. Permanently mark settings of valves and other adjustment devices allowing settings to be restored. Set and lock memory stops. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

D. Testing and adjusting of balancing valves shall be performed by an independent NEBB Accredited Test and Balance Contractor. A final settings and flow report shall be submitted to the VA Contracting Officer's Representative (COR).

**3.5 STARTUP AND TESTING**

A. Perform tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.

B. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.

C. The CxA will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and CxA. Provide a minimum notice of 10 working days prior to startup and testing.

**3.6 COMMISSIONING**

A. Provide commissioning documentation in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

B. Components provided under this section of the specification will be tested as part of a larger system.

**3.7 DEMONSTRATION AND TRAINING**

A. Provide services of manufacturer's technical representative for 4 hours to instruct each VA personnel responsible in operation and maintenance of the system.

B. Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

- - E N D - -

**SECTION 22 07 11**
**PLUMBING INSULATION**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

A. Field applied insulation for thermal efficiency and condensation control for the following:
   1. Plumbing piping and equipment.
   2. Re-insulation of plumbing piping and equipment after asbestos abatement and or replacement of any part of existing insulation system (insulation, vapor retarder jacket, protective coverings/jacket) damaged during construction.

B. Definitions:
   1. ASJ: All Service Jacket, Kraft paper, white finish facing or jacket.
   2. Air conditioned space: Space having air temperature and/or humidity controlled by mechanical equipment.
   3. All insulation systems installed within supply, return, exhaust, relief and ventilation air plenums shall be limited to uninhabited crawl spaces, areas above a ceiling or below the floor, attic spaces, interiors of air conditioned or heating ducts, and mechanical equipment rooms shall be noncombustible or shall be listed and labeled as having a flame spread indexes of not more than 25 and a smoke-developed index of not more than 50 when tested in accordance with ASTM E84 or UL 723. Note: ICC IMC, Section 602.2.1.
   4. Cold: Equipment or piping handling media at design temperature of 15 degrees C (60 degrees F) or below.
   5. Concealed: Piping above ceilings and in chases, interstitial space, and pipe spaces.
   6. Exposed: Piping and equipment exposed to view in finished areas including mechanical equipment rooms or exposed to outdoor weather. Shafts, chases, interstitial spaces, unfinished attics, crawl spaces and pipe basements are not considered finished areas.
   7. FSK: Foil-scrim-Kraft facing.
   8. Hot: Plumbing equipment or piping handling media above 40 degrees C (104 degrees F).
   9. Density: $kg/m^3$ - kilograms per cubic meter (Pcf - pounds per cubic foot).

10. Thermal conductance: Heat flow rate through materials.
    a. Flat surface: Watts per square meter (BTU per hour per square foot).
    b. Pipe or Cylinder: Watts per linear meter (BTU per hour per linear foot) for a given outside diameter.
11. Thermal Conductivity (k): Watts per meter, per degree K (BTU - inch thickness, per hour, per square foot, per degree F temperature difference).
12. Vapor Retarder (Vapor Barrier): A material which retards the transmission (migration) of water vapor. Performance of the vapor retarder is rated in terms of permeance (perms). For the purpose of this specification, vapor retarders/vapor barriers shall have a maximum published permeance of .02 perms.
13. HWR: Hot water recirculating.
14. CW: Cold water.
15. SW: Soft water.
16. HW: Hot water.
17. PVDC: Polyvinylidene chloride vapor retarder jacketing, white.

**1.2 RELATED WORK**

A. Section 01 00 00, GENERAL REQUIREMENTS.

B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C.

D. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

E. Section 02 82 11, TRADITIONAL ASBESTOS ABATEMENT: Insulation containing asbestos material.

F. Section 02 82 13.13, GLOVEBAG ASBESTOS ABATEMENT: Insulation containing asbestos material.

G. Section 07 84 00, FIRESTOPPING: Mineral fiber and bond breaker behind sealant.

H.

I. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING: General mechanical requirements and items, which are common to more than one section of Division 22.

J. Section 22 05 19, METERS AND GAGES FOR PLUMBING PIPING: Hot and cold water piping.

K. Section 22 05 23, GENERAL-DUTY VALVES FOR PLUMBING PIPING: Hot and cold water piping.

L.

M. Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

N.

O.

**1.3 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. American Society for Testing and Materials (ASTM):

B209-2014 .....Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

C411-2011 .....Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation

C449-2007 (R2013) .....Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement

C450-2008 (R2014) .....Standard Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging

Adjunct to C450 .....Compilation of Tables that Provide Recommended Dimensions for Prefab and Field Thermal Insulating Covers, etc.

C533-2013 .....Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation

C534/C534M-2014 .....Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form

C547-2015 .....Standard Specification for Mineral Fiber Pipe Insulation

C552-2014 .....Standard Specification for Cellular Glass Thermal Insulation

C553-2013 .....Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications

C591-2013 .....Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation

C680-2014 .....Standard Practice for Estimate of the Heat Gain or Loss and the Surface Temperatures of Insulated Flat, Cylindrical, and Spherical Systems by Use of Computer Programs

C612-2014 .....Standard Specification for Mineral Fiber Block and Board Thermal Insulation

C1126-2014 .....Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation

C1136-2012 .....Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation

C1710-2011 .....Standard Guide for Installation of Flexible Closed Cell Preformed Insulation in Tube and Sheet Form

D1668/D1668M-1997a (2014)e1 Standard Specification for Glass Fabrics (Woven and Treated) for Roofing and Waterproofing

E84-2015a .....Standard Test Method for Surface Burning Characteristics of Building Materials

E2231-2015 .....Standard Practice for Specimen Preparation and Mounting of Pipe and Duct Insulation to Assess Surface Burning Characteristics

C. Federal Specifications (Fed. Spec.):

L-P-535E-1979 .....Plastic Sheet (Sheeting): Plastic Strip; Poly (Vinyl Chloride) and Poly (Vinyl Chloride - Vinyl Acetate), Rigid.

D. International Code Council, (ICC):

IMC-2012 .....International Mechanical Code

E. Military Specifications (Mil. Spec.):

MIL-A-3316C (2)-1990 ...Adhesives, Fire-Resistant, Thermal Insulation

MIL-A-24179A (2)-1987 ..Adhesive, Flexible Unicellular-Plastic Thermal Insulation

MIL-PRF-19565C (1)-1988 Coating Compounds, Thermal Insulation, Fire-and Water-Resistant, Vapor-Barrier

MIL-C-20079H-1987 .....Cloth, Glass; Tape, Textile Glass; and Thread, Glass and Wire-Reinforced Glass

F. National Fire Protection Association (NFPA):

90A-2015 .....Standard for the Installation of Air-Conditioning and Ventilating Systems

G. Underwriters Laboratories, Inc (UL):

723-2008 (R2013) .....Standard for Test for Surface Burning Characteristics of Building Materials

1887-2004 (R2013) .....Standard for Fire Test of Plastic Sprinkler Pipe for Visible Flame and Smoke Characteristics

H. 3E Plus® version 4.1 Insulation Thickness Computer Program: Available from NAIMA with free download; https:insulationinstitute.org/tools-resources/

**1.4 SUBMITTALS**

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 22 07 11, PLUMBING INSULATION", with applicable paragraph identification.

C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.

D. Shop Drawings:

1. All information, clearly presented, shall be included to determine compliance with drawings and specifications and ASTM Designation, Federal and Military specifications.
   a. Insulation materials: Specify each type used and state surface burning characteristics.
   b. Insulation facings and jackets: Each type used and state surface burning characteristics.
   c. Insulation accessory materials: Each type used.
   d. Manufacturer's installation and fitting fabrication instructions for flexible unicellular insulation shall follow the guidelines in accordance with ASTM C1710.

e. Make reference to applicable specification paragraph numbers for coordination.

f. All insulation fittings (exception flexible unicellular insulation) shall be fabricated in accordance with ASTM C450 and the referenced Adjunct to ASTM C450.

F. Completed System Readiness Checklist provided by the CxA and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

**1.5 QUALITY ASSURANCE**

A. Refer to article QUALITY ASSURANCE, in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

B. Criteria:

1. Comply with NFPA 90A, particularly paragraphs 4.3.3.1 through 4.3.3.6, 4.3.11.2.6, parts of which are quoted as follows:

**4.3.3.1** Pipe and duct insulation and 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 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 ASTM E84 and appropriate mounting practice, e.g. ASTM E2231.

4.3.3.3 Coverings and linings for air ducts, pipes, plenums and panels including all pipe and duct insulation materials shall not flame, glow, smolder, or smoke when tested in accordance with a similar test for pipe covering, ASTM C411, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation, at the temperature to which they are exposed in service. In no case shall the test temperature be below 121 degrees C (250 degrees F).

4.3.11.2.6.3 Nonferrous fire sprinkler piping 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 1887, Standard for Safety Fire Test of Plastic Sprinkler Pipe for Visible Flame and Smoke Characteristics.

4.3.11.2.6.8 Smoke detectors shall not be required to meet the provisions of Section 4.3.

2. Test methods: ASTM E84, UL 723, and ASTM E2231.

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 shall have a manufacturer's stamp or label giving the name of the manufacturer, description of the material, and the production date or code.

D. Bio-Based Materials: For products designated by the USDA's Bio-Preferred Program, provide products that meet or exceed USDA recommendations for bio-based content, so long as products meet all performance requirements in this specifications section. For more information regarding the product categories covered by the Bio-Preferred Program, visit http:www.biopreferred.gov.

**1.6 AS-BUILT DOCUMENTATION**

A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.

B. Submit operation and maintenance data updated to include submittal review comments, substitutions and construction revisions shall be in electronic version on compact disc or DVD inserted into a three ring binder. All aspects of system operation and maintenance procedures, including piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices such as damper and door closure interlocks shall be included. A List of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.

C. The installing contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. As-built drawings are to be provided, and a copy of them in Auto-CAD version __14__ provided on compact disk or DVD. Should the installing contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement.

D. Certification documentation shall be provided prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and certification that all results of tests were within limits specified.

**1.7 STORAGE AND HANDLING OF MATERIAL**

A. Store materials in clean and dry environment, pipe insulation 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.

**PART 2 - PRODUCTS**

**2.1 MINERAL FIBER OR FIBER GLASS**

A.

C. ASTM C547 (Pipe Fitting Insulation and Preformed Pipe Insulation), Class 1, k = 0.037 (0.26) at 24 degrees C (75 degrees F), for use at temperatures up to 230 degrees C (446 degrees F) with an all service vapor retarder jacket (ASJ) and with polyvinyl chloride (PVC) premolded fitting covering.

**2.6 FLEXIBLE ELASTOMERIC CELLULAR THERMAL**

A. ASTM C534/C534M, k = 0.039 (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 (199 degrees F). Under high humidity exposures for condensation control an external vapor retarder/barrier jacket is required. Consult ASTM C1710.

**2.8 INSULATION FACINGS AND JACKETS**

A. Vapor Retarder, higher strength with low water permeance = 0.02 or less perm rating, Beach puncture 50 units for insulation facing on pipe insulation jackets. Facings and jackets shall be ASJ or PVDC Vapor Retarder jacketing.

B. ASJ shall be white finish (kraft paper) bonded to 0.025 mm (1 mil) thick aluminum foil, fiberglass reinforced, with pressure sensitive adhesive closure. Comply with ASTM C1136. Beach puncture is 50 units, suitable for painting without sizing. Jackets shall have minimum 40 mm (1-1/2 inch) lap on longitudinal joints and minimum 75 mm (3 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: FSK or PVDC type for concealed ductwork and equipment.

D. Except for flexible elastomeric cellular thermal insulation (not for high humidity exposures), field applied vapor barrier jackets shall be provided, in addition to the specified facings and jackets, on all exterior piping as well as on interior piping exposed to outdoor air (i.e.; in ventilated attics, piping in ventilated (not air conditioned) spaces, etc.)in high humidity locations conveying fluids below ambient temperature. The vapor barrier jacket shall consist of a multi-layer laminated cladding with a maximum water vapor permeance of 0.001 perms. The minimum puncture resistance shall be 35 cm-kg (30 inch-pounds) for interior locations and 92 cm-kg (80 inch-pounds) for exterior or exposed locations or where the insulation is subject to damage.

E. Except for cellular glass thermal insulation, when all longitudinal and circumferential joints are vapor sealed with a vapor barrier mastic or caulking, vapor barrier jackets may not be provided. For aesthetic and physical abuse applications, exterior jacketing is recommended. Otherwise field applied vapor barrier jackets shall be provided, in addition to the applicable specified facings and jackets, on all exterior piping as well as on interior piping exposed to outdoor air (i.e.; in ventilated attics, piping in ventilated (not air conditioned) spaces, etc.) in high humidity locations conveying fluids below ambient

temperature. The vapor barrier jacket shall consist of a multi-layer laminated cladding with a maximum water vapor permeance of 0.001 perms. The minimum puncture resistance shall be 35 cm-kg (30 inch-pounds) for interior locations and 92 cm-kg (80 inch-pounds) for exterior or exposed locations or where the insulation is subject to damage.

F. G. Pipe fitting insulation covering (jackets): Fitting covering shall be premolded to match shape of fitting and shall be PVC conforming to Fed Spec L-P-535E, 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. Staples, tacks, or any other attachment that penetrates the PVC covering is not allowed on any form of a vapor barrier system in below ambient process temperature applications.

## 2.9 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 or high density Polyisocyanurate insulation of the same thickness as adjacent insulation. Density of Polyisocyanurate insulation shall be a minimum of 48 kg/m$^3$ (3.0 pcf).

| **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 high density Polyisocyanurate (for temperatures up to 149 degrees C (300 degrees F)), cellular glass or calcium silicate. Insulation at supports

shall have same thickness as adjacent insulation. Density of Polyisocyanurate insulation shall be a minimum of 48 kg/$m^3$ (3.0 pcf).

**2.10 ADHESIVE, MASTIC, CEMENT**

A. Mil. Spec. MIL-A-3316, Class 1: Jacket and lap adhesive and protective finish coating for insulation.

B. Mil. Spec. MIL-A-3316, 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-PRF-19565C, Type I: Protective finish for outdoor use.

E. Mil. Spec. MIL-PRFC-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.

**2.11 MECHANICAL FASTENERS**

A. Pins, anchors: Welded pins, or metal or nylon anchors with galvanized steel or fiber washer, or clips. Pin diameter shall be as recommended by the insulation manufacturer.

B. Staples: Outward clinching galvanized steel. Staples are not allowed for below ambient vapor barrier applications.

C. Wire: 1.3 mm thick (18 gage) soft annealed galvanized or 1.9 mm (14 gage) copper clad steel or nickel copper alloy or stainless steel.

D. Bands: 13 mm (1/2 inch) nominal width, brass, galvanized steel, aluminum or stainless steel.

E. Tacks, rivets, screws or any other attachment device capable of penetrating the vapor retarder shall NOT be used to attach/close the any type of vapor retarder jacketing. Thumb tacks sometimes used on PVC jacketing and preformed fitting covers closures are not allowed for below ambient vapor barrier applications.

**2.12 REINFORCEMENT AND FINISHES**

A. PVC fitting cover: Fed. Spec L-P-535E, Composition A, 11-86 Type II, Grade GU, with Form B Mineral Fiber insert, for media temperature 10 to 121 degrees C (50 to 250 degrees F). Below 10 degrees C (50 degrees F) and above 121 degrees C (250 degrees F) provide mitered pipe insulation

of the same type as insulating straight pipe. Provide double layer insert. Provide vapor barrier pressure sensitive tape matching the color of the PVC jacket.

**2.13 FIRESTOPPING MATERIAL**

A. Other than pipe insulation, refer to Section 07 84 00, FIRESTOPPING.

**2.14 FLAME AND SMOKE**

A. Unless shown otherwise all assembled systems shall meet flame spread 25 and smoke developed 50 rating as developed under ASTM and UL standards and specifications. See paragraph "Quality Assurance".

**PART 3 - EXECUTION**

**3.1 GENERAL REQUIREMENTS**

A. Required pressure tests of piping joints and connections shall be completed and the work approved by the Contracting Officer’s Representative (COR) 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 or as noted, insulate all specified equipment, and piping (pipe, fittings, valves, accessories). Insulate each pipe individually. Do not use scrap pieces of insulation where a full length section will fit.

C. Where removal of insulation of piping and equipment is required to comply with Section 02 82 11, TRADITIONAL ASBESTOS ABATEMENT and Section 02 82 13.13, GLOVEBAG ASBESTOS ABATEMENT, such areas shall be reinsulated to comply with this specification.

D. Insulation materials shall be installed with smooth and even surfaces, with jackets and facings drawn tight and smoothly cemented down and sealed at all laps. Insulation shall be continuous through all sleeves and openings, except at fire dampers and duct heaters (NFPA 90A).

E. Vapor retarders shall be continuous and uninterrupted throughout systems with operating temperature 15 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).

F. Install vapor stops with operating temperature 15 degrees C (60 degrees F) and below at all insulation terminations on either side of valves, pumps, fittings, and equipment and particularly in straight lengths

every 4.6 to 6.1 meters (approx. 15 to 20 feet) of pipe insulation. The annular space between the pipe and pipe insulation of approx. 25 mm (1 inch) in length at every vapor stop shall be sealed with appropriate vapor barrier sealant. Bio-based materials shall be utilized when possible.

G. Construct insulation on parts of equipment such as cold water pumps 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. Do not insulate over equipment nameplate data.

H. 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 coating (caution about coating’s maximum temperature limit) or jacket material.

I. Protect all insulations 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.

J. Plumbing work not to be insulated unless otherwise noted:
   1. Piping and valves of fire protection system.
   2. Chromium plated brass piping.
   3. Water piping in contact with earth.
   4. Distilled water piping.

K. Apply insulation materials subject to the manufacturer's recommended temperature limits. Apply adhesives, mastic and coatings at the manufacturer's recommended minimum wet or dry film thickness. Bio-based materials shall be utilized when possible.

L. Elbows, flanges and other fittings shall be insulated with the same material as is used on the pipe straights. Use of polyurethane or polyisocyanurate spray-foam to fill a PVC elbow jacket is prohibited on cold applications.

M. Firestop Pipe insulation:
   1. Provide firestopping insulation at fire and smoke barriers through penetrations. Firestopping insulation shall be UL listed as defined in Section 07 84 00, FIRESTOPPING.

2. Pipe penetrations requiring fire stop insulation including, but not limited to the following:
   a. Pipe risers through floors
   b. Pipe chase walls and floors
   c. Smoke partitions
   d. Fire partitions
   e. Hourly rated walls

A. Provide PVC jackets over insulation as follows:
   1. Piping exposed in building, within 1829 mm (6 feet) of the floor, on piping that is not precluded in previous sections.
   2. A 50 mm (2 inch) jacket overlap is required at longitudinal and circumferential joints with the overlap at the bottom.

**3.2 INSULATION INSTALLATION**

B. Molded Mineral Fiber Pipe and Tubing Covering:
   1. Fit insulation to pipe, aligning all 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 except for cold piping. Seal all vapor retarder penetrations on cold piping with a generous application of vapor barrier mastic. Provide cellar glass 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 15 degrees C (60 degrees F) or more.
      b. Factory premolded, one piece PVC covers with mineral fiber, (Form B), inserts surface temperature of above 4 degrees C (40 degrees F) to 121 degrees C (250 degrees F). Provide mitered preformed insulation of the same type as the installed straight pipe insulation for pipe temperatures below 4 degrees C (40 degrees F). Secure first layer of mineral fiber insulation with twine. Seal seam edges with vapor barrier mastic and secure with fitting tape.
      c. Factory preformed, ASTM C547 or fabricated mitered sections, joined with adhesive or (hot only) wired in place. (Bio-based

materials shall be utilized when possible.) For hot piping finish with a smoothing coat of finishing cement. For cold fittings, 15 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 the schedule at the end of this section.

**3.3 COMMISSIONING**

A. Provide commissioning documentation in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

B. Components provided under this section of the specification will be tested as part of a larger system.

**3.4 PIPE INSULATION SCHEDULE**

A. Provide insulation for piping systems as scheduled below:

| **Insulation Thickness Millimeters (Inches)** | | | | | |
|---|---|---|---|---|---|
| | | **Nominal Pipe Size Millimeters (Inches)** | | | |
| **Operating Temperature Range/Service** | **Insulation Material** | **Less than 25 (1)** | **25 – 32 (1 – 1¼)** | **38 – 75 (1½ - 3)** | **100 (4) and Greater** |
| 38-60 degrees C (100-140 degrees F) (Domestic Hot Water Supply and Return) | Mineral Fiber (Above ground piping only) | 38 (1.5) | 38 (1.5) | 50 (2.0) | 50 (2.0) |

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**SECTION 22 11 00**
**FACILITY WATER DISTRIBUTION**

## PART 1 - GENERAL

### 1.1 DESCRIPTION

A. Domestic water systems, including piping, equipment and all necessary accessories as designated in this section.

B. A complete listing of all acronyms and abbreviations are included in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

### 1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.

B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

D. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

E. Section 07 84 00, FIRESTOPPING.

F. Section 07 92 00, JOINT SEALANTS.

G. Section 09 91 00, PAINTING.

I. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

J. Section 22 07 11, PLUMBING INSULATION.

K. SECTION 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

### 1.3 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):

A13.1-2007 (R2013) .....Scheme for Identification of Piping Systems

B16.3-2011 .....Malleable Iron Threaded Fittings: Classes 150 and 300

B16.9-2012 .....Factory-Made Wrought Buttwelding Fittings

B16.11-2011 .....Forged Fittings, Socket-Welding and Threaded

B16.12-2009 (R2014) ....Cast Iron Threaded Drainage Fittings

B16.15-2013 .....Cast Copper Alloy Threaded Fittings: Classes 125 and 250

B16.18-2012 .....Cast Copper Alloy Solder Joint Pressure Fittings

B16.22-2013 .....Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings

B16.24-2011 .....Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 600, 900, 1500, and 2500

B16.51-2013 .....Copper and Copper Alloy Press-Connect Fittings

ASME Boiler and Pressure Vessel Code -

BPVC Section IX-2015 ...Welding, Brazing, and Fusing Qualifications

C. American Society of Sanitary Engineers (ASSE):

1010-2004 .....Performance Requirements for Water Hammer Arresters

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

A47/A47M-1999 (R2014) ..Standard Specification for Ferritic Malleable Iron Castings

A53/A53M-2012 .....Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

A183-2014 .....Standard Specification for Carbon Steel Track Bolts and Nuts

A269/A269M-2014e1 .....Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service

A312/A312M-2015 .....Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes

A403/A403M-2014 .....Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings

A536-1984 (R2014) .....Standard Specification for Ductile Iron Castings

A733-2013 .....Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples

B32-2008 (R2014) .....Standard Specification for Solder Metal

B43-2014 .....Standard Specification for Seamless Red Brass Pipe, Standard Sizes

B61-2008 (R2013) .....Standard Specification for Steam or Valve Bronze Castings

B62-2009 .....Standard Specification for Composition Bronze or Ounce Metal Castings

B75/B75M-2011 .....Standard Specification for Seamless Copper Tube

B88-2014 .....Standard Specification for Seamless Copper Water Tube

B584-2014 .....Standard Specification for Copper Alloy Sand Castings for General Applications

B687-1999 (R2011) .....Standard Specification for Brass, Copper, and Chromium-Plated Pipe Nipples

C919-2012 .....Standard Practice for Use of Sealants in Acoustical Applications

D1785-2012 .....Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

D2000-2012 .....Standard Classification System for Rubber Products in Automotive Applications

D2564-2012 .....Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems

D2657-2007 .....Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings

D2855-1996 (R2010) .....Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings

D4101-2014 .....Standard Specification for Polypropylene Injection and Extrusion Materials

E1120-2008 .....Standard Specification for Liquid Chlorine

E1229-2008 .....Standard Specification for Calcium Hypochlorite

F2389-2010 .....Standard Specification for Pressure-rated Polypropylene (PP) Piping Systems

F2620-2013 .....Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings

F2769-2014 .....Standard Specification for Polyethylene of Raised Temperature (PE-RT) Plastic Hot and Cold-Water Tubing and Distribution Systems

E. American Water Works Association (AWWA):

C110-2012 .....Ductile-Iron and Gray-Iron Fittings

C151-2009 .....Ductile Iron Pipe, Centrifugally Cast

C153-2011 .....Ductile-Iron Compact Fittings

C203-2008 .....Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied

C213-2007 .....Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines

C651-2014 .....Disinfecting Water Mains

F. American Welding Society (AWS):

A5.8M/A5.8-2011-AMD1 ...Specification for Filler Metals for Brazing and Braze Welding

G. International Code Council (ICC):

IPC-2012 .....International Plumbing Code

H. Manufacturers Specification Society (MSS):

SP-58-2009 .....Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation

SP-72-2010a .....Ball Valves with Flanged or Butt-Welding Ends for General Service

SP-110-2010 .....Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

I. NSF International (NSF):

14-2015 .....Plastics Piping System Components and Related Materials

61-2014a .....Drinking Water System Components – Health Effects

372-2011 .....Drinking Water System Components – Lead Content

J. Plumbing and Drainage Institute (PDI):

PDI-WH 201-2010 .....Water Hammer Arrestors

K. Department of Veterans Affairs:

H-18-8-2013 .....Seismic Design Handbook

**1.4 SUBMITTALS**

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 22 11 00, FACILITY WATER DISTRIBUTIONS", with applicable paragraph identification.

C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.
   1. All items listed in Part 2 - Products.

D. Complete operating and maintenance manuals including wiring diagrams, technical data sheets and information for ordering replacement parts:
   1. Include complete list indicating all components of the systems.
   2. Include complete diagrams of the internal wiring for each item of equipment.
   3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

E. Completed System Readiness Checklist provided by the CxA and completed by the Contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

F. Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

**1.5 QUALITY ASSURANCE**

A. A certificate shall be submitted prior to welding of steel piping showing the Welder’s certification. The certificate shall be current and no more than one year old. Welder’s qualifications shall be in accordance with ASME BPVC Section IX.

B. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be by the same manufacturer as the groove components.

C. All pipe, couplings, fittings, and specialties shall bear the identification of the manufacturer and any markings required by the applicable referenced standards.

D. Bio-Based Materials: For products designated by the USDA’s Bio-Preferred Program, provide products that meet or exceed USDA recommendations for bio-based content, so long as products meet all performance requirements in this specifications section. For more information regarding the product categories covered by the Bio-Preferred Program, visit http:www.biopreferred.gov.

**1.6 SPARE PARTS**

A. For mechanical press-connect fittings, provide tools required for each pipe size used at the facility.

**1.7 AS-BUILT DOCUMENTATION**

A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.

B. Submit operation and maintenance data updated to include submittal review comments, substitutions and construction revisions shall be in electronic version on compact disc or DVD inserted into a three ring binder. All aspects of system operation and maintenance procedures, including piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices shall be included. A list of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.

C. The installing contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. As-built drawings are to be provided, and a copy of them in Auto-CAD version __14__ provided on compact disk or DVD. Should the installing contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement.

D. Certification documentation shall be provided to COR 10 working days prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and certificate if applicable that all results of tests were within limits specified. If a certificate is not available, all documentation shall be on the Certifier's letterhead.

**PART 2 - PRODUCTS**

**2.1 MATERIALS**

A. Material or equipment containing a weighted average of greater than 0.25 percent lead are prohibited in any potable water system intended for human consumption, and shall be certified in accordance with NSF 61 or NSF 372. Endpoint devices used to dispense water for drinking shall meet the requirements of NSF 61, Section 9.

B. Plastic pipe, fittings, and solvent cement shall meet NSF 14 and shall be NSF listed for the service intended.

**2.3 ABOVE GROUND (INTERIOR) WATER PIPING**

A. Pipe: Copper tube, ASTM B88, Type K or L, drawn. For pipe 150 mm (6 inches) and larger, stainless steel, ASTM A312, schedule 10 shall be used.

B. Fittings for Copper Tube:

1. Wrought copper or bronze castings conforming to ASME B16.18 and B16.22. Unions shall be bronze, MSS SP-72, MSS SP-110, solder or braze joints. Use 95/5 tin and antimony for all soldered joints.
2. Grooved fittings, 50 to 150 mm (2 to 6 inch) wrought copper ASTM B75/B75M C12200, 125 to 150 mm (5 to 6 inch) bronze casting ASTM B584, C84400. Mechanical grooved couplings, 2070 kpa (300 psig) minimum ductile iron, ASTM A536 Grade 448-310-12 (Grade 65-45-12), or malleable iron, ASTM A47/A47M Grade 22410 (Grade 32510) housing, with EPDM gasket, steel track head bolts, ASTM A183, coated with copper colored alkyd enamel.
3. Mechanical press-connect fittings for copper pipe and tube shall conform to the material and sizing requirements of ASME B16.51, NSF 61 approved, 50 mm (2 inch) size and smaller mechanical press-connect fittings, double pressed type, with EPDM (ethylene propylene diene monomer) non-toxic synthetic rubber sealing elements and un-pressed fitting identification feature.
4. 
5. Flanged fittings, bronze, class 150, solder-joint ends conforming to ASME B16.24.

C. Fittings for Stainless Steel:

1. Stainless steel butt-welded fittings, Type 316, Schedule 10, conforming to ASME B16.9.

2. Grooved fittings, stainless steel, Type 316, Schedule 10 , conforming to ASTM A403/A403M. Segmentally fabricated fittings are not allowed. Mechanical grooved couplings, ductile iron, 4138 kPa (600 psig), ASTM A536 Grade 448-310-12 (Grade 65-45-12), or malleable iron, ASTM A47/A47M Grade 22410 (Grade 32510) housing, with EPDM gasket, steel track head bolts, ASTM A183, coated with copper colored alkyd enamel.

D. Adapters: Provide adapters for joining pipe or tubing with dissimilar end connections.

E. Solder: ASTM B32 alloy type Sb5, HA or HB. Provide non-corrosive flux.

F. Brazing alloy: AWS A5.8M/A5.8, brazing filler metals shall be BCuP series for copper to copper joints and BAg series for copper to steel joints.

**2.4 EXPOSED WATER PIPING**

A. Finished Room: Use full iron pipe size chrome plated brass piping for exposed water piping connecting fixtures, casework, cabinets, equipment and reagent racks when not concealed by apron including those furnished by the Government or specified in other sections.

1. Pipe: ASTM B43, standard weight.
2. Fittings: ASME B16.15 cast bronze threaded fittings with chrome finish.
3. Nipples: ASTM B687, Chromium-plated.
4. Unions: MSS SP-72, MSS SP-110, brass or bronze with chrome finish. Unions 65 mm (2-1/2 inches) and larger shall be flange type with approved gaskets.

B. Unfinished Rooms, Mechanical Rooms and Kitchens: Chrome-plated brass piping is not required. Paint piping systems as specified in Section 09 91 00, PAINTING.

A.

**2.6 TRAP PRIMER WATER PIPING**

A. Pipe: Copper tube, ASTM B88, type K, hard drawn.

B. Fittings: Bronze castings conforming to ASME B16.18 Solder joints.

C. Solder: ASTM B32 alloy type Sb5. Provide non-corrosive flux.

**2.7 STRAINERS**

A. Provide on high pressure side of pressure reducing valves, on suction side of pumps, on inlet side of indicating and control instruments and

equipment subject to sediment damage and where shown on drawings. Strainer element shall be removable without disconnection of piping.

B. Water: Basket or "Y" type with easily removable cover and brass strainer basket.

C. Body: Less than 75 mm (3 inches), brass or bronze; 75 mm (3 inches) and greater, cast iron or semi-steel.

**2.8 DIELECTRIC FITTINGS**

A. Provide dielectric couplings or unions between pipe of dissimilar metals.

**2.9 STERILIZATION CHEMICALS**

A. Hypochlorite: ASTM E1229.

B. Liquid Chlorine: ASTM E1120.

**2.10 WATER HAMMER ARRESTER**

A. Closed copper tube chamber with permanently sealed 413 kPa (60 psig) air charge above a Double O-ring piston. Two high heat Buna-N 0-rings pressure packed and lubricated with FDA approved silicone compound. All units shall be designed in accordance with ASSE 1010. Access shall be provided where devices are concealed within partitions or above ceilings. Size and install in accordance with PDI-WH 201 requirements. Provide water hammer arrestors at:

1. All solenoid valves.
2. All groups of two or more flush valves.
3. All quick opening or closing valves.
4. All medical washing equipment.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

A. General: Comply with the International Plumbing Code and the following:

1. Install branch piping for water from the piping system and connect to all fixtures, valves, cocks, outlets, casework, cabinets and equipment, including those furnished by the Government or specified in other sections.
2. Pipe shall be round and straight. Cutting shall be done with proper tools. Pipe, except for plastic and glass, shall be reamed to remove burrs and a clean smooth finish restored to full pipe inside diameter.
3. All pipe runs shall be laid out to avoid interference with other work/trades.

4. Install union and shut-off valve on pressure piping at connections to equipment.
5. Pipe Hangers, Supports and Accessories:
   a. All piping shall be supported per the IPC, H-18-8 Seismic Design Handbook, MSS SP-58, and SMACNA as required.
   b. Shop Painting and Plating: Hangers, supports, rods, inserts and accessories used for pipe supports shall be shop coated with zinc chromate primer paint. Electroplated copper hanger rods, hangers and accessories may be used with copper tubing.
   c. Floor, Wall and Ceiling Plates, Supports, Hangers:
      1) Solid or split un-plated cast iron.
      2) All plates shall be provided with set screws.
      3) Pipe Hangers: Height adjustable clevis type.
      4) Adjustable Floor Rests and Base Flanges: Steel.
      5) Concrete Inserts: "Universal" or continuous slotted type.
      6) Hanger Rods: Mild, low carbon steel, fully threaded or Threaded at each end with two removable nuts at each end for positioning rod and hanger and locking each in place.
      7) Pipe Hangers and Riser Clamps: Malleable iron or carbon steel. Pipe Hangers and riser clamps shall have a copper finish when supporting bare copper pipe or tubing.
      8) Rollers: Cast iron.
      9) Self-drilling type expansion shields shall be "Phillips" type, with case hardened steel expander plugs.
      10) Hangers and supports utilized with insulated pipe and tubing shall have 180 degree (minimum) metal protection shield centered on and welded to the hanger and support. The shield thickness and length shall be engineered and sized for distribution of loads to preclude crushing of insulation without breaking the vapor barrier. The shield shall be sized for the insulation and have flared edges to protect vapor-retardant jacket facing. To prevent the shield from sliding out of the clevis hanger during pipe movement, center-ribbed shields shall be used.
      11) Miscellaneous Materials: As specified, required, directed or as noted on the drawings for proper installation of hangers, supports and accessories. If the vertical distance exceeds 6.1

m (20 feet) for cast iron pipe additional support shall be provided in the center of that span. Provide all necessary auxiliary steel to provide that support.

12) With the installation of each flexible expansion joint, provide piping restraints for the upstream and downstream section of the piping at the flexible expansion joint. Provide calculations supporting the restraint length design and type of selected restraints. Restraint calculations shall be based on the criteria from the manufacturer regarding their restraint design.

6. Install chrome plated cast brass escutcheon with set screw at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.
7. Penetrations:
   a. Firestopping: Where pipes 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. Completely fill and seal clearances between raceways and openings with the firestopping materials.
   b. Waterproofing: At floor penetrations, completely seal clearances around the pipe and make watertight with sealant as specified in Section 07 92 00, JOINT SEALANTS. Bio-based materials shall be utilized when possible.
   c. Acoustical sealant: Where pipes pass through sound rated walls, seal around the pipe penetration with an acoustical sealant that is compliant with ASTM C919.

B. Domestic Water piping shall conform to the following:
   1. Grade all lines to facilitate drainage. Provide drain valves at bottom of risers and all low points in system. Design domestic hot water circulating lines with no traps.
   2. Connect branch lines at bottom of main serving fixtures below and pitch down so that main may be drained through fixture. Connect branch lines to top of main serving only fixtures located on floor above.

**3.2 TESTS**

A. General: Test system either in its entirety or in sections. Submit testing plan to COR 10 working days prior to test date.

B. Potable Water System: Test after installation of piping and domestic water heaters, but before piping is concealed, before covering is applied, and before plumbing fixtures are connected. Fill systems with water and maintain hydrostatic pressure of 1035 kPa (150 psig) gage for two hours. No decrease in pressure is allowed. Provide a pressure gage with a shutoff and bleeder valve at the highest point of the piping being tested. Pressure gauge shall have 1 psig increments.

D. All Other Piping Tests: Test new installed piping under 1-1/2 times actual operating conditions and prove tight.

E. The test pressure shall hold for the minimum time duration required by the applicable plumbing code or authority having jurisdiction.

**3.3 STERILIZATION**

A. After tests have been successfully completed, thoroughly flush and sterilize the interior domestic water distribution system in accordance with AWWA C651.

B. Use liquid chlorine or hypochlorite for sterilization.

**3.4 COMMISSIONING**

A. Provide commissioning documentation in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

B. Components provided under this section of the specification will be tested as part of a larger system.

**3.5 DEMONSTRATION AND TRAINING**

A. Provide services of manufacturer’s technical representative for four hours to instruct VA Personnel in operation and maintenance of the system.

B. Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

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**SECTION 22 13 00**
**FACILITY SANITARY AND VENT PIPING**

## PART 1 - GENERAL

### 1.1 DESCRIPTION

A. This section pertains to sanitary sewer and vent systems, including piping, equipment and all necessary accessories as designated in this section.

B. A complete listing of common acronyms and abbreviations are included in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

### 1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.

B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

D.

E. Section 07 84 00, FIRESTOPPING: Penetrations in rated enclosures.

F. Section 07 92 00, JOINT SEALANTS: Sealant products.

G. Section 09 91 00, PAINTING: Preparation and finish painting and identification of piping systems.

H. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING: Pipe Hangers and Supports, Materials Identification.

I. Section 22 07 11, PLUMBING INSULATION.

J. Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS

## 1.3 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. Where conflicts occur these specifications and the VHA standard will govern.

B. American Society of Mechanical Engineers (ASME):

A13.1-2007 .....Identification of Piping Systems

A112.36.2M-1991 .....Cleanouts

A112.6.3-2019 .....Floor and Trench Drains

B1.20.1-2013 .....Pipe Threads, General Purpose (Inch)

B16.1-2015 .....Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250

B16.4-2016 .....Grey Iron Threaded Fittings Classes 125 and 250

B16.15-2018 .....Cast Copper Alloy Threaded Fittings, Classes 125 and 250

B16.18-2018 .....Cast Copper Alloy Solder Joint Pressure Fittings

B16.21-2016 .....Nonmetallic Flat Gaskets for Pipe Flanges

B16.22-2018 .....Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings

B16.23-2016 .....Cast Copper Alloy Solder Joint Drainage Fittings: DWV

B16.24-2016 .....Cast Copper Alloy Pipe Flanges and Flanged Fittings, and Valves: Classes 150, 300, 600, 900, 1500, and 2500

B16.29-2017 .....Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fittings: DWV

B16.39-2014 .....Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300

B18.2.1-2012 .....Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series)

C. American Society of Sanitary Engineers (ASSE):

1001-2017 .....Performance Requirements for Atmospheric Type Vacuum Breakers

1018-2001 .....Performance Requirements for Trap Seal Primer Valves – Potable Water Supplied

1044-2015 .....Performance Requirements for Trap Seal Primer Devices – Drainage Types and Electronic Design Types

1079-2012 .....Performance Requirements for Dielectric Pipe Unions

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

A53/A53M-2018 .....Standard Specification for Pipe, Steel, Black And Hot-Dipped, Zinc-coated, Welded and Seamless

A74-2017 .....Standard Specification for Cast Iron Soil Pipe and Fittings

A888-2018a .....Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

B32-2008(R2014) .....Standard Specification for Solder Metal

B43-2015 .....Standard Specification for Seamless Red Brass Pipe, Standard Sizes

B88-2016 .....Standard Specification for Seamless Copper Water Tube

B306-2013 .....Standard Specification for Copper Drainage Tube (DWV)

B687-1999(R2016) .....Standard Specification for Brass, Copper, and Chromium-Plated Pipe Nipples

B813-2016 .....Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube

B828-2016 .....Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings

C564-2014 .....Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings

D2321-2018 .....Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications

D2564-2012(R3018) .....Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems

D2665-2014 .....Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings

D2855-2015 .....Standard Practice for Two-Step (Primer and Solvent Cement) Method of Joining Poly(Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) CPVCP Pipe and Piping Components with Tapered Sockets

D5926-2015 .....Standard Specification for Poly(Vinyl Chloride) (PVC) Gaskets for Drain, Waste, and Vent (DWV), Sewer, Sanitary, and Storm Plumbing Systems

F402-2018 .....Standard Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings

F477-2014 .....Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

F1545-2015e1 .....Standard Specification for Plastic-Lined Ferrous Metal Pipe, Fittings, and Flanges

E. Cast Iron Soil Pipe Institute (CISPI):

2006 .....Cast Iron Soil Pipe and Fittings Handbook

301-2012 .....Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

310-2012 .....Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

F. Copper Development Association, Inc. (CDA):

A4015-14/19 .....Copper Tube Handbook

G. International Code Council (ICC):

IPC-2018 .....International Plumbing Code

H. Manufacturers Standardization Society (MSS):

SP-123-2018 .....Non-Ferrous Threaded and Solder-Joint Unions for Use with Copper Water Tube

I. National Fire Protection Association (NFPA):

70-2020 .....National Electrical Code (NEC)

J. Underwriters' Laboratories, Inc. (UL):

508-99 (R2013) .....Standard For Industrial Control Equipment

**1.4 SUBMITTALS**

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 22 13 00, FACILITY SANITARY AND VENT PIPING", with applicable paragraph identification.

C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.

1. Piping.
2. Floor Drains.
3. Cleanouts.
4. Trap Seal Protection.
5. Pipe Fittings.
6. Traps.
7. Exposed Piping and Fittings.

D. Detailed shop drawing of clamping device and extensions when required in connection with the waterproofing membrane or the floor drain.

E. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replaceable parts, and troubleshooting guide:

1. Include complete list indicating all components of the systems.
2. Include complete diagrams of the internal wiring for each item of equipment.
3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

F. Completed System Readiness Checklist provided by the CXA and completed by the Contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

G. Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

**1.5 QUALITY ASSURANCE**

A. Bio-Based Materials: For products designated by the USDA's bio-based Bio-Preferred Program, provide products that meet or exceed USDA recommendations for bio-based content, so long as products meet all performance requirements in this specifications section. For more information regarding the product categories covered by the Bio-Preferred Program, visit http:www.biopreferred.gov.

B. Refer to Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS for additional sustainable design requirements.

**1.6 AS-BUILT DOCUMENTATION**

A. Comply with requirements in Paragraph "AS-BUILT DOCUMENTATION" of Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

**PART 2 - PRODUCTS**

**2.1 SANITARY WASTE, DRAIN, AND VENT PIPING**

A. Cast iron waste, drain, and vent pipe and fittings.

1. Cast iron waste, drain, and vent pipe and fittings shall be used for the following applications:
   a. Pipe buried in or in contact with earth.
   b. Interior waste and vent piping above grade.
2. Cast iron Pipe shall be bell and spigot or hubless (plain end or no-hub or hubless).
3. The material for all pipe and fittings shall be cast iron soil pipe and fittings and shall conform to the requirements of CISPI 301, ASTM A888, or ASTM A74.
4. Cast iron pipe and fittings shall be made from a minimum of 95 percent post-consumer recycled material.
5. Joints for hubless pipe and fittings shall conform to the manufacturer's installation instructions. Couplings for hubless joints shall conform to CISPI 310. Joints for hub and spigot pipe shall be installed with compression gaskets conforming to the requirements of ASTM C564.

B. Copper Tube, (DWV):

1. Copper DWV tube sanitary waste, drain and vent pipe may be used for piping above ground, except for urinal drains.

2. The copper DWV tube shall be drainage type, drawn temper conforming to ASTM B306.
3. The copper drainage fittings shall be cast copper or wrought copper conforming to ASME B16.23 or ASME B16.29.
4. The joints shall be lead free, using a water flushable flux, and conforming to ASTM B32.

5.

**2.2 EXPOSED WASTE PIPING**

A. Chrome plated brass piping of full iron pipe size shall be used in finished rooms for exposed waste piping connecting fixtures, casework, cabinets, equipment and reagent racks when not concealed by apron including those furnished by the Government or specified in other sections.
   1. The Pipe shall meet ASTM B43, regular weight.
   2. The Fittings shall conform to ASME B16.15 or ASTM D2665.
   3. Nipples shall conform to ASTM B687, Chromium-plated.
   4. Unions shall be brass or bronze with chrome finish. Unions 65 mm (2-1/2 inches) and larger shall be flange type with approved gaskets.

B. In unfinished Rooms such as mechanical Rooms and Kitchens, Chrome-plated brass piping is not required. The pipe materials specified under the paragraph "Sanitary Waste, Drain, and Vent Piping" can be used. The sanitary pipe in unfinished rooms shall be painted as specified in Section 09 91 00, PAINTING.

**2.3 SPECIALTY PIPE FITTINGS**

A. Transition pipe couplings shall join piping with small differences in outside diameters or different materials. End connections shall be of the same size and compatible with the pipes being joined. The transition coupling shall be elastomeric, sleeve type reducing or transition pattern and include shear and corrosion resistant metal, tension band and tightening mechanism on each end. The transition coupling sleeve coupling shall be of the following material:
   1. For cast iron soil pipes, the sleeve material shall be rubber conforming to ASTM C564.
   2.

3. For dissimilar pipes, the sleeve material shall be PVC conforming to ASTM D5926, or other material compatible with the pipe materials being joined.

B. The dielectric fittings shall conform to ASSE 1079 with a pressure rating of 861 kPa (125 psig) at a minimum temperature of 82 degrees C (180 degrees F). The end connection shall be solder joint copper alloy and threaded ferrous.

C. Dielectric flange insulating kits shall be of non-conducting materials for field assembly of companion flanges with a pressure rating of 1035 kPa (150 psig). The gasket shall be neoprene or phenolic. The bolt sleeves shall be phenolic or polyethylene. The washers shall be phenolic with steel backing washers.

D. The di-electric nipples shall be electroplated steel nipple complying with ASTM F1545 with a pressure rating of 2070 kPa (300 psig) at 107 degrees C (225 degrees F). The end connection shall be male threaded. The lining shall be inert and noncorrosive propylene.

**2.4 CLEANOUTS**

A. Cleanouts shall be the same size as the pipe, up to 100 mm (4 inches); and not less than 100 mm (4 inches) for larger pipe. Cleanouts shall be easily accessible and shall be gastight and watertight. Minimum clearance of 600 mm (24 inches) shall be provided for clearing a clogged sanitary line.

B. Floor cleanouts shall be gray iron housing with clamping device and round, secured, scoriated, gray iron cover conforming to ASME A112.36.2M. A gray iron ferrule with hubless, socket, inside calk or spigot connection and counter sunk, taper-thread, brass or bronze closure plug shall be included. The frame and cover material and finish shall be nickel-bronze copper alloy with a square shape. The cleanout shall be vertically adjustable for a minimum of 50 mm (2 inches). When a waterproof membrane is used in the floor system, clamping collars shall be provided on the cleanouts. Cleanouts shall consist of wye fittings and eighth bends with brass or bronze screw plugs. Cleanouts in the resilient tile floors, quarry tile and ceramic tile floors shall be provided with square top covers recessed for tile insertion. In the carpeted areas, carpet cleanout markers shall be provided. Two way cleanouts shall be provided where indicated in the contract document and at every building exit. The loading classification for cleanouts in

sidewalk areas or subject to vehicular traffic shall be heavy duty type.

C. Cleanouts shall be provided at or near the base of the vertical stacks with the cleanout plug located approximately 600 mm (24 inches) above the floor. If there are no fixtures installed on the lowest floor, the cleanout shall be installed at the base of the stack. The cleanouts shall be extended to the wall access cover. Cleanout shall consist of sanitary tees. Nickel-bronze square frame and stainless steel cover with minimum opening of 150 by 150 mm (6 by 6 inches) shall be furnished at each wall cleanout. Where the piping is concealed, a fixture trap or a fixture with integral trap, readily removable without disturbing concealed pipe, shall be accepted as a cleanout equivalent providing the opening to be used as a cleanout opening is the size required.

D. In horizontal runs above grade, cleanouts shall consist of cast brass tapered screw plug in fitting or caulked/hubless cast iron ferrule. Plain end (hubless) piping in interstitial space or above ceiling may use plain end (hubless) blind plug and clamp.

**2.5 FLOOR DRAINS**

A. General Data: floor drain shall comply with ASME A112.6.3. A caulking flange, inside gasket, or hubless connection shall be provided for connection to cast iron pipe, screwed or no hub outlets for connection to steel pipe. The drain connection shall be bottom outlet. A membrane clamp and extensions shall be provided, if required, where installed in connection with waterproof membrane. Puncturing membrane other than for drain opening shall not be permitted. Double drainage pattern floor drains shall have integral seepage pan for embedding into floor construction, and weep holes to provide adequate drainage from pan to drain pipe. For drains not installed in connection with a waterproof membrane, a .45 kg (16-ounce) soft copper 1.1 to 1.8 Kg (2.5 to 4 lbs.) flashing membrane, 600 mm (24 inches) square or another approved waterproof membrane shall be provided.

B. Type E (FD-E) floor drain shall comply with ASME A112.6.3. The type E floor drain shall have a heavy, cast iron body, double drainage pattern, heavy non-tilting nickel bronze ductile iron grate not less

than 300 mm (12 inches) square, removable sediment bucket. Clearance between body and bucket shall be ample for free flow of waste water. For traffic use, an extra heavy duty load classification ductile iron grate shall be provided.

**2.6 TRAPS**

A. Traps shall be provided on all sanitary branch waste connections from fixtures or equipment not provided with traps. Exposed brass shall be polished brass chromium plated with nipple and set screw escutcheons. Concealed traps may be rough cast brass or same material as the piping they are connected to. Slip joints are prohibited on sewer side of trap. Traps shall correspond to fittings on cast iron soil pipe or steel pipe respectively, and size shall be as required by connected service or fixture.

**2.7 PRIMER VALVES AND TRAP SEAL PRIMER SYSTEMS**

1. .

B. Trap Primer (TP-2): The trap seal primer valve shall be hydraulic, supply type with a pressure rating of 861 kPa (125 psig) and conforming to standard ASSE 1018.

1. The inlet and outlet connections shall be 15 mm or DN15 (NPS 1/2 inch)
2. The trap seal primer valve shall be fully automatic with an all brass or bronze body.
3. The trap seal primer valve shall be activated by a drop in building water pressure, no adjustment required.
4. The trap seal primer valve shall include a manifold when serving two, three, or four traps.
5. The manifold shall be omitted when serving only one trap.

**2.8 PENETRATION SLEEVES**

A. A sleeve flashing device shall be provided at points where pipes pass through membrane waterproofed floors or walls. The sleeve flashing device shall be manufactured, cast iron fitting with clamping device that forms a sleeve for the pipe floor penetration of the floor membrane. A galvanized steel pipe extension shall be included in the top of the fitting that shall extend 50 mm (2 inches) above finished floor and galvanized steel pipe extension in the bottom of the fitting

that shall extend through the floor slab. A waterproof caulked joint shall be provided at the top hub.

**PART 3 - EXECUTION**

**3.1 PIPE INSTALLATION**

A. The pipe installation shall comply with the requirements of the International Plumbing Code (IPC) and these specifications.

B. Branch piping shall be installed for waste from the respective piping systems and connect to all fixtures, valves, cocks, outlets, casework, cabinets and equipment, including those furnished by the Government or specified in other sections.

C. Pipe shall be round and straight. Cutting shall be done with proper tools. Pipe shall be reamed to full size after cutting.

D. All pipe runs shall be laid out to avoid interference with other work.

E. The piping shall be installed above accessible ceilings where possible.

F. The piping shall be installed to permit valve servicing or operation.

G. The piping shall be installed free of sags and bends.

H. Seismic restraint shall be installed where required by code.

I. Changes in direction for soil and waste drainage and vent piping shall be made using appropriate branches, bends and long sweep bends. Sanitary tees and short sweep quarter bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Long turn double wye branch and eighth bend fittings shall be used if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow greater than 90 degrees. Proper size of standard increaser and reducers shall be used if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

J. Buried soil and waste drainage and vent piping shall be laid beginning at the low point of each system. Piping shall be installed true to grades and alignment indicated with unbroken continuity of invert. Hub ends shall be placed upstream. Required gaskets shall be installed according to manufacturer’s written instruction for use of lubricants, cements, and other installation requirements.

K. Cast iron piping shall be installed according to CISPI’s “Cast Iron Soil Pipe and Fittings Handbook,” Chapter IV, “Installation of Cast Iron Soil Pipe and Fittings”

L. Aboveground copper tubing shall be installed according to Copper Development Association's (CDA) "Copper Tube Handbook".

M. Aboveground PVC piping shall be installed according to ASTM D2665. Underground PVC piping shall be installed according to ASTM D2321.

N. If an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no additional cost or time to the Government.

**3.2 JOINT CONSTRUCTION**

A. Hub and spigot, cast iron piping with gasket joints shall be joined in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Hub and spigot, cast iron piping with calked joints shall be joined in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.

C. Hubless or No-hub, cast iron piping shall be joined in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless piping coupling joints.

D. For threaded joints, thread pipe with tapered pipe threads according to ASME B1.20.1. The threads shall be cut full and clean using sharp disc cutters. Threaded pipe ends shall be reamed to remove burrs and restored to full pipe inside diameter. Pipe fittings and valves shall be joined as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is required by the pipe service.
2. Pipe sections with damaged threads shall be replaced with new sections of pipe.

E. Copper tube and fittings with soldered joints shall be joined according to ASTM B828. A water flushable, lead free flux conforming to ASTM B813 and a lead-free alloy solder conforming to ASTM B32 shall be used.

F.

**3.3 SPECIALTY PIPE FITTINGS**

A. Transition coupling shall be installed at pipe joints with small differences in pipe outside diameters.

B. Dielectric fittings shall be installed at connections of dissimilar metal piping and tubing.

## 3.4 PIPE HANGERS, SUPPORTS AND ACCESSORIES

A. All piping shall be supported according to the International Plumbing Code (IPC), Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, and these specifications. Where conflicts arise between these the code and Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING the most restrictive or the requirement that specifies supports with highest loading or shortest spacing shall apply.

B. Hangers, supports, rods, inserts and accessories used for pipe supports shall be painted according to Section 09 91 00, PAINTING. Electroplated copper hanger rods, hangers and accessories may be used with copper tubing.

C. Horizontal piping and tubing shall be supported within 300 mm (12 inches) of each fitting or coupling.

D. Horizontal cast iron piping shall be supported with the following maximum horizontal spacing and minimum hanger rod diameters:

1. 40 mm or DN40 to 50 mm or DN50 (NPS 1-1/2 inch to NPS 2 inch): 1500 mm (60 inches) with 10 mm (3/8 inch) rod.

E. The maximum spacing for plastic pipe shall be 1.22 m (4 feet).

F. Vertical piping and tubing shall be supported at the base, at each floor, and at intervals no greater than 4.6 m (15 feet).

G. In addition to the requirements in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, Floor, Wall and Ceiling Plates, Supports, Hangers shall have the following characteristics:

1. Solid or split unplated cast iron.
2. All plates shall be provided with set screws.
3. Height adjustable clevis type pipe hangers.
4. Adjustable floor rests and base flanges shall be steel.
5. Hanger rods shall be low carbon steel, fully threaded or threaded at each end with two removable nuts at each end for positioning rod and hanger and locking each in place.
6. Riser clamps shall be malleable iron or steel.
7. Rollers shall be cast iron.
8. See Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, for requirements on insulated pipe protective shields at hanger supports.

H. Miscellaneous materials shall be provided as specified, required, directed or as noted in the contract documents for proper installation

of hangers, supports and accessories. If the vertical distance exceeds 6.1 m (20 feet) for cast iron pipe additional support shall be provided in the center of that span. All necessary auxiliary steel shall be provided to provide that support.

I. Cast escutcheon with set screw shall be provided at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.

J. Penetrations:

1. Fire Stopping: Where pipes pass through fire partitions, fire walls, smoke partitions, or floors, a fire stop shall be installed that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING. Clearances between raceways and openings shall be completely filled and sealed with the fire stopping materials.
2. Water proofing: At floor penetrations, clearances shall be completely sealed around the pipe and make watertight with sealant as specified in Section 07 92 00, JOINT SEALANTS.

K. Exhaust vents shall be extended separately through roof. Sanitary vents shall not connect to exhaust vents.

**3.5 TESTS**

A. Sanitary waste and drain systems shall be tested either in its entirety or in sections.

B. Waste System tests shall be conducted before trenches are backfilled or fixtures are connected. A water test or air test shall be conducted, as directed.

1. If entire system is tested for a water test, tightly close all openings in pipes except highest opening, and fill system with water to point of overflow. If the waste system is tested in sections, tightly plug each opening except highest opening of section under test, fill each section with water and test with at least a 3 m (10 foot) head of water. In testing successive sections, test at least upper 3 m (10 feet) of next preceding section so that each joint or pipe except upper most 3 m (10 feet) of system has been submitted to a test of at least a 3 m (10 foot) head of water. Water shall be kept in the system, or in portion under test, for at least 15

minutes before inspection starts. System shall then be tight at all joints.

2. For an air test, an air pressure of 34 kPa (5 psig) gauge shall be maintained for at least 15 minutes without leakage. A force pump and mercury column gauge shall be used for the air test.
3. After installing all fixtures and equipment, open water supply so that all p-traps can be observed. For 15 minutes of operation, all p-traps shall be inspected for leaks and any leaks found shall be corrected.
4. Final Tests: Either one of the following tests may be used.
   a. Smoke Test: After fixtures are permanently connected and traps are filled with water, fill entire drainage and vent systems with smoke under pressure of .25 kPa (1 inch of water) with a smoke machine. Chemical smoke is prohibited.
   b. Peppermint Test: Introduce 60 ml (2 ounces) of peppermint into each line or stack.

**3.6 COMMISSIONING**

A. Provide commissioning documentation in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

B. Components provided under this section of the specification shall be tested as part of a larger system.

**3.7 DEMONSTRATION AND TRAINING**

A. Provide services of manufacturer’s technical representative for 4 hours to instruct each VA personnel responsible in operation and maintenance of the system.

B. Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

- - - E N D - -

**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. Exterior: Piping, ductwork, and equipment exposed to weather be it temperature, humidity, precipitation, wind, or solar radiation.

C. Abbreviations/Acronyms:

1. ac: Alternating Current
2. AC: Air Conditioning
3. ACU: Air Conditioning Unit
4. ACR: Air Conditioning and Refrigeration
5. AI: Analog Input
6. AISI: American Iron and Steel Institute
7. AO: Analog Output
8. ASJ: All Service Jacket
9. AWG: American Wire Gauge
10. BACnet: Building Automation and Control Networking Protocol
11. BAg: Silver-Copper-Zinc Brazing Alloy
12. BAS: Building Automation System
13. BCuP: Silver-Copper-Phosphorus Brazing Alloy
14. bhp: Brake Horsepower
15. Btu: British Thermal Unit
16. Btu/h: British Thermal Unit Per Hour
17. CDA: Copper Development Association
18. C: Celsius
19. CD: Compact Disk
20. CFM: Cubic Foot Per Minute
21. CH: Chilled Water Supply
22. CHR: Chilled Water Return
23. CLR: Color
24. CO: Carbon Monoxide
25. COR: Contracting Officer’s Representative

26. CPD: Condensate Pump Discharge
27. CPM: Cycles Per Minute
28. CPVC: Chlorinated Polyvinyl Chloride
29. CRS: Corrosion Resistant Steel
30. CTPD: Condensate Transfer Pump Discharge
31. CTPS: Condensate Transfer Pump Suction
32. CW: Cold Water
33. CWP: Cold Working Pressure
34. CxA: Commissioning Agent
35. dB: Decibels
36. dB(A): Decibels (A weighted)
37. DDC: Direct Digital Control
38. DI: Digital Input
39. DO: Digital Output
40. DVD: Digital Video Disc
41. DN: Diameter Nominal
42. DWV: Drainage, Waste and Vent
43. EPDM: Ethylene Propylene Diene Monomer
44. EPT: Ethylene Propylene Terpolymer
45. ETO: Ethylene Oxide
46. F: Fahrenheit
47. FAR: Federal Acquisition Regulations
48. FD: Floor Drain
49. FED: Federal
50. FG: Fiberglass
51. FGR: Flue Gas Recirculation
52. FOS: Fuel Oil Supply
53. FOR: Fuel Oil Return
54. FSK: Foil-Scrim-Kraft facing
55. FWPD: Feedwater Pump Discharge
56. FWPS: Feedwater Pump Suction
57. GC: Chilled Glycol Water Supply
58. GCR: Chilled Glycol Water Return
59. GH: Hot Glycol Water Heating Supply
60. GHR: Hot Glycol Water Heating Return
61. gpm: Gallons Per Minute
62. HDPE: High Density Polyethylene

63. Hg: Mercury
64. HOA: Hands-Off-Automatic
65. hp: Horsepower
66. HPS: High Pressure Steam (414 kPa (60 psig) and above)
67. HPR: High Pressure Steam Condensate Return
68. HW: Hot Water
69. HWH: Hot Water Heating Supply
70. HWHR: Hot Water Heating Return
71. Hz: Hertz
72. ID: Inside Diameter
73. IPS: Iron Pipe Size
74. kg: Kilogram
75. klb: 1000 lb
76. kPa: Kilopascal
77. lb: Pound
78. lb/hr: Pounds Per Hour
79. L/s: Liters Per Second
80. L/min: Liters Per Minute
81. LPS: Low Pressure Steam (103 kPa (15 psig) and below)
82. LPR: Low Pressure Steam Condensate Gravity Return
83. MAWP: Maximum Allowable Working Pressure
84. MAX: Maximum
85. MBtu/h: 1000 Btu/h
86. MBtu: 1000 Btu
87. MED: Medical
88. m: Meter
89. MFG: Manufacturer
90. mg: Milligram
91. mg/L: Milligrams Per Liter
92. MIN: Minimum
93. MJ: Megajoules
94. ml: Milliliter
95. mm: Millimeter
96. MPS: Medium Pressure Steam (110 kPa (16 psig) through 414 kPa (60 psig))
97. MPR: Medium Pressure Steam Condensate Return
98. MW: Megawatt

99. NC: Normally Closed
100. NF: Oil Free Dry (Nitrogen)
101. Nm: Newton Meter
102. NO: Normally Open
103. NOx: Nitrous Oxide
104. NPT: National Pipe Thread
105. NPS: Nominal Pipe Size
106. OD: Outside Diameter
107. OSD: Open Sight Drain
108. OS&Y: Outside Stem and Yoke
109. PC: Pumped Condensate
110. PID: Proportional-Integral-Differential
111. PLC: Programmable Logic Controllers
112. PP: Polypropylene
113. PPE: Personal Protection Equipment
114. ppb: Parts Per Billion
115. ppm: Parts Per Million
116. PRV: Pressure Reducing Valve \
117. PSIA: Pounds Per Square Inch Absolute
118. psig: Pounds Per Square Inch Gauge
119. PTFE: Polytetrafluoroethylene
120. PVC: Polyvinyl Chloride
121. PVDC: Polyvinylidene Chloride Vapor Retarder Jacketing, White
122. PVDF: Polyvinylidene Fluoride
123. rad: Radians
124. RH: Relative Humidity
125. RO: Reverse Osmosis
126. rms: Root Mean Square
127. RPM: Revolutions Per Minute
128. RS: Refrigerant Suction
129. RTD: Resistance Temperature Detectors
130. RTRF: Reinforced Thermosetting Resin Fittings
131. RTRP: Reinforced Thermosetting Resin Pipe
132. SCFM: Standard Cubic Feet Per Minute
133. SPEC: Specification
134. SPS: Sterile Processing Services
135. STD: Standard

136. SDR: Standard Dimension Ratio
137. SUS: Saybolt Universal Second
138. SW: Soft water
139. SWP: Steam Working Pressure
140. TAB: Testing, Adjusting, and Balancing
141. TDH: Total Dynamic Head
142. TEFC: Totally Enclosed Fan-Cooled
143. TFE: Tetrafluoroethylene
144. THERM: 100,000 Btu
145. THHN: Thermoplastic High-Heat Resistant Nylon Coated Wire
146. THWN: Thermoplastic Heat & Water-Resistant Nylon Coated Wire
147. T/P: Temperature and Pressure
148. USDA: U.S. Department of Agriculture
149. V: Volt
150. VAC: Vacuum
151. VA: Veterans Administration
152. VAC: Voltage in Alternating Current
153. VA CFM: VA Construction & Facilities Management
154. VA CFM CSS: VA Construction & Facilities Management, Consulting Support Service
155. VAMC: Veterans Administration Medical Center
156. VHA OCAMES: Veterans Health Administration – Office of Capital Asset Management Engineering and Support
157. VR: Vacuum condensate return
158. WCB: Wrought Carbon Steel, Grade B
159. WG: Water Gauge or Water Column
160. WOG: Water, Oil, Gas

**1.2 RELATED WORK**

A. Section 01 00 00, GENERAL REQUIREMENTS.
B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
C. Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT.
D. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.
E. Section 07 84 00, FIRESTOPPING.
F. Section 07 92 00, JOINT SEALANTS.
G. Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.
H. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.
I. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

J. Section 23 36 00, AIR TERMINAL UNITS.

K. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES.

**1.3 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. Where conflicts occur these specifications and the VHA standard will govern.

B. Air Movement and Control Association (AMCA):

410-1996.....Recommended Safety Practices for Users and Installers of Industrial and Commercial Fans

C. American Society of Mechanical Engineers (ASME):

B31.1-2018.....Power Piping

B31.9-2014.....Building Services Piping

ASME Boiler and Pressure Vessel Code:

BPVC Section IX-2019 Welding, Brazing, and Fusing Qualifications

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

A36/A36M-2014.....Standard Specification for Carbon Structural Steel

A575-1996(R2018).....Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades

E. Association for Rubber Products Manufacturers (ARPM):

IP-20-2015.....Specifications for Drives Using Classical V-Belts and Sheaves

IP-21-2016.....Specifications for Drives Using Double-V (Hexagonal) Belts

IP-24-2016.....Specifications for Drives Using Synchronous Belts

IP-27-2015.....Specifications for Drives Using Curvilinear Toothed Synchronous Belts

F. Manufacturers Standardization Society (MSS) of the Valve and Fittings Industry, Inc.:

SP-58-2018.....Pipe Hangers and Supports-Materials, Design, Manufacture, Selection, Application, and Installation

SP-127-2014a.....Bracing for Piping Systems: Seismic-Wind-Dynamic Design, Selection, and Application

G. Military Specifications (MIL):

MIL-P-21035B-2013.....Paint High Zinc Dust Content, Galvanizing Repair (Metric)

H. National Fire Protection Association (NFPA):

70-2017.....National Electrical Code (NEC)

101-2018.....Life Safety Code

I. Department of Veterans Affairs (VA):

PG-18-10-2016.....Physical Security and Resiliency Design Manual

**1.4 SUBMITTALS**

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 23 05 11, COMMON WORK RESULTS FOR HVAC", with applicable paragraph identification.

C. If the project is phased submit complete phasing plan/schedule with manpower levels prior to commencing work. The phasing plan shall be detailed enough to provide milestones in the process that can be verified.

D. Contractor shall make all necessary field measurements and investigations to assure that the equipment and assemblies will meet contract requirements, and all equipment that requires regular maintenance, calibration, etc are accessable from the floor or permanent work platform. It is the Contractor's responsibility to ensure all submittals meet the VA specifications and requirements and it is assumed by the VA that all submittals do meet the VA specifications unless the Contractor has requested a variance in writing and approved by COR prior to the submittal. If at any time during the project it is found that any item does not meet the VA specifications and there was no variance approval the Contractor shall correct at no additional cost or time to the Government even if a submittal was approved.

E. If equipment is submitted which differs in arrangement from that shown, provide documentation proving equivalent performance, design standards and drawings that show the rearrangement of all associated systems. Additionally, any impacts on ancillary equipment or services such as foundations, piping, and electrical shall be the Contractor's

responsibility to design, supply, and install at no additional cost or time to the Government. VA approval will be given only if all features of the equipment and associated systems, including accessibility, are equivalent to that required by the contract.

F. Prior to submitting shop drawings for approval, Contractor shall certify in writing that manufacturers of all major items of equipment have each reviewed contract documents, and have jointly coordinated and properly integrated their equipment and controls to provide a complete and efficient installation.

G. Submittals and shop drawings for interdependent items, containing applicable descriptive information, shall be furnished together. Coordinate and properly integrate materials and equipment to provide a completely compatible and efficient installation.

H. Coordination/Shop Drawings:

1. Submit complete consolidated and coordinated shop drawings for all new systems, and for existing systems that are in the same areas.
2. The coordination/shop 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 coordination/shop drawings of all piping and duct systems. The drawings should include all lockout/tagout points for all energy/hazard sources for each piece of equipment. Coordinate lockout/tagout procedures and practices with local VA requirements.
3. Do not install equipment foundations, equipment or piping until coordination/shop drawings have been approved.
4. In addition, for HVAC systems, provide details of the following:

a. Mechanical equipment rooms.

b.

c. Hangers, inserts, supports, and bracing.

d. Pipe sleeves.

e. Duct or equipment penetrations of floors, walls, ceilings, or roofs.

I. Manufacturer's Literature and Data: Include full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity. 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 COR.
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 complete stress analysis for variable spring and constant support hangers.
6. Wall, floor, and ceiling plates.

J. HVAC Maintenance Data and Operating Instructions:

1. Maintenance and operating manuals in accordance with Section 01 00 00, GENERAL REQUIREMENTS, Article, INSTRUCTIONS, for systems and equipment.
2. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replacement parts, and troubleshooting guide:
   a. Include complete list indicating all components of the systems.
   b. Include complete diagrams of the internal wiring for each item of equipment.
   c. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.
3. Provide a listing of recommended replacement parts for keeping in stock supply, including sources of supply, for equipment. Include in the listing belts for equipment: Belt manufacturer, model number, size and style, and distinguished whether of multiple belt sets.

K. Provide copies of approved HVAC equipment submittals to the TAB and Commissioning Subcontractor.

L. Completed System Readiness Checklist provided by the Commissioning Agent and completed by the Contractor, signed by a qualified technician

and dated on the date of completion, in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

M. Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

**1.5 QUALITY ASSURANCE**

A. Mechanical, electrical and associated systems shall be safe, reliable, efficient, durable, easily and safely operable and maintainable, easily and safely accessible, and in compliance with applicable codes as specified. The systems shall be comprised of high quality institutional-class and industrial-class products of manufacturers that are experienced specialists in the required product lines. All construction firms and personnel shall be experienced and qualified specialists in industrial and institutional HVAC.

B. 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 (or longer as specified elsewhere). The design, model and size of each item shall have been in satisfactory and efficient operation on at least three installations for approximately three years. However, digital electronics devices, software and systems such as controls, instruments, computer work station, shall be the current generation of technology and basic design that has a proven satisfactory service record of at least three years. See other specification sections for any exceptions and/or additional requirements.
2. Refer to all other sections for quality assurance requirements for systems and equipment specified therein.

3. All items furnished shall be free from defects that would adversely affect the performance, maintainability and appearance of individual components and overall assembly.
4. The products and execution of work specified in Division 33 shall conform to the referenced codes and standards as required by the specifications. Local codes and amendments shall be enforced, along with requirements of local utility companies. The most stringent requirements of these specifications, local codes, or utility company requirements shall always apply. Any conflicts shall be brought to the attention of the COR.
5. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be of the same manufacturer and model number, or if different models are required they shall be of the same manufacturer and identical to the greatest extent possible (i.e., same model series).
6. Assembled Units: Performance and warranty of all components that make up an assembled unit shall be the responsibility of the manufacturer of the completed assembly.
7. 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.
8. Use of asbestos products or equipment or materials containing asbestos is prohibited.

E. HVAC Equipment Service Providers: Service providers shall be authorized and trained by the manufacturers of the equipment supplied. These providers shall be capable of responding onsite and provide acceptable service to restore equipment operations within 4 hours of receipt of notification by phone, e-mail or fax in event of an emergency, such as the shutdown of equipment; or within 24 hours in a non-emergency. Submit names, mail and e-mail addresses and phone numbers of service personnel and companies providing service under these conditions for (as applicable to the project): fans, air handling units, chillers, cooling towers, control systems, pumps, critical instrumentation, computer workstation and programming.

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 BPVC Section IX. Provide proof of current certification.
   2. Comply with provisions of ASME B31 series "Code for Pressure Piping".
   3. Certify that each welder and welding operator has passed American Welding Society (AWS) qualification tests for the welding processes involved, and that certification is current.
   4. All welds shall be stamped according to the provisions of the AWS or ASME as required herein and by the associated code.

G. 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 COR with submittals. 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 and removal by the Contractor and no additional cost or time to the Government.

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 documents to the COR for resolution. Provide written hard copies and computer files on CD or DVD of manufacturer’s installation instructions to the COR with submittals prior to commencing installation of any item. Installation of the item will not be allowed to proceed until the recommendations are received and approved by the VA. 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 documents to the COR for resolution. Failure of the Contractor to resolve, or point out any issues will result in the Contractor correcting at no additional cost or time to the Government.

3. Complete coordination/shop drawings shall be required in accordance with Article, SUBMITTALS. Construction work shall not start on any system until the coordination/shop drawings have been approved by VA.
4. Workmanship/craftsmanship will be of the highest quality and standards. The VA reserves the right to reject any work based on poor quality of workmanship this work shall be removed and done again at no additional cost or time to the Government.

I. Upon request by Government, provide lists of previous installations for selected items of equipment. Include contact persons who will serve as references, with current telephone numbers and e-mail addresses.

J. Guaranty: Warranty of Construction, FAR Clause 52.246-21.

**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 or theft.
2. Repair damaged equipment in first class, new operating condition and appearance; or, replace same as determined and directed by the COR. Such repair or replacement shall be at no additional cost or time to the Government.
3. Protect interiors of new equipment and piping systems against entry of foreign matter. Clean both inside and outside before painting or placing equipment in operation.
4. Existing equipment and piping being worked on by the Contractor shall be under the custody and responsibility of the Contractor and shall be protected as required for new work.

B. Cleanliness of Piping and Equipment Systems:
   1. Exercise care in storage and handling of equipment and piping material to be incorporated in the work. Remove debris arising from cutting, threading and welding of piping.
   2. Piping systems shall be flushed, blown or pigged as necessary to deliver clean systems.
   3. Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems.

**1.7 AS-BUILT DOCUMENTATION**

A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.

B. Submit operation and maintenance data updated to include submittal review comments, VA approved substitutions and construction revisions shall be in electronic version on CD or DVD inserted into a three-ring binder. All aspects of system operation and maintenance procedures, including applicable piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices shall be included. A List of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.

C. The installing Contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. Should the installing Contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement. Provide record drawings as follows:
   1. As-built drawings are to be provided, with a copy of them on AutoCAD version 14 provided on CD or DVD. The CAD drawings

shall use multiple line layers with a separate individual layer for each system.

2.

D. The as-built drawings shall indicate the location and type of all lockout/tagout points for all energy sources for all equipment and pumps to include breaker location and numbers, valve tag numbers, etc. Coordinate lockout/tagout procedures and practices with local VA requirements.

E. Certification documentation shall be provided to COR 21 working days prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and provide documentation/certification that all results of tests were within limits specified. Test results shall contain written sequence of test procedure with written test results annotated at each step along with the expected outcome or setpoint. The results shall include all readings, including but not limited to data on device (make, model and performance characteristics_), normal pressures, switch ranges, trip points, amp readings, and calibration data to include equipment serial numbers or individual identifications, etc.

**1.8 JOB CONDITIONS – WORK IN EXISTING BUILDING**

A. Building Operation: Government employees will be continuously operating and managing all facilities, including temporary facilities that serve the VAMC.

B. Maintenance of Service: Schedule all work to permit continuous service as required by the VAMC.

C.

D. Building Working Environment: Maintain the architectural and structural integrity of the building and the working environment at all times. Maintain the interior of building at 18 degrees C (65 degrees F) minimum. Limit the opening of doors, windows or other access openings to brief periods as necessary for rigging purposes. Storm water or ground water leakage is prohibited. Provide daily clean-up of construction and demolition debris on all floor surfaces and on all equipment being operated by VA. Maintain all egress routes and safety systems/devices.

E. Acceptance of Work for Government Operation: As new equipment, systems and facilities are made available for operation and these items are deemed of beneficial use to the Government, inspections will be made and tests will be performed. Based on the inspections, a list of contract deficiencies will be issued to the Contractor. After correction of deficiencies as necessary for beneficial use, the Contracting Officer will process necessary acceptance and the equipment will then be under the control and operation of Government personnel.

**PART 2 - PRODUCTS**

**2.1 FACTORY-ASSEMBLED PRODUCTS**

A. Provide maximum standardization of components to reduce spare part requirements.

B. Performance and warranty of all components that make up an assembled unit shall be the responsibility of the manufacturer of the completed assembly.

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. Equipment and components of equipment shall bear manufacturer's name and trademark, model number, serial number and performance data on a nameplate 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 must be approved by the VA, but may 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 ELECTRIC MOTORS**

A. All material and equipment furnished and installation methods shall conform to the requirements of Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC AND STEAM GENERATION EQUIPMENT; Section 26 29 11, MOTOR CONTROLLERS; and, Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES. Provide all electrical wiring, conduit, and devices necessary for the proper connection, protection and operation of the systems. Provide special energy efficient premium efficiency type motors as scheduled.

**2.4 EQUIPMENT AND MATERIALS IDENTIFICATION**

A. Use symbols, nomenclature and equipment numbers specified, shown on the contract documents and shown in the maintenance manuals. In addition, 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.

B. Interior (Indoor) Equipment: Engraved nameplates, with letters not less than 5 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 5 mm (3/16 inch) high riveted or bolted to the equipment.

D. Control Items: Label all instrumentation, 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. HVAC and Mechanical Rooms: Provide for all valves other than for equipment in Section 23 82 00, CONVECTION HEATING AND COOLING UNITS and Section 23 36 00, AIR TERMNAL UNITS.
2. Valve tags: Engraved black filled numbers and letters not less than 15 mm (1/2 inch) high for number designation, and not less than 6 mm (1/4 inch) for service designation on 19-gauge 40 mm

(1-1/2 inches) round brass disc, attached with brass "S" hook or brass chain.

3. Valve lists: Typed or printed plastic coated card(s), sized 215 mm (8-1/2 inches) by 275 mm (11 inches) showing tag number, valve function and area of control, for each service or system. Punch sheets for a 3-ring notebook.
4. Provide detailed plan for each floor of the building indicating the location and valve number for each valve. Identify location of each valve with a color-coded thumb tack in ceiling.

F. Ceiling Grid Labels:

1. 50 mm (2 inch) long by 15 mm (1/2 inch) wide by 0.025 mm (1 mil) thick UV resistant metalized polyester label with red border color and black custom lettering on white background interior. Peel and stick adhesive backing. Label and adhesive manufactured specifically for use in equipment inventory tagging.
2. Custom print labels with above ceiling HVAC equipment numbers.

**2.5 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 BOILER PLANT INSULATION, for firestop pipe and duct insulation.

**2.6 HVAC PIPE AND EQUIPMENT SUPPORTS AND RESTRAINTS**

A. Pipe Supports: Comply with MSS SP-58. Type Numbers specified refer to this standard. For selection and application comply with MSS SP-58. Refer to Section 05 50 00, METAL FABRICATIONS, for miscellaneous metal support materials and prime coat painting requirements.

B. 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 100 mm (4 inches) thick when approved by the COR for each job condition.
3. Power-driven fasteners: Permitted in existing concrete or masonry not less than 100 mm (4 inches) thick when approved by the COR for each job condition.

C. 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 23 mm (7/8 inch) outside diameter.

D. Attachment to existing structure: Support from existing floor/roof frame.

E. Hanger Rods: Hot-rolled steel, ASTM A36/A36M or ASTM 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 40 mm (1-1/2 inches) minimum of adjustment and incorporate locknuts. All-thread rods are acceptable.

F. 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 (12 gauge), designed to accept special spring held, hardened steel nuts. Trapeze hangers are prohibited for use for steam supply and condensate piping.

1. Allowable hanger load: Manufacturers rating less 91 kg (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 15 mm (1/2 inch) galvanized steel bands, or preinsulated calcium silicate shield for insulated piping at each hanger.

G. Supports for Piping Systems:

1. Select hangers sized to encircle insulation on insulated piping. Refer to Section 23 07 11, HVAC AND BOILER PLANT 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.

**2.7 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 (1 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 through beams or ribs are prohibited, but may be installed in concrete beam flanges. Any deviation from these requirements must receive prior approval of COR.

D. Sheet Metal, Plastic, or Moisture-resistant Fiber Sleeves: Provide for pipe passing through floors, interior walls, and partitions, unless brass or steel pipe sleeves are specifically called for below.

E. Cast Iron or Zinc Coated Pipe Sleeves: Provide for pipe passing through exterior walls below grade. Make space between sleeve and pipe watertight with a modular or link rubber seal. Seal shall be applied at both ends of sleeve.

F. Galvanized Steel or an alternate Black Iron Pipe with asphalt coating Sleeves: Provide for pipe passing through concrete beam flanges, except where brass pipe sleeves are called for. Provide sleeve for pipe passing through floor of mechanical rooms, 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.

**2.8 DUCT PENETRATIONS**

A. Provide curbs for roof mounted piping, ductwork and equipment. Curbs shall be 450 mm (18 inches) high with continuously welded seams, built-in cant strip, interior baffle with acoustic insulation, curb bottom, hinged curb adapter.

B. Provide firestopping for openings through fire and smoke barriers, maintaining minimum required rating of floor, ceiling or wall assembly. See section 07 84 00, FIRESTOPPING.

**2.9 SPECIAL TOOLS AND LUBRICANTS**

A. Furnish, and turn over to the COR, tools not readily available commercially, that are required for disassembly or adjustment of equipment and machinery furnished.

B. Grease Guns with Attachments for Applicable Fittings: One for each type of grease required for each motor or other equipment.

C. Refrigerant Tools: Provide system charging/Evacuation equipment, gauges, fittings, and tools required for maintenance of furnished equipment.

D. Tool Containers: Hardwood or metal, permanently identified for intended service and mounted, or located, where directed by the COR.

E. Lubricants: A minimum of 0.95 L (1 quart) of oil, and 0.45 kg (1 pound) of grease, of equipment manufacturer's recommended grade and type, in unopened containers and properly identified as to use for each different application.

**2.10 WALL, FLOOR AND CEILING PLATES**

A. Material and Type: Chrome plated brass or chrome plated steel, one piece or split type with concealed hinge, with set screw for fastening to pipe, or sleeve. Use plates that fit tight around pipes, cover openings around pipes and cover the entire pipe sleeve projection.

B. Thickness: Not less than 2.4 mm (3/32 inch) for floor plates. For wall and ceiling plates, not less than 0.64 mm (0.025 inch) for up to 80 mm (3-inch pipe), 0.89 mm (0.035 inch) for larger pipe.

C. Locations: Use where pipe penetrates floors, walls and ceilings in exposed locations, in finished areas only. Provide a watertight joint in spaces where brass or steel pipe sleeves are specified.

**2.11 ASBESTOS**

A. Materials containing asbestos are prohibited.

**PART 3 - EXECUTION**

**3.1 GENERAL**

A. If an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no additional cost or time to the Government.

## 3.2 ARRANGEMENT AND INSTALLATION OF EQUIPMENT AND PIPING

A. Location of piping, sleeves, inserts, hangers, and equipment, access provisions shall be coordinated with the work of all trades. The coordination/shop drawings shall be submitted for review. Locate piping, sleeves, inserts, hangers, ductwork and equipment clear of windows, doors, openings, light outlets, and other services and utilities. Equipment coordination/shop drawings shall be prepared to coordinate proper location and personnel access of all facilities. The drawings shall be submitted for review. 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 gauges 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 contract documents.

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 is prohibited, except as permitted by COR where working area space is limited.
2. Locate holes to avoid interference with structural members such as slabs, columns, ribs, beams or reinforcing. Holes shall be laid out in advance and drilling done only after approval by COR. If the Contractor considers it necessary to drill through structural members, this matter shall be referred to COR for approval.
3. Do not penetrate membrane waterproofing.

F. Minor Piping: Generally, small diameter pipe runs from drips and drains, water cooling, and other service are not shown but must be provided.

G. Electrical Interconnection of Instrumentation or Controls: This generally not shown but must be provided. This includes interconnections of sensors, transmitters, transducers, control devices, control and instrumentation panels, instruments and computer workstations. Devices shall be located so they are easily accessible for testing, maintenance, calibration, etc. The COR has the final determination on what is accessible and what is not. Comply with NFPA 70.

H. Protection and Cleaning:

1. Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations and as approved by the COR. Damaged or defective items in the opinion of the COR, shall be replaced.
2. Protect all finished parts of equipment, such as shafts and bearings where accessible, from rust prior to operation by means of protective grease coating and wrapping. Close pipe openings with caps or plugs during installation. Tightly cover and protect fixtures and equipment against dirt, water chemical, or mechanical injury. At completion of all work thoroughly clean fixtures, exposed materials and equipment.

I. Concrete and Grout: Use concrete and non-shrink grout 20 MPa (3000 psig) minimum, specified in Section 03 30 00, CAST-IN-PLACE CONCRETE.

J. Install gauges, thermometers, valves and other devices with due regard for ease in reading or operating and maintaining said devices. Locate and position thermometers and gauges to be easily read by operator or staff standing on floor or walkway provided. Servicing shall not require dismantling adjacent equipment or pipe work.

K. Install steam piping expansion joints as per manufacturer’s recommendations.

L. Work in Existing Building:

1. Perform as specified in Article, OPERATIONS AND STORAGE AREAS, Article, ALTERATIONS, and Article, RESTORATION of the Section 01

00 00, GENERAL REQUIREMENTS for relocation of existing equipment, alterations and restoration of existing building(s).

2. As specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, OPERATIONS AND STORAGE AREAS, make alterations to existing service piping at times that will least interfere with normal operation of the facility.

M. Switchgear/Electrical Equipment Drip Protection: Every effort shall be made to eliminate the installation of pipe above electrical and data/telephone switchgear. If this is not possible, encase pipe in a second pipe with a minimum of joints. Installation of piping, ductwork, leak protection apparatus or other installations foreign to the electrical installation shall not be located in the space equal to the width and depth of the equipment and extending from to a height of 1.8 m (6 feet) above the equipment or to ceiling structure, whichever is lower (NFPA 70).

N. Inaccessible Equipment:

1. Where the Government determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance or inspections, equipment shall be removed and reinstalled or remedial action performed as directed at no additional cost or time 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, but not limited to motors, fans, pumps, belt guards, transformers, high voltage lines, conduit and raceways, piping, hot surfaces, and ductwork. The COR has final determination on whether an installation meets this requirement or not.

**3.3 TEMPORARY PIPING AND EQUIPMENT**

A. Continuity of operation of existing facilities will generally require temporary installation or relocation of equipment and piping.

B. The Contractor shall provide all required facilities in accordance with the requirements of phased construction and maintenance of service. All piping and equipment shall be properly supported, sloped to drain, operate without excessive stress, and shall be insulated where injury can occur to personnel by contact with operating facilities. The

requirements of Article, ARRANGEMENT AND INSTALLATION OF EQUIPMENT AND PIPING apply.

C. Temporary facilities and piping shall be completely removed and any openings in structures sealed. Provide necessary blind flanges and caps to seal open piping remaining in service.

D.

**3.4 PIPE AND EQUIPMENT SUPPORTS**

A. Where hanger spacing does not correspond with joist or rib spacing, use structural steel channels designed by a structural engineer, secured directly to joist and rib structure that will correspond to the required hanger spacing, and then suspend the equipment and piping from the channels. Drill or burn holes in structural steel only with the prior approval of the COR.

B. Use of chain pipe supports; wire or strap hangers; wood for blocking, stays and bracing; or, hangers suspended from piping above are prohibited. Replace or thoroughly clean rusty products and paint with zinc primer.

C. Hanger rods shall be used 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-58. 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.

**3.5 MECHANICAL DEMOLITION**

A. In an operating facility, maintain the operation, cleanliness and safety. Government personnel will be carrying on their normal duties of operating, cleaning and maintaining equipment and plant operation. Confine the work to the immediate area concerned; maintain cleanliness and wet down demolished materials to eliminate dust. Debris accumulated in the area to the detriment of plant operation is prohibited. Perform all flame cutting to maintain the fire safety integrity of this plant. Adequate fire extinguishing facilities shall be available at all times. Perform all work in accordance with recognized fire protection standards. Inspection will be made by personnel of the VAMC, and Contractor shall follow all directives of the COR with regard to rigging, safety, fire safety, and maintenance of operations.

B. Unless specified otherwise, all piping, wiring, conduit, and other devices associated with the equipment not re-used in the new work shall be completely removed from Government property per Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT. This includes all concrete pads, pipe, valves, fittings, insulation, and all hangers including the top connection and any fastenings to building structural systems. All openings shall be sealed after removal of equipment, pipes, ducts, and other penetrations in roof, walls, floors, in an approved manner and in accordance with contract documents where specifically covered. Structural integrity of the building system shall be maintained. Reference shall also be made to the contract documents of the other disciplines in the project for additional facilities to be demolished or handled.

C. All indicated valves including gate, globe, ball, butterfly and check, all pressure gauges and thermometers with wells shall remain Government property and shall be removed and delivered to COR and stored as directed. The Contractor shall remove all other material and equipment, devices and demolition debris under these contract documents. Such material shall be removed from Government property expeditiously and shall not be allowed to accumulate.

**3.6 CLEANING AND PAINTING**

A. Prior to final inspection and acceptance of the plant and facilities for beneficial use by the Government, the plant facilities, equipment

and systems shall be thoroughly cleaned and painted. Refer to Section 09 91 00, PAINTING.

B. In addition, the following special conditions apply:

1. Cleaning shall be thorough. Solvents, cleaning materials and methods recommended by the manufacturers shall be used for the specific tasks. All rust shall be removed prior to painting and from surfaces to remain unpainted. Repair scratches, scuffs, and abrasions prior to applying prime and finish coats.
2. The following material and equipment shall not be painted:
   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. Nameplates.
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 paint type and color as utilized by the pump manufacturer.
5. Temporary Facilities: Apply paint to surfaces that do not have existing finish coats. This may include painting exposed metals where hangers were removed or where equipment was moved or removed.
6. Paint shall withstand the following temperatures without peeling or discoloration:
   a. Condensate and Feedwater: 38 degrees C (100 degrees F) on insulation jacket surface and 121 degrees C (250 degrees F) on metal pipe surface.
   b. Steam: 52 degrees C (125 degrees F) on insulation jacket surface and 190 degrees C (374 degrees F) on metal pipe surface.

7. Final result shall be smooth, even-colored, even-textured factory finish on all items. Completely repaint the entire piece of equipment if necessary to achieve this.
8. Lead based paints are prohibited.

**3.7 IDENTIFICATION SIGNS**

A. Provide laminated plastic signs, with engraved lettering not less than 5 mm (3/16 inch) high, designating functions, for all equipment, switches, motor controllers, relays, meters, control devices, including automatic control valves. Nomenclature and identification symbols shall correspond to that used in maintenance manual, and in diagrams specified elsewhere. Attach by chain, adhesive, or screws.

B. Factory Built Equipment: Metal plate, securely attached, with name and address of manufacturer, serial number, model number, size, performance.

C. Pipe Identification: Refer to Section 09 91 00, PAINTING.

D. Attach ceiling grid label on ceiling grid location directly underneath above-ceiling air terminal, control system component, valve, filter unit, fan etc.

**3.8 STARTUP, TEMPORARY OPERATION AND TESTING**

A. Perform tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.

B. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.

C. The Commissioning Agent will observe startup and Contractor testing of selected equipment. Coordinate the startup and Contractor testing schedules with COR and Commissioning Agent. Provide a minimum notice of 10 working days prior to startup and testing.

D. Startup of equipment shall be performed as described in equipment specifications. Vibration within specified tolerance shall be verified 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 in individual Division 23 specification sections and submit the test reports and records to the COR.

B. Should evidence of malfunction in any tested system, or piece of equipment or component part thereof, occur during or as a result of tests, make proper corrections, repairs or replacements, and repeat tests at no additional cost or time 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 conduct such performance tests and finalize control settings for heating systems and for cooling systems respectively during first actual seasonal use of respective systems following completion of work. Rescheduling of these tests shall be requested in writing to COR for approval.

D. No adjustments may be made during the acceptance inspection. All adjustments shall have been made by this point.

E. Perform tests as required for commissioning provisions in accordance with Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS and Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

**3.10 COMMISSIONING**

A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

B. Components provided under this section of the specification will be tested as part of a larger system.

**3.11 DEMONSTRATION AND TRAINING**

A. Provide services of manufacturer’s technical representative for 4 hours to instruct each VA personnel responsible in operation and maintenance of the system.

B. Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

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**SECTION 23 05 93**
**TESTING, ADJUSTING, AND BALANCING FOR HVAC**

## PART 1 - GENERAL

### 1.1 DESCRIPTION

A. Testing, adjusting, and balancing (TAB) of heating, ventilating and air conditioning (HVAC) systems. TAB includes the following:

1. Planning systematic TAB procedures.
3. Systems Inspection report.
5. Systems Readiness Report.
6. Balancing air and water distribution systems; adjustment of total system to provide design performance; and testing performance of equipment and automatic controls.
8. Recording and reporting results.

B. Definitions:

1. Basic TAB used in this Section: Chapter 39, "Testing, Adjusting and Balancing" of 2019 ASHRAE Handbook, "HVAC Applications".
2. TAB: Testing, Adjusting and Balancing; the process of checking and adjusting HVAC systems to meet design objectives.
3. AABC: Associated Air Balance Council.
4. NEBB: National Environmental Balancing Bureau.
5. TABB: Testing Adjusting and Balancing Bureau
6. SMACNA: Sheet Metal Contractors National Association
7. Hydronic Systems: Includes ,  heating hot water .
8. Air Systems: Includes all outside air, supply air, return air, exhaust air and relief air systems.
9. Flow rate tolerance: The allowable percentage variation, minus to plus, of actual flow rate from values (design) in the contract documents.

### 1.2 RELATED WORK

A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

B. GENERATION.

C. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

F. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

G. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

H. Section 23 31 00, HVAC DUCTS AND CASINGS.

G. Section 23 36 00, AIR TERMINAL UNITS.

**1.3 QUALITY ASSURANCE**

A. Refer to Articles, Quality Assurance and Submittals, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC, Section 23 05 10, COMMON WORK RESULTS FOR BOILER PLANTS and STEAM GENERATION, and Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

B. Qualifications:

1. TAB Agency: The TAB agency shall be a subcontractor of the General Contractor and shall report to and be paid by the General Contractor.
2. The TAB agency shall be either a certified member of AABC, NEEB, TABB or NEBB to perform TAB service for HVAC, water balancing and vibrations and sound testing of equipment. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the agency loses subject certification during this period, the General Contractor shall immediately notify the COR and submit another qualified TAB firm for approval. Any agency that has been the subject of disciplinary action by either the AABC, TABB or NEBB within the five years preceding Contract Award shall not be eligible to perform any work related to the TAB. All work performed in this Section and in other related Sections by the TAB agency shall be considered invalid if the TAB agency loses its certification prior to Contract completion, and the successor agency’s review shows unsatisfactory work performed by the predecessor agency.
3. TAB Specialist: The TAB specialist shall be either a member of AABC or TABB or an experienced technician of the Agency certified by NEBB. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the Specialist loses subject certification during this period, the General Contractor shall immediately notify the Resident Engineer and submit another TAB Specialist for approval. Any individual that has been the subject of disciplinary action by either the AABC or the NEBB within the five years preceding Contract Award shall not be eligible to perform any duties related to the HVAC systems, including TAB. All work specified in this Section and in other related Sections performed by the TAB specialist shall be considered invalid if the

TAB Specialist loses its certification prior to Contract completion and must be performed by an approved successor.

4. TAB Specialist shall be identified by the General Contractor within 60 days after the notice to proceed. The TAB specialist will be coordinating, scheduling and reporting all TAB work and related activities and will provide necessary information as required by the Resident Engineer. The responsibilities would specifically include:
   a. Shall directly supervise all TAB work.
   b. Shall sign the TAB reports that bear the seal of the TAB standard. The reports shall be accompanied by report forms and schematic drawings required by the TAB standard, AABC, TABB or NEBB.
   c. Would follow all TAB work through its satisfactory completion.
   d. Shall provide final markings of settings of all HVAC adjustment devices.
   e. Permanently mark location of duct test ports.
   f. Shall document critical paths from the fan or pump. These critical paths are ones in which are 100% open from the fan or pump to the terminal device. This will show the least amount of restriction is being imposed on the system by the TAB firm.
5. All TAB technicians performing actual TAB work shall be experienced and must have done satisfactory work on a minimum of 3 projects comparable in size and complexity to this project. Qualifications must be certified by the TAB agency in writing. The lead technician shall be certified by AABC, TABB or NEBB

C. Test Equipment Criteria: The instrumentation shall meet the accuracy/calibration requirements established by AABC National Standards, TABB/SMACNA International Standards, or by NEBB Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems and instrument manufacturer. Provide calibration history of the instruments to be used for test and balance purpose.

D. TAB Criteria:
   1. One or more of the applicable AABC, NEBB,TABB or SMACNA publications, supplemented by ASHRAE Handbook "2019 HVAC Applications" Chapter 39, and requirements stated herein shall be the basis for planning, procedures, and reports.

2. Flow rate tolerance: Following tolerances are allowed. For tolerances not mentioned herein follow 2011 ASHRAE Handbook "2019 HVAC Applications", Chapter 39, as a guideline. Air Filter resistance during tests, artificially imposed if necessary, shall be at least 100 percent of manufacturer recommended change over pressure drop values for pre-filters and after-filters.
   a. Air handling unit and all other fans, cubic meters/min (cubic feet per minute): Minus 0 percent to plus 10 percent.
   b. Air terminal units (maximum values): Minus 2 percent to plus 10 percent.
   c.
   d. Minimum outside air: 0 percent to plus 10 percent.
   e. Individual room air outlets and inlets, and air flow rates not mentioned above: Minus 5 percent to plus 10 percent except if the air to a space is 100 CFM or less the tolerance would be minus 5 to plus 5 percent.
   f.
   g.
   h.
3. Systems shall be adjusted for energy efficient operation as described in PART 3.
4.

**1.4 SUBMITTALS**

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

B. Submit names and qualifications of TAB agency and TAB specialists within 60 days after the notice to proceed. Submit information on three recently completed projects and a list of proposed test equipment.

C. For use by the Resident Engineer staff, submit one complete set of applicable AABC,NEBB or TABB publications that will be the basis of TAB work.

D. Submit Following for Review and Approval:
   1. Design Review Report within 90 days for conventional design projects and within 60 days for design-build projects after the system layout on air and water side is completed by the Contractor.
   2. Systems inspection report on equipment and installation for conformance with design.

3. Duct Air Leakage Test Report.
4. Systems Readiness Report.
5. Intermediate and Final TAB reports covering flow balance and adjustments, performance tests, vibration tests and sound tests.
6. Include in final reports uncorrected installation deficiencies noted during TAB and applicable explanatory comments on test results that differ from design requirements.
7. Include in each report the critical path for each balanced branch (air and hydronic. Every branch shall have at least one terminal device damper 100% open.

E. Prior to request for Final or Partial Final inspection, submit completed Test and Balance report for the area with noted critical paths.

**1.5 APPLICABLE PUBLICATIONS**

A. The following publications form a part of this specification to the extent indicated by the reference thereto. In text the publications are referenced to by the acronym of the organization.

B. American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE):

Handbook 2019 .....HVAC Applications ASHRAE Handbook, Chapter 39, Testing, Adjusting, and Balancing and Chapter 49, Sound and Vibration Control

C. Associated Air Balance Council (AABC):

7th Edition 2016 .....AABC National Standards for Total System Balance

D. National Environmental Balancing Bureau (NEBB):

9th Edition 2019 .....Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems

3rd Edition 2015 .....Procedural Standards for the Measurement of Sound and Vibration

2rd Edition 2019 ... Standard for Whole Building Technical Commissioning of New Construction

E. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):

3rd Edition 2005 .....HVAC SYSTEMS Testing, Adjusting and Balancing

TABB- TAB Procedural Guide Current Edition

**PART 2 - PRODUCTS**

**2.1 PLUGS**

Provide plastic plugs to seal holes drilled in ductwork for test purposes.

**2.2 INSULATION REPAIR MATERIAL**

See Section 23 07 11, HVAC and BOILER PLANT INSULATION Provide for repair of insulation removed or damaged for TAB work.

**PART 3 - EXECUTION**

**3.1 GENERAL**

A. Refer to TAB Criteria in Article, Quality Assurance.

B. Obtain applicable contract documents and copies of approved submittals for HVAC equipment and automatic control systems.

**3.3 SYSTEMS INSPECTION REPORT**

A. Inspect equipment and installation for conformance with design.

B. The inspection and report is to be done after air distribution equipment is on site and duct installation has begun, but well in advance of performance testing and balancing work. The purpose of the inspection is to identify and report deviations from design and ensure that systems will be ready for TAB at the appropriate time.

C. Reports: Follow check list format developed by AABC, NEBB or SMACNA (TABB), supplemented by narrative comments, with emphasis on air handling units and fans. Check for conformance with submittals. Verify that diffuser and register sizes are correct. Check air terminal unit installation including their duct sizes and routing.

**3.5 SYSTEM READINESS REPORT**

A.

B. Inspect each System to ensure that it is complete including installation and operation of controls. Submit report to RE in standard format and forms prepared and or approved by the Commissioning Agent.

C. Verify that all items such as ductwork piping, dampers, valves, ports, terminals, connectors, etc., that is required for TAB are installed. Provide a report to the Resident Engineer.

**3.6 TAB REPORTS**

A.

B. The TAB contractor shall provide raw data immediately in writing to the Resident Engineer if there is a problem in achieving intended results before submitting a formal report.

C. If over 20 percent of readings in the intermediate report fall outside the acceptable range, the TAB report shall be considered invalid and all contract TAB work shall be repeated after engineering and construction have been evaluated and re-submitted for approval at no additional cost to the owner.

D. Do not proceed with the remaining systems until intermediate report is approved by the Resident Engineer.

**3.7 TAB PROCEDURES**

A. TAB shall be performed in accordance with the requirement of the Standard under which TAB agency is certified by either AABC, TABB or NEBB. Balancing shall be done proportionally to all applicable systems.

1. At least one trunk damper shall be 100% open.
2. At least one branch damper shall be 100%open per trunk.
3. At least one terminal device duct be 100% open per branch.

B. General: During TAB all related system components shall be in full operation. Fan and pump rotation, motor loads and equipment vibration shall be checked and corrected as necessary before proceeding with TAB. Set controls and/or block off parts of distribution systems to simulate design operation of variable volume air or water systems for test and balance work.

C. Coordinate TAB procedures with existing systems and any phased construction completion requirements for the project. Provide TAB reports for pre construction air and water flow rate and for each phase of the project prior to partial final inspections of each phase of the project. Return existing areas outside the work area to pre constructed conditions.

D. Allow 14 days time in construction schedule for TAB and submission of all reports for an organized and timely correction of deficiencies.

E. Air Balance and Equipment Test: Include, fans, terminal units, room diffusers/outlets/inlets, ,

1. Artificially load air filters by partial blanking to produce static air pressure drop of manufacturer’s recommended pressure drop.

2. Adjust fan speeds to provide design air flow. V-belt drives, including fixed pitch pulley requirements, are specified in Section 23 05 11, COMMON WORK RESULTS FOR HVAC  Section 23 05 10,
3. Test and balance systems in all specified modes of operation, including variable volume, economizer, and fire emergency modes. Verify that dampers and other HVAC controls function properly.
4.

.

F. Water Balance and Equipment Test: Include, coils,:
1
2. Adjust flow rates for equipment. Set coils and evaporator to values on equipment submittals, if different from values on contract drawings.
3. Primary-secondary (variable volume) systems: Coordinate TAB with Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC. Balance systems at design water flow and then verify that variable flow controls function as designed.
4. Record final measurements for hydronic equipment on performance data sheets. Include entering and leaving water temperatures for heating and cooling coils, and for convertors. Include entering and leaving air temperatures (DB/WB for cooling coils) for air handling units and reheat coils. Make air and water temperature measurements at the same time.

**3.10 MARKING OF SETTINGS**

Following approval of Tab final Report, the setting of all HVAC adjustment devices including valves, splitters and dampers shall be permanently marked by the TAB Specialist so that adjustment can be restored if disturbed at any time. Style and colors used for markings shall be coordinated with the Resident Engineer.

**3.11 IDENTIFICATION OF TEST PORTS**

The TAB Specialist shall permanently and legibly identify the location points of duct test ports. If the ductwork has exterior insulation, the identification shall be made on the exterior side of the insulation. All penetrations through ductwork and ductwork insulation shall be sealed to prevent air leaks and maintain integrity of vapor barrier.

A.

**3.13 COMMISSIONING**

A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00 – COMMISSIONING OF HVAC SYSTEMS for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.

B. Components provided under this section of the specification will be tested as part of a larger system. Refer to Section 23 08 00 – COMMISSIONING OF HVAC SYSTEMS and related sections for contractor responsibilities for system commissioning.

**3.14 CRITICAL FLOW PATH**

A. Provide a documented critical path for all fluid flows. There shall be at least one terminal device that can be traced back to the fan or pump where there is no damper or valves that are less than 100% open.

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**SECTION 23 08 00**

**COMMISSIONING OF HVAC SYSTEMS**

## PART 1 - GENERAL

### 1.1 DESCRIPTION

A. The requirements of this Section apply to all sections of Division 23.

B. This project will have selected building systems commissioned. The complete list of equipment and systems to be commissioned is specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. The commissioning process, which the Contractor is responsible to execute, is defined in Section 01 91 00 GENERAL COMMISSIONING REQUIRMENTS. A Commissioning Agent (CxA) appointed by the VA will manage the commissioning process.

### 1.2 RELATED WORK

A. Section 01 00 00 GENERAL REQUIREMENTS.

B. Section 01 33 00 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

D. Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC.

E. Section 23 09 23 DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

### 1.3 SUMMARY

A. This Section includes requirements for commissioning the HVAC systems of the related subsystems and equipment. This Section supplements the general requirements specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

B. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for more details regarding processes and procedures as well as roles and responsibilities for all Commissioning Team members.

### 1.4 DEFINITIONS

A. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for definitions.

### 1.5 COMMISSIONED SYSTEMS

A. Commissioning of a system or systems specified in Division 23 is part of the construction process. Documentation and testing of these systems, as well as training of the VA’s Operation and Maintenance personnel in accordance with the requirements of Section 01 91 00

GENERAL COMMISSIONING REQUIREMENTS and of Division 23, is required in cooperation with the VA and the Commissioning Agent.

B. The Facility HVAC systems commissioning will include the systems listed in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

**1.6 SUBMITTALS**

A. The commissioning process requires review of selected Submittals that pertain to the systems to be commissioned. The Commissioning Agent will provide a list of submittals that will be reviewed by the Commissioning Agent. This list will be reviewed and approved by the VA prior to forwarding to the Contractor. Refer to Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, and SAMPLES for further details.

B. The commissioning process requires Submittal review simultaneously with engineering review. Specific submittal requirements related to the commissioning process are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

**1.7 APPLICABLE PUBLICATIONS**

A. The following publications form a part of this specification to the extent indicated by the reference thereto. In text the publications are referenced to by the acronym of the organization.

B. Department of Veterans Affairs (VA):

PG 18-10 2007 .....Mission Critical Facilities - DRAFT

PG 18-10 2007 .....Life-Safety Protected Facilities - DRAFT

C. American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE):

HANDBOOK 2019 .....HVAC Applications ASHRAE Handbook, Chapter 39, Testing, Adjusting, and Balancing, Chapter 44, HVAC Commissioning and Chapter 49, Sound and Vibration Control

HANDBOOK 2017 .....HVAC Fundamentals ASHRAE Handbook, Chapter 8, Sound and Vibration

D. Associated Air Balance Council (AABC):

7th Edition 2016 .....AABC National Standards for Total System Balance

E. National Environmental Balancing Bureau (NEBB):

9th Edition 2019 .....Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems

3rd Edition 2015 .....Procedural Standards for the Measurement of Sound and Vibration

2rd Edition 2019 ... Standard for Whole Building Technical Commissioning of New Construction

F. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):

0062006... .....HVAC Duct Construction Standard - Metal and Flexible Duct

3rd Edition 2005 ... HVAC Systems Testing, Adjusting and Balancing

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

**PART 3 - EXECUTION**

**3.1 CONSTRUCTION INSPECTIONS**

A. Commissioning of HVAC systems will require inspection of individual elements of the HVAC systems construction throughout the construction period. The Contractor shall coordinate with the Commissioning Agent in accordance with Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS and the Commissioning plan to schedule HVAC systems inspections as required to support the Commissioning Process.

**3.2 PRE-FUNCTIONAL CHECKLISTS**

A. The Contractor shall complete Pre-Functional Checklists to verify systems, subsystems, and equipment installation is complete and systems are ready for Systems Functional Performance Testing. The Commissioning Agent will prepare Pre-Functional Checklists to be used to document equipment installation. Refer to Sections 23 05 41 NOISE AND VIBRATION CONTROL for HVAC PIPING AND EQUIPMENT, Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC and Section 23 09 23 DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC requirements. The Contractor shall complete the checklists. Completed checklists shall be submitted to the VA and to the Commissioning Agent for review. The Commissioning Agent may spot check a sample of completed checklists. If the Commissioning Agent determines that the information provided on the checklist is not accurate, the Commissioning Agent will return the marked-up checklist to the Contractor for correction and resubmission. If the Commissioning Agent determines that a significant number of completed checklists for similar equipment are not accurate, the Commissioning Agent will select a broader sample of checklists for review. If the Commissioning Agent determines that a significant

number of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and resubmission. Refer to SECTION 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for Pre-Functional Checklists, Equipment Startup Reports, and other commissioning documents.

**3.3 CONTRACTORS TESTS**

A. Contractor tests as required by other sections of Division 23 shall be scheduled and documented in accordance with Section 01 00 00 GENERAL REQUIREMENTS. All testing shall be incorporated into the project schedule. Contractor shall provide no less than 7 calendar days' notice of testing. The Commissioning Agent will witness selected Contractor tests at the sole discretion of the Commissioning Agent. Contractor tests shall be completed prior to scheduling Systems Functional Performance Testing.

**3.4 SYSTEMS FUNCTIONAL PERFORMANCE TESTING:**

A. The Commissioning Process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions. The Commissioning Agent will prepare detailed Systems Functional Performance Test procedures for review and approval by the Resident Engineer. The Contractor shall review and comment on the tests prior to approval. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The Commissioning Agent will witness and document the testing. The Contractor shall sign the test reports to verify tests were performed. See Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS, for additional requirements.

**3.5 TRAINING OF VA PERSONNEL**

A. Training of the VA operation and maintenance personnel is required in cooperation with the Resident Engineer and Commissioning Agent. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. Contractor shall submit training agendas and trainer resumes in accordance with the requirements of Section 01 91 00 GENERAL COMMISSIONING

REQUIREMENTS. The instruction shall be scheduled in coordination with the VA Resident Engineer after submission and approval of formal training plans. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS and Division 23 Sections for additional Contractor training requirements.

**----- END ----**

**SECTION 23 09 23**
**DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC**

## PART 1 – GENERAL

### 1.1 DESCRIPTION

A. General Contractor shall provide direct-digital control system(s) as indicated on the project documents, point list, interoperability tables, drawings and as described in these specifications. Include a complete and working direct-digital control system. Include all engineering, programming, configuration/setup hardware and software, controls and installation materials, installation labor, commissioning and start-up, training, final project documentation and warranty. A System Integrator and Direct Digital Controls Contractor shall be two separate direct subcontractors of General Contractor.

1. The direct-digital control system(s) shall consist of high-speed, peer-to-peer network of DDC controllers, a control system server, all configuration and setup software and hardware devices, and an Engineering Control Center. Provide a remote user using a standard HTML 5 web browser JCI Building Controllers to access the control system graphics and change adjustable setpoints with the proper password.
2. All new building controllers shall be native BACnet. All new BACNet workstations, controllers, devices and components shall be listed by BACnet Testing Laboratories. All new BACNet workstations, controllers, devices and components shall be accessible using a HTML5 Web browser interface. Browsers shall not require the use of an extension or add on software in order to access aforementioned workstations, controllers, devices, and components.
   a. If used, gateways shall be BTL listed.

   b. If used, gateways shall provide all object properties and read/write services shown on VA-approved interoperability schedules.

3. The work administered by this Section of the technical specifications shall include all labor, materials, special tools, equipment, enclosures, power supplies, software, software licenses, Project specific software configurations and database entries,

interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, submittals, testing, verification, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, Warranty, specified services and any other items required for a complete and fully functional Controls System.

4. The control systems shall be designed such that each mechanical system shall operate under stand-alone mode. The A/E shall designate what each "mechanical systems" is composed of. The contractor administered by this Section of the technical specifications shall provide controllers for each mechanical system. In the event of a network communication failure, or the loss of any other controller, the control system shall continue to operate independently. Failure of the ECC shall have no effect on the field controllers, including those involved with global strategies.
5. The control system shall accommodate 1 2 Engineering Control Center(s) and the control system shall accommodate 5 10 20 web-based Users simultaneously, and the access to the system should be limited only by operator password.

B. Some products are furnished but not installed by the contractor administered by this Section of the technical specifications. The contractor administered by this Section of the technical specifications shall formally coordinate in writing and receive from other contractors formal acknowledgements in writing prior to submission the installation of the products. These products include but are not limited to the following:
   1. Control valves.
   2. Flow switches.
   3. Flow meters.
   4. Sensor wells and sockets in piping.
   5. Terminal unit controllers.

C. Some products are installed but not furnished by the contractor administered by this Section of the technical specifications. The contractor administered by this Section of the technical specifications shall formally coordinate in writing and receive from other contractors formal acknowledgements in writing prior to submission the procurement

of the products. These products include but are not limited to the following:

1. Refrigerant leak detection system.
2. Factory-furnished accessory thermostats and sensors furnished with unitary equipment.

D. Some products are not provided by, but are nevertheless integrated with the work executed by, the contractor administered by this Section of the technical specifications. These products include but are not limited to the following:

1. Fire alarm systems. If zoned fire alarm is required by the project-specific requirements, this interface shall require multiple relays, which are provided and installed by the fire alarm system contractor, to be monitored.
2.
8. The following systems have limited control (as individually noted below) from the ECC:
   a.
   o. Isolation rooms: pressure outside of acceptable limit alarms.

E. Responsibility Table:

| **Work/Item/System** | **Furnish** | **Install** | **Low Voltage Wiring** | **Line Power** |
|---|---|---|---|---|
| Control system low voltage and communication wiring | 23 09 23 | 23 09 23 | 23 09 23 | N/A |
| Terminal units | 23 | 23 | N/A | 26 |
| Controllers for terminal units | 23 09 23 | 23 | 23 09 23 | 16 |
| LAN conduits and raceway | 23 09 23 | 23 09 23 | N/A | N/A |
| Automatic dampers (not furnished with equipment) | 23 09 23 | 23 | N/A | N/A |
| Automatic damper actuators | 23 09 23 | 23 09 23 | 23 09 23 | 23 09 23 |
| Manual valves | 23 | 23 | N/A | N/A |
| Automatic valves | 23 09 23 | 23 | 23 09 23 | 23 09 23 |
| Pipe insertion devices and taps, flow and pressure stations. | 23 | 23 | N/A | N/A |
| Thermowells | 23 09 23 | 23 | N/A | N/A |

| Work/Item/System | Furnish | Install | Low Voltage Wiring | Line Power |
|---|---|---|---|---|
| Current Switches | 23 09 23 | 23 09 23 | 23 09 23 | N/A |
| Control Relays | 23 09 23 | 23 09 23 | 23 09 23 | N/A |
| Power distribution system monitoring interfaces | 23 09 23 | 23 09 23 | 23 09 23 | 26 |
| Interface with chiller/boiler controls | 23 09 23 | 23 09 23 | 23 09 23 | 26 |
| Chiller/boiler controls interface with control system | 23 | 23 | 23 09 23 | 26 |
| All control system nodes, equipment, housings, enclosures and panels. | 23 09 23 | 23 09 23 | 23 09 23 | 26 |
| Smoke detectors | 28 31 00 | 28 31 00 | 28 31 00 | 28 31 00 |
| Fire/Smoke Dampers | 23 | 23 | 28 31 00 | 28 31 00 |
| Smoke Dampers | 23 | 23 | 28 31 00 | 28 31 00 |
| Fire Dampers | 23 | 23 | N/A | N/A |
| Chiller/starter interlock wiring | N/A | N/A | 26 | 26 |
| Chiller Flow Switches | 23 | 23 | 23 | N/A |
| Boiler interlock wiring | 23 | 23 | 23 | 26 |
| Boiler Flow Switches | 23 | 23 | 23 | N/A |
| Water treatment system | 23 | 23 | 23 | 26 |
| VFDs | 23 | 26 | 23 09 23 | 26 |
| Refrigerant monitors | 23 | 23 09 23 | 23 09 23 | 26 |
| Laboratory Environmental Controls | 23 09 23 | 23 09 23 | 23 09 23 | 26 |
| Fume hood controls | 23 09 23 | 23 09 23 | 23 09 23 | 26 |
| Medical gas panels | 23 | 23 | 26 | 26 |
| Laboratory Air Valves | 23 | 23 | 23 09 23 | N/A |
| Computer Room A/C Unit field-mounted controls | 23 | 23 | 26 | 26 |
| Control system interface with CRU A/C controls | 23 09 23 | 23 09 23 | 23 09 23 | 26 |
| CRU A/C unit controls interface with control system | 23 | 23 09 23 | 23 09 23 | 26 |

| Work/Item/System | Furnish | Install | Low Voltage Wiring | Line Power |
|---|---|---|---|---|
| Fire Alarm shutdown relay interlock wiring | 28 | 28 | 28 | 26 |
| Control system monitoring of fire alarm smoke control relay | 28 | 28 | 23 09 23 | 28 |
| Fire-fighter's smoke control station (FSCS | 28 | 28 | 28 | 28 |
| Fan Coil Unit controls (not furnished with equipment) | 23 09 23 | 23 09 23 | 23 09 23 | 26 |
| Unit Heater controls (not furnished with equipment) | 23 09 23 | 23 09 23 | 23 09 23 | 26 |
| Packaged RTU space-mounted controls (not furnished with equipment) | 23 09 23 | 23 09 23 | 23 09 23 | 26 |
| Packaged RTU unit-mounted controls (not furnished with equipment) | 23 09 23 | 23 09 23 | 23 09 23 | 26 |
| Cooling Tower Vibration Switches | 23 | 23 | 23 09 23 | 23 09 23 |
| Cooling Tower Level Control Devices | 23 | 23 | 23 09 23 | 23 09 23 |
| Cooling Tower makeup water control devices | 23 | 23 | 23 09 23 | 23 09 23 |
| Starters, HOA switches | 23 | 23 | N/A | 26 |

F. This facility's existing direct-digital control (DDC) system is manufactured by , and its ECC is located at . The existing system's top-end communications is via . The existing system's ECC and controllers were installed in the year of . The contractor administered by this Section of the technical specifications shall observe the capabilities, communication network, services, spare capacity of the existing control system and its ECC prior to beginning work.

1. Remove existing direct-digital control system ECC, communications network and controllers. Replace with new BACnet ECC, network and controllers compliant with this Section of the technical specifications.

2. Provide a new BACnet ECC, communications network, and controllers. Provide a programmable internetworking gateway allowing for real-time communication between the existing direct-digital control system and the new BACnet control system. Real-time communication shall provide all object properties and read/write services shown on VA-approved interoperability schedules. The contractor administered by this Section of the technical specifications shall provide all necessary investigation and site-specific programming to execute the interoperability schedules.
   a. The combined system shall operate and function as one complete system including one database of control point objects and global control logic capabilities. Facility operators shall have complete operations and control capability over all systems, new and existing including; monitoring, trending, graphing, scheduling, alarm management, global point sharing, global strategy deployment, graphical operations interface and custom reporting as specified.
   b. The combined system shall operate and function as one complete system including one database of control point objects and global control logic capabilities. Facility operators shall have limited operations and control capability over the legacy systems, as described in the VA-approved interoperability schedules.
3. Upgrade the existing direct-digital control system's ECC to include all properties and services required by an ASHRAE Standard 135 BACnet B-AWS Profile. The upgraded ECC shall continue to communicate with the existing direct-digital control system's devices. The upgraded ECC shall communicate directly with the new native-BACnet devices over the existing control system's communications network without the use of a gateway. Provide programming converting the existing non-BACnet devices, objects and services to ASHRAE Standard 135 BACnet-complaint BIBBs. The contractor administered by this Section of the technical specifications shall provide all necessary investigation and site-specific programming to execute the interoperability schedules.
   a. The performance requirement for the combined system: the combined system shall operate and function as one complete system including one database of control point objects and global

control logic capabilities. Facility operators shall have complete operations and control capability over all systems, new and existing including; monitoring, trending, graphing, scheduling, alarm management, global point sharing, global strategy deployment, graphical operations interface and custom reporting as specified.

b. The combined system shall operate and function as one complete system including one database of control point objects and global control logic capabilities. Facility operators shall have limited operations and control capability over the legacy systems as described in the VA-approved interoperability schedule.

4. Leave existing direct-digital control system intact and in place. Provide a new ASHRAE Standard 135 BACnet-compliant ECC in the same room as the existing system's ECC, and provide a new standalone BACnet-compliant control system serving the work in this project. No interoperability is required.

G. This campus has standardized on an existing standard ASHRAE Standard 135, BACnet/IP Control System supported by a preselected controls service company. This entity is referred to as the "Control System Integrator" in this Section of the technical specifications. The Control system integrator is responsible for ECC system graphics and expansion. It also prescribes control system-specific commissioning/ verification procedures to the contractor administered by this Section of the technical specification. It lastly provides limited assistance to the contractor administered by this Section of the technical specification in its commissioning/verification work.

1. The General Contractor of this project shall directly hire the Control System Integrator in a contract separate from the contract procuring the controls contractor administered by this Section of the technical specifications.

2. The contractor administered by this Section of the technical specifications shall coordinate all work with the Control System Integrator. The contractor administered by this Section of the technical specifications shall integrate the ASHRAE Standard 135, BACnet/IP control network(s) with the Control System Integrator's B-AWS through an Ethernet connection provided by either the Control System Integrator or VA.

3. The contractor administered by this Section of the technical specifications shall provide a peer-to-peer networked, stand-alone, distributed control system. This direct digital control (DDC) system at least shall include one portable operator terminal - laptop, one digital display unit, microprocessor-based controllers, instrumentation, end control devices, wiring, piping, software, and related systems. This contractor is responsible for all device mounting and wiring.
4. Responsibility Table:

| **Item/Task** | **Section 23 09 23 contactor** | **Control system integrator** | **VA** |
|---|---|---|---|
| ECC expansion | | X | |
| ECC programming | | X | |
| Devices, controllers, control panels and equipment | X | | |
| Point addressing: all hardware and software points including setpoint, calculated point, data point(analog/ binary), and reset schedule point | X | | |
| Point mapping | | X | |
| Network Programming | X | | |
| ECC Graphics | | X | |
| Controller programming and sequences | X | | |
| Integrity of LAN communications | | | X |
| Electrical wiring | X | | |
| Operator system training | | X | |
| LAN connections to devices | | | X |
| LAN connections to ECC | | | X |
| IP addresses | | | X |
| Overall system verification (Cx) | | X | |
| Controller and system verification | X | | |

H. Unitary standalone systems including Unit Heaters, Cabinet Unit Heaters, Fan Coil Units, Base Board Heaters, thermal comfort ventilation fans, and similar units for control of room environment conditions may be equipped with integral controls furnished and installed by the equipment manufacturer or field mounted. Refer to equipment specifications and as indicated in project documents. Application of standalone unitary controls is limited to at least those systems wherein remote monitoring, alarm and start-up are not necessary. Examples of such systems include:

1. Light-switch-operated toilet exhaust
2. Vestibule heater

3. Exterior stair heater
4. Attic heating and ventilation
5. Mechanical or electrical room heating and ventilation.

I. The direct-digital control system shall start and stop equipment, move (position) damper actuators and valve actuators, and vary speed of equipment to execute the mission of the control system. Use electricity as the motive force for all damper and valve actuators, unless use of pneumatics as motive force is specifically granted in writing by the VA.

**1.2 RELATED WORK**

A. Section 13 21 29, Constant Temperature Rooms.
B. Section 23 09 11, Instrumentation and Control for Boiler Plant.
C. Section 23 21 13, Hydronic Piping.
D. Section 23 22 13, Steam and Condensate Heating Piping.
E. Section 23 31 00, HVAC Ducts and Casings.
F. Section 23 36 00, Air Terminal Units.
G. Section 23 38 13, Commercial-Kitchen Hoods.
H. Section 23 52 33, Water-Tube Boilers.
I. Section 23 52 39, Fire-Tube Boilers.
J. Section 23 64 00, Packaged Water Chillers.
K. Section 23 73 00, Indoor Central-Station Air-Handling Units.
L. Section 23 74 13, Packaged, Outdoor, Central-Station Air-Handling Units.
M. Section 23 81 00, Decentralized Unitary HVAC Equipment.
N. Section 23 81 23, Computer-Room Air-Conditioners.
O. Section 23 81 43, Air-Source Unitary Heat Pumps.
P. Section 23 81 46, Water-Source Unitary Heat Pumps.
Q. Section 23 84 00, Humidity Control Equipment.
R. Section 25 10 10, Advanced Utility Metering System.
S. Section 26 05 11, Requirements for Electrical Installations.
T. Section 26 05 21, Low-Voltage Electrical Power Conductors and Cables (600 Volts and Below).
U. Section 26 05 26, Grounding and Bonding for Electrical Systems.
V. Section 26 05 33, Raceway and Boxes for Electrical Systems.
W. Section 26 09 23, Lighting Controls.
X. Section 26 22 21, Specialty Transformers.
Z. Section 26 27 26, Wiring Devices.

AA. Section 26 29 11, Motor Starters.

BB. Section 26 32 13, Engine Generators.

CC. Section 27 15 00, Communications Horizontal Cabling

DD. Section 28 31 00, Fire Detection and Alarm.

**1.3 DEFINITION**

A. Algorithm: A logical procedure for solving a recurrent mathematical problem; A prescribed set of well-defined rules or processes for the solution of a problem in a finite number of steps.

B. Analog: A continuously varying signal value (e.g., temperature, current, velocity etc.

C. BACnet: A Data Communication Protocol for Building Automation and Control Networks -as defined by ANSI/ASHRAE Standard 135. This communications protocol allows diverse building automation devices to communicate data and services over a network.

D. BACnet/IP: Annex J of Standard 135. It defines and allows for using a reserved UDP socket to transmit BACnet messages over IP networks. A BACnet/IP network is a collection of one or more IP sub-networks that share the same BACnet network number.

E. BACnet Internetwork: Two or more BACnet networks connected with routers. The two networks may use different LAN technologies.

F. BACnet Network: One or more BACnet segments that have the same network address and are interconnected by bridges at the physical and data link layers.

G. BACnet Segment: One or more physical segments of BACnet devices on a BACnet network, connected at the physical layer by repeaters.

H. BACnet Broadcast Management Device (BBMD): A communications device which broadcasts BACnet messages to all BACnet/IP devices and other BBMDs connected to the same BACnet/IP network.

I. BACnet Interoperability Building Blocks (BIBBs): BACnet Interoperability Building Blocks (BIBBs) are collections of one or more BACnet services. These are prescribed in terms of an "A" and a "B" device. Both of these devices are nodes on a BACnet internetwork.

J. BACnet Testing Laboratories (BTL). The organization responsible for testing products for compliance with the BACnet standard, operated under the direction of BACnet International.

K. Baud: It is a signal change in a communication link. One signal change can represent one or more bits of information depending on type of

transmission scheme. Simple peripheral communication is normally one bit per Baud. (e.g., Baud rate = 78,000 Baud/sec is 78,000 bits/sec, if one signal change = 1 bit).

L. Binary: A two-state system where a high signal level represents an "ON" condition and an "OFF" condition is represented by a low signal level.

M. BMP or bmp: Suffix, computerized image file, used after the period in a DOS-based computer file to show that the file is an image stored as a series of pixels.

N. Bus Topology: A network topology that physically interconnects workstations and network devices in parallel on a network segment.

O. Control Unit (CU): Generic term for any controlling unit, stand-alone, microprocessor based, digital controller residing on secondary LAN or Primary LAN, used for local controls or global controls

P. Deadband: A temperature range over which no heating or cooling is supplied, i.e., 22-25 degrees C (72-78 degrees F), as opposed to a single point change over or overlap).

Q. Device: a control system component that contains a BACnet Device Object and uses BACnet to communicate with other devices.

R. Device Object: Every BACnet device requires one Device Object, whose properties represent the network visible properties of that device. Every Device Object requires a unique Object Identifier number on the BACnet internetwork. This number is often referred to as the device instance.

S. Device Profile: A specific group of services describing BACnet capabilities of a device, as defined in ASHRAE Standard 135-2008, Annex L. Standard device profiles include BACnet Operator Workstations (B-OWS), BACnet Building Controllers (B-BC), BACnet Advanced Application Controllers (B-AAC), BACnet Application Specific Controllers (B-ASC), BACnet Smart Actuator (B-SA), and BACnet Smart Sensor (B-SS). Each device used in new construction is required to have a PICS statement listing which service and BIBBs are supported by the device.

T. Diagnostic Program: A software test program, which is used to detect and report system or peripheral malfunctions and failures. Generally, this system is performed at the initial startup of the system.

U. Direct Digital Control (DDC): Microprocessor based control including Analog/Digital conversion and program logic. A control loop or subsystem in which digital and analog information is received and

processed by a microprocessor, and digital control signals are generated based on control algorithms and transmitted to field devices in order to achieve a set of predefined conditions.

V. Distributed Control System: A system in which the processing of system data is decentralized and control decisions can and are made at the subsystem level. System operational programs and information are provided to the remote subsystems and status is reported back to the Engineering Control Center. Upon the loss of communication with the Engineering Control center, the subsystems shall be capable of operating in a stand-alone mode using the last best available data.

W. Download: The electronic transfer of programs and data files from a central computer or operation workstation with secondary memory devices to remote computers in a network (distributed) system.

X. DXF: An AutoCAD 2-D graphics file format. Many CAD systems import and export the DXF format for graphics interchange.

Y. Electrical Control: A control circuit that operates on line or low voltage and uses a mechanical means, such as a temperature sensitive bimetal or bellows, to perform control functions, such as actuating a switch or positioning a potentiometer.

Z. Electronic Control: A control circuit that operates on low voltage and uses a solid-state components to amplify input signals and perform control functions, such as operating a relay or providing an output signal to position an actuator.

AA. Engineering Control Center (ECC): The centralized control point for the intelligent control network. The ECC comprises of personal computer and connected devices to form a single workstation.

BB. Ethernet: A trademark for a system for exchanging messages between computers on a local area network using coaxial, fiber optic, or twisted-pair cables.

CC. Firmware: Firmware is software programmed into read only memory (ROM) chips. Software may not be changed without physically altering the chip.

DD. Gateway: Communication hardware connecting two or more different protocols. It translates one protocol into equivalent concepts for the other protocol. In BACnet applications, a gateway has BACnet on one side and non-BACnet (usually proprietary) protocols on the other side.

EE. GIF: Abbreviation of Graphic interchange format.

FF. Graphic Program (GP): Program used to produce images of air handler systems, fans, chillers, pumps, and building spaces. These images can be animated and/or color-coded to indicate operation of the equipment.

GG. Graphic Sequence of Operation: It is a graphical representation of the sequence of operation, showing all inputs and output logical blocks.

HH. I/O Unit: The section of a digital control system through which information is received and transmitted. I/O refers to analog input (AI, digital input (DI), analog output (AO) and digital output (DO). Analog signals are continuous and represent temperature, pressure, flow rate etc, whereas digital signals convert electronic signals to digital pulses (values), represent motor status, filter status, on-off equipment etc.

II. I/P: a method for conveying and routing packets of information over LAN paths. User Datagram Protocol (UDP) conveys information to “sockets” without confirmation of receipt. Transmission Control Protocol (TCP) establishes "sessions", which have end-to-end confirmation and guaranteed sequence of delivery.

JJ. JPEG: A standardized image compression mechanism stands for Joint Photographic Experts Group, the original name of the committee that wrote the standard.

KK. Local Area Network (LAN): A communication bus that interconnects operator workstation and digital controllers for peer-to-peer communications, sharing resources and exchanging information.

LL. Network Repeater: A device that receives data packet from one network and rebroadcasts to another network. No routing information is added to the protocol.

MM. MS/TP: Master-slave/token-passing (ISO/IEC 8802, Part 3). It uses twisted-pair wiring for relatively low speed and low cost communication.

NN. Native BACnet Device: A device that uses BACnet as its primary method of communication with other BACnet devices without intermediary gateways. A system that uses native BACnet devices at all levels is a native BACnet system.

OO. Network Number: A site-specific number assigned to each network segment to identify for routing. This network number must be unique throughout the BACnet internetwork.

PP. Object: The concept of organizing BACnet information into standard components with various associated properties. Examples include analog input objects and binary output objects.

QQ. Object Identifier: An object property used to identify the object, including object type and instance. Object Identifiers must be unique within a device.

RR. Object Properties: Attributes of an object. Examples include present value and high limit properties of an analog input object. Properties are defined in ASHRAE 135; some are optional and some are required. Objects are controlled by reading from and writing to object properties.

SS. Operating system (OS): Software, which controls the execution of computer application programs.

TT. PCX: File type for an image file. When photographs are scanned onto a personal computer they can be saved as PCX files and viewed or changed by a special application program as Photo Shop.

UU. Peripheral: Different components that make the control system function as one unit. Peripherals include monitor, printer, and I/O unit.

VV. Peer-to-Peer: A networking architecture that treats all network stations as equal partners- any device can initiate and respond to communication with other devices.

WW. PICS: Protocol Implementation Conformance Statement, describing the BACnet capabilities of a device. All BACnet devices have published PICS.

XX. PID: Proportional, integral, and derivative control, used to control modulating equipment to maintain a setpoint.

YY. Repeater: A network component that connects two or more physical segments at the physical layer.

ZZ. Router: a component that joins together two or more networks using different LAN technologies. Examples include joining a BACnet Ethernet LAN to a BACnet MS/TP LAN.

AAA. Sensors: devices measuring state points or flows, which are then transmitted back to the DDC system.

BBB. Thermostats : devices measuring temperatures, which are used in control of standalone or unitary systems and equipment not attached to the DDC system.

**1.4 QUALITY ASSURANCE**

A. Criteria:

1. Single Source Responsibility of subcontractor: Either the DDC Contractor or the System Integrator shall obtain hardware and software supplied under this Section and delegate the responsibility to a single source controls installation subcontractor. The Integration subcontractor shall be responsible for the complete design, installation, integration, and commissioning of the system. The controls subcontractor shall be in the business of design, installation and service of such building automation control systems similar in size and complexity.
2. Equipment and Materials: Equipment and materials shall be cataloged products of manufacturers regularly engaged in production and installation of HVAC control systems. Products shall be manufacturer’s latest standard design and have been tested and proven in actual use.
3. The controls subcontractor shall provide a list of no less than five similar projects which have building control systems as specified in this Section. These projects must be on-line and functional such that the Department of Veterans Affairs (VA) representative could observe the control systems in full operation.
4. The controls subcontractor shall have an in-place facility within 50 100 miles with technical staff, spare parts inventory for the next five (5) years, and necessary test and diagnostic equipment to support the control systems.
5. The controls subcontractor shall have minimum of three years of experience in design and installation of building automation systems similar in performance to those specified in this Section. Provide evidence of experience by submitting resumes of the project manager, the local branch manager, project engineer, the application engineering staff, and the electronic technicians who would be involved with the supervision, the engineering, and the installation of the control systems. Training and experience of these personnel shall not be less than three years. Failure to disclose this information will be a ground for disqualification of the supplier.
6. Provide a competent and experienced Project Manager employed by the Controls Contractor. The Project Manager shall be supported as

necessary by other Contractor employees in order to provide professional engineering, technical and management service for the work. The Project Manager shall attend scheduled Project Meetings as required and shall be empowered to make technical, scheduling and related decisions on behalf of the Controls Contractor.

B. Codes and Standards:
   1. All work shall conform to the applicable Codes and Standards.
   2. Electronic equipment shall conform to the requirements of FCC Regulation, Part 15, Governing Radio Frequency Electromagnetic Interference, and be so labeled.

**1.5 PERFORMANCE**

A. The system shall conform to the following:
   1. Graphic Display: The system shall display up to four (4) graphics on a single screen with a minimum of twenty (20) dynamic points per graphic. All current data shall be displayed within ten (10) seconds of the request.
   2. Graphic Refresh: The system shall update all dynamic points with current data within eight (8) seconds. Data refresh shall be automatic, without operator intervention.
   3. Object Command: The maximum time between the command of a binary object by the operator and the reaction by the device shall be two(2) seconds. Analog objects shall start to adjust within two (2) seconds.
   4. Object Scan: All changes of state and change of analog values shall be transmitted over the high-speed network such that any data used or displayed at a controller or work-station will be current, within the prior six (6) seconds.
   5. Alarm Response Time: The maximum time from when an object goes into alarm to when it is annunciated at the workstation shall not exceed (10) seconds.
   6. Program Execution Frequency: Custom and standard applications shall be capable of running as often as once every (5) seconds. The Contractor shall be responsible for selecting execution times consistent with the mechanical process under control.
   7. Multiple Alarm Annunciations: All workstations on the network shall receive alarms within five (5) seconds of each other.

8. Performance: Programmable Controllers shall be able to execute DDC PID control loops at a selectable frequency from at least once every one (1) second. The controller shall scan and update the process value and output generated by this calculation at this same frequency.
9. Reporting Accuracy: Listed below are minimum acceptable reporting end-to-end accuracies for all values reported by the specified system:

| **Measured Variable** | **Reported Accuracy** |
|---|---|
| Space temperature | ±0.5°C (±1°F) |
| Ducted air temperature | ±0.5°C [±1°F] |
| Outdoor air temperature | ±1.0°C [±2°F] |
| Dew Point | ±1.5°C [±3°F] |
| Water temperature | ±0.5°C [±1°F] |
| Relative humidity | ±2% RH |
| Water flow | ±1% of reading |
| Air flow (terminal) | ±10% of reading |
| Air flow (measuring stations) | ±5% of reading |
| Carbon Monoxide (CO) | ±5% of reading |
| Carbon Dioxide ($CO_2$) | ±50 ppm |
| Air pressure (ducts) | ±25 Pa [±0.1"w.c.] |
| Air pressure (space) | ±0.3 Pa [±0.001"w.c.] |
| Water pressure | ±2% of full scale *Note 1 |
| Electrical Power | ±0.5% of reading |

Note 1: for both absolute and differential pressure

10. Control stability and accuracy: Control sequences shall maintain measured variable at setpoint within the following tolerances:

| Controlled Variable | Control Accuracy | Range of Medium |
|---|---|---|
| Air Pressure | ±50 Pa (±0.2 in. w.g.) | 0–1.5 kPa (0–6 in. w.g.) |
| Air Pressure | ±3 Pa (±0.01 in. w.g.) | -25 to 25 Pa (-0.1 to 0.1 in. w.g.) |
| Airflow | ±10% of full scale | |
| Space Temperature | ±1.0°C (±2.0°F) | |
| Duct Temperature | ±1.5°C (±3°F) | |
| Humidity | ±5% RH | MRI, SPS, PHARMACY |
| Fluid Pressure | ±10 kPa (±1.5 psi) | 0–1 MPa (1–150 psi) |
| Fluid Pressure | ±250 Pa (±1.0 in. w.g.) | 0–12.5 kPa (0–50 in. w.g.) differential |

11. Extent of direct digital control: control design shall allow for at least the points indicated on the points lists on the drawings.

**1.6 WARRANTY**

A. Labor and materials for control systems shall be warranted for a period as specified under Warranty in FAR clause 52.246-21.

B. Control system failures during the warranty period shall be adjusted, repaired, or replaced at no cost or reduction in service to the owner. The system includes all computer equipment, transmission equipment, and all sensors and control devices.

C. The on-line support service shall allow the Controls supplier to dial out over telephone lines to or connect via (through password-limited access) VPN through the internet to monitor and control the facility’s building automation system. This remote connection to the facility shall be within two (2) hours of the time that the problem is reported. This coverage shall include normal business hours, after business hours, weekend and holidays. If the problem cannot be resolved with on-line support services, the Controls supplier shall dispatch the qualified personnel to the job site to resolve the problem within 8 24 hours after the problem is reported.

D. Controls subcontractor shall be responsible for temporary operations and maintenance of the control systems during the construction period until final commissioning, training of facility operators and acceptance of the project by VA.

**1.7 SUBMITTALS**

A. Submit shop drawings in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Manufacturer's literature and data for all components including but not limited to the following:

1. A wiring diagram for each type of input device and output device including DDC controllers, modems, repeaters, etc. Diagram shall show how the device is wired and powered, showing typical connections at the digital controllers and each power supply, as well as the device itself. Show for all field connected devices, including but not limited to, control relays, motor starters, electric or electronic actuators, and temperature pressure, flow and humidity sensors and transmitters.
2. A diagram of each terminal strip, including digital controller terminal strips, terminal strip location, termination numbers and the associated point names.
3. Control dampers and control valves schedule, including the size and pressure drop.
4. Control air-supply components, and computations for sizing compressors, receivers and main air-piping, if pneumatic controls are furnished.
5. Catalog cut sheets of all equipment used. This includes, but is not limited to software (by manufacturer and by third parties), DDC controllers, panels, peripherals, airflow measuring stations and associated components, and auxiliary control devices such as sensors, actuators, and control dampers. When manufacturer's cut sheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted. Each submitted piece of literature and drawings should clearly reference the specification and/or drawings that it supposed to represent.
6. Sequence of operations for each system and the associated control diagrams. Equipment and control labels shall correspond to those shown on the drawings.
7. Color prints of proposed graphics with a list of points for display.
8. Furnish a BACnet Protocol Implementation Conformance Statement (PICS) for each BACnet-compliant device.

9. Schematic wiring diagrams for all control, communication and power wiring. Provide a schematic drawing of the central system installation. Label all cables and ports with computer manufacturers' model numbers and functions. Show all interface wiring to the control system.
10. An instrumentation list for each controlled system. Each element of the controlled system shall be listed in table format. The table shall show element name, type of device, manufacturer, model number, and product data sheet number.
11. Riser diagrams of wiring between central control unit(CCU)and all control panels.
12. Plan drawings showing routing of LAN and locations of control panels, controllers, routers, gateways, ECC, and larger controlled devices.
13. Construction details for all installed conduit, cabling, raceway, cabinets, and similar. Construction details of all penetrations and their protection.
14. Quantities of submitted items may be reviewed but it is the responsibility of the contractor administered by this Section of the technical specifications to provide sufficient quantities for a complete and working system.

C. Product Certificates: Compliance with Article, QUALITY ASSURANCE.

D. Licenses: Provide licenses for all software residing on and used by the Controls Systems, ECC, and portable OWS and transfer these licenses to the Owner prior to completion.

E. As Built Control Drawings:
1. Furnish three (3) copies of as-built drawings for each control system. The documents shall be submitted for approval prior to final completion.
2. Furnish one (1) set of applicable control system prints for each mechanical system for wall mounting. The documents shall be submitted for approval prior to final completion.
3. Furnish one (1) CD-ROM in CAD DWG and/or .DXF format for the drawings noted in subparagraphs above.

F. Operation and Maintenance (O/M) Manuals):
1. Submit in accordance with Article, INSTRUCTIONS, in Specification Section 01 00 00, GENERAL REQUIREMENTS.

2. Include the following documentation:
   a. General description and specifications for all components, including logging on/off, alarm handling, producing trend reports, overriding computer control, and changing set points and other variables.
   b. Detailed illustrations of all the control systems specified for ease of maintenance and repair/replacement procedures, and complete calibration procedures.
   c. One copy of the final version of all software provided including operating systems, programming language, operator workstation software, and graphics software.
   d. Complete troubleshooting procedures and guidelines for all systems.
   e. Complete operating instructions for all systems.
   f. Recommended preventive maintenance procedures for all system components including a schedule of tasks for inspection, cleaning and calibration. Provide a list of recommended spare parts needed to minimize downtime.
   g. Training Manuals: Submit the course outline and training material to the Owner for approval three (3) weeks prior to the training to VA facility personnel. These persons will be responsible for maintaining and the operation of the control systems, including programming. The Owner reserves the right to modify any or all of the course outline and training material.
   h. Licenses, guaranty, and other pertaining documents for all equipment and systems.

G. Submit Performance Report to COR prior to final inspection.

**1.8 INSTRUCTIONS**

A. Instructions to VA operations personnel: Perform in accordance with Article, INSTRUCTIONS, in Specification Section 01 00 00, GENERAL REQUIREMENTS, and as noted below. Contractor shall also video tape instruction sessions noted below.
   1. First Phase: Formal instructions to the VA facilities personnel for a total of 16 32 48 hours, given in multiple training sessions (each no longer than four hours in length), conducted sometime between the completed installation and prior to the performance test

period of the control system, at a time mutually agreeable to the Contractor and the VA.

2. Second Phase: This phase of training shall comprise of on the job training during start-up, checkout period, and performance test period. VA facilities personnel will work with the Contractor's installation and test personnel on a daily basis during start-up and checkout period. During the performance test period, controls subcontractor will provide 8 16 32 48 hours of instructions, given in multiple training sessions (each no longer than four hours in length), to the VA facilities personnel.
3. The O/M Manuals shall contain approved submittals as outlined in Article 1.7, SUBMITTALS. The Controls subcontractor will review the manual contents with VA facilities personnel during second phase of training.
4. Training shall be given by direct employees of the controls system subcontractor.

**1.9 PROJECT CONDITIONS (ENVIRONMENTAL CONDITIONS OF OPERATION)**

A. The ECC and peripheral devices and system support equipment shall be designed to operate in ambient condition of 20 to 35°C (65 to 90°F) at a relative humidity of 20 to 80% non-condensing.

B. The Controllers used outdoors shall be mounted in NEMA 4 waterproof enclosures, and shall be rated for operation at -40 to 65°C (-40 to 150°F).

C. All electronic equipment shall operate properly with power fluctuations of plus 10 percent to minus 15 percent of nominal supply voltage.

D. Sensors and controlling devices shall be designed to operate in the environment, which they are sensing or controlling.

**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 of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE):
135-2017.....BACNET Building Automation and Control Networks

C. American Society of Mechanical Engineers (ASME):

B16.18-2018.....Cast Copper Alloy Solder Joint Pressure Fittings.
B16.22-2018.....Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

D. American Society of Testing Materials (ASTM):

B32-2014.....Standard Specification for Solder Metal
B88-2016.....Standard Specifications for Seamless Copper Water Tube
B88M-2018.....Standard Specification for Seamless Copper Water Tube (Metric)
B280-2019/.....Standard Specification for Seamless Copper Tube for Air-Conditioning and Refrigeration Field Service
D2737-2018.....Standard Specification for Polyethylene (PE) Plastic Tubing

E. Federal Communication Commission (FCC):

Rules and Regulations Title 47 Chapter 1-2014 Part 15: Radio Frequency Devices.

F. Institute of Electrical and Electronic Engineers (IEEE):

802.3-2018.....Information Technology-Telecommunications and Information Exchange between Systems-Local and Metropolitan Area Networks- Specific Requirements-Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access method and Physical Layer Specifications

G. National Fire Protection Association (NFPA):

70-2017.....National Electric Code
90A-2018.....Standard for Installation of Air-Conditioning and Ventilation Systems

H. Underwriter Laboratories Inc (UL):

94-2013.....Tests for Flammability of Plastic Materials for Parts and Devices and Appliances
294-2013.....Access Control System Units
486A/486B-2018.....Wire Connectors
555S-2014(R2016).....Standard for Smoke Dampers
916-2015.....Energy Management Equipment
1076-2018.....Proprietary Burglar Alarm Units and Systems

**PART 2 – PRODUCS**

**2.1 MATERIALS**

A. Use new products that the manufacturer is currently manufacturing and that have been installed in a minimum of **25** installations. Spare parts shall be available for at least **five** years after completion of this contract.

**2.2 CONTROLS SYSTEM ARCHITECTURE**

A. General

1. The Controls Systems shall consist of multiple Nodes and associated equipment connected by industry standard digital and communication network arrangements.
2. The ECC, building controllers and principal communications network equipment shall be standard products of recognized major manufacturers available through normal PC and computer vendor channels – not "Clones" assembled by a third-party subcontractor.
3. The networks shall, at minimum, comprise, as necessary, the following:
   a. A fixed ECC and a portable operator’s terminal.
   b. Network computer processing, data storage and BACnet-compliant communication equipment including Servers and digital data processors.
   c. BACnet-compliant routers, bridges, switches, hubs, modems, gateways, interfaces and similar communication equipment.
   d. Active processing BACnet-compliant building controllers connected to other BACNet-compliant controllers together with their power supplies and associated equipment.
   e. Addressable elements, sensors, transducers and end devices.
   f. Third-party equipment interfaces and gateways as described and required by the Contract Documents.
   g. Other components required for a complete and working Control Systems as specified.

B. The Specifications for the individual elements and component subsystems shall be minimum requirements and shall be augmented as necessary by the Contractor to achieve both compliance with all applicable codes, standards, and to meet all requirements of the Contract Documents.

C. Network Architecture

1. The Controls communication network shall utilize BACnet communications protocol operating over a standard Ethernet LAN and operate at a minimum speed of 100 Mb/sec.
2. The networks shall utilize only copper and optical fiber communication media as appropriate and shall comply with applicable codes, ordinances and regulations. They may also utilize digital

wireless technologies as appropriate to the application and if approved by the VA.

3. All necessary telephone lines, ISDN lines and internet Service Provider services and connections will be provided by the VA.

D. Third Party Interfaces:

1. The contractor administered by this Section of the technical specifications shall include necessary hardware, equipment, software and programming to allow data communications between the controls systems and building systems supplied by other trades.
2. Other manufacturers and contractors supplying other associated systems and equipment shall provide their necessary hardware, software and start-up at their cost and shall cooperate fully with the contractor administered by this Section of the technical specifications in a timely manner and at their cost to ensure complete functional integration.

E. Servers:

1. Provide data storage server(s) to archive historical data including trends, alarm and event histories and transaction logs.
2. Equip these server(s) with the same software tool set that is located in the BACnet building controllers for system configuration and custom logic definition and color graphic configuration.
3. Access to all information on the data storage server(s) shall be through the same browser functionality used to access individual nodes. When logged onto a server the operator will be able to also interact with any other controller on the control system as required for the functional operation of the controls systems. The contractor administered by this Section of the technical specifications shall provide all necessary digital processor programmable data storage server(s).
4. These server(s) shall be utilized for controls systems application configuration, for archiving, reporting and trending of data, for operator transaction archiving and reporting, for network information management, for alarm annunciation, for operator interface tasks, for controls application management and similar.

These server(s) shall utilize IT industry standard data base platforms which utilize a database declarative language designed for managing data in relational database management systems (RDBMS) such as SQL.

**2.3 COMMUNICATION**

A. Control products, communication media, connectors, repeaters, hubs, and routers shall comprise a BACnet internetwork. Controller and operator interface communication shall conform to ANSI/ASHRAE Standard 135, BACnet.

1. The Data link / physical layer protocol between the ECC and all B-BC's (for communication) acceptable to the VA throughout its facilities is Ethernet (ISO 8802-3) and BACnet/IP.
2. The ARCNET data link / physical protocol may be used in new BACnet sub-networks in VA non-healthcare and non-lab (i.e., business and cemetery) facilities.

subnets.

3. The MS/TP data link / physical layer protocol is not acceptable to the VA in any new BACnet network or sub-network in its healthcare or lab facilities.

B. Each controller shall have a communication port for connection to an operator interface.

C. Project drawings indicate remote buildings or sites to be connected by a nominal 56,000 baud modem over voice-grade telephone lines. In each remote location a modem and field device connection shall allow communication with each controller on the internetwork as specified in Paragraph D.

D. Internetwork operator interface and value passing shall be transparent to internetwork architecture.

1. An operator interface connected to a controller shall allow the operator to interface with each internetwork controller as if directly connected. Controller information such as data, status, reports, system software, and custom programs shall be viewable and editable from each internet controller.
2. Inputs, outputs, and control variables used to integrate control strategies across multiple controllers shall be readable by each controller on the internetwork. Program and test all cross-controller links required to execute specified control system operation. An authorized operator shall be able to edit cross-controller links by typing a standard object address.

E. System shall be expandable to at least twice the required input and output objects with additional controllers, associated devices, and

wiring. Expansion shall not require operator interface hardware additions or software revisions.

F. ECCs and Controllers with real-time clocks shall use the BACnet Time Synchronization service. The system shall automatically synchronize system clocks daily from an operator-designated device via the internetwork. The system shall automatically adjust for daylight savings and standard time as applicable.

**2.4 ENGINEERING CONTROL CENTER (ECC)**

A. The ECC shall reside on a high-speed network with controllers as shown on system drawings. The ECC and each standard browser connected to server shall be able to access all system information.

*B.* ECC and controllers shall communicate using BACnet protocol. ECC and control network backbone shall communicate using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol and BACnet/IP addressing as specified in ASHRAE/ANSI 135, BACnet Annex J.

C. Hardware: ECC shall conform to the BACnet Advanced Workstation (B-AWS) Profile and shall be BTL-Listed as a B-AWS device.

1. ECC shall be based on commercially available server grade hardware. Computers based on desktop architectures shall not be permitted. ECC shall have remote management capabilities.
2. Processor(s):
   a. Processors shall be either Intel Xeon or AMD EPYC chips sets designed specifically for server use. Desktop processors will not be allowed.
   b. Minimum core count shall be 16 cores. Each Core shall be capable of executing 2 threads simultaneously.

   Minimum base clock speed shall be 3.0 GHz
3. Memory:
   a. Engineering Control Center shall be equipped with a minimum of 32G of DDR4 Error Correcting Code (ECC) memory. After installation of required 32G of RAM, the motherboard must still have a minimum of 2 DIMM slots open for expansion. Motherboard shall be capable of minimum of 64GB of ECC memory.
   b. Minimum speed shall be 2133MHz for memory
4. Storage:
   a. ECC shall be equipped with a RAID capable drive controller capable of handling at least 8 internal, hot swappable drives.

b. All installed drives shall be “Enterprise Class” drives designed specifically for server use.

c. Minimum configuration shall consist of 6 drives in 2 separate RAID arrays:

1) The operating system shall be stored on a RAID 1 array compromising of 2 drives with each drive having a minimum capacity of 1TB each.

2 The B-AWS software and all its related databases shall be stored in RAID 5 array consisting of 4 drives with each drive have a minimum of 4TB capacity for a minimum storage capacity of 12TB’s.

3) An alternative configuration for the 2 RAID arrays described above is 8 drives arrayed in a RAID 10 configuration. In this case the OS RAID array would consist of 4 drives of 1TB minimum each, and the B-AWS RAID array consisting of 4 drives of 16TB minimum each. This configuration would provide faster write times and much quicker rebuild times in the event of a drive failure.

d. ECC will include an 16X DVD R/W drive

5. Case:

a. Case shall have space for a minimum of 8 hot swap 3.5” hard drives and one internal optical drive

b. Real-time clock:

1) Accuracy: Plus or minus 1 minute per month.

2) Time Keeping Format:24-hour time format including seconds, minutes, hours, date, day, and month; automatic reset by software.

3) Clock shall function for one year without power.

4) Provide automatic time correction once every 24 hours by synchronizing clock with the Time Service Department of the U.S. Naval Observatory.

c. Serial ports: Four USB ports and two RS-232-F serial ports for general use, with additional ports as required. Data transmission rates shall be selectable under program control.

d. Parallel port: Enhanced.

e. Sound card: For playback and recording of digital WAV sound files associated with audible warning and alarm functions.

f. Color monitor: PC compatible, not less than 22 inches, LCD type, with a minimum resolution of 1280 by 1024 pixels, non-interlaced, and a maximum dot pitch of 0.28 mm.

g. Keyboard: Minimum of 64 characters, standard ASCII character set based on ANSI INCITS 154.

h. Mouse: Standard, compatible with installed software.

i. Removable disk storage: Include the following, each with appropriate controller:

1) Minimum 1 TB removable hard disk, maximum average access time of 10 ms.

j. Network interface card (NIC): integrated 10-100-1000 Base-TX Ethernet NIC with an RJ45 connector or a 100Base-FX Ethernet NIC with an SC/ST connector.

6. Cable modem: 42.88 MBit/s, DOCSIS 2.0 Certified, also backwards compatible with DOCSIS 1.1/1.0 standards. Provide Ethernet or USB connectivity.

7. Optical modem: full duplex link, for use on 10 GBase-R single-mode and multi-mode fiber with a XENPAK module.

8. Auto-dial modem: 56,600 bps, full duplex for asynchronous communications. With error detection, auto answer/autodial, and call-in-progress detection. Modem shall comply with requirements in ITU-T v.34, ITU-T v.42, ITU-T v.42 Appendix VI for error correction, and ITU-T v.42 BIS for data compression standards; and shall be suitable for operating on unconditioned voice-grade telephone lines complying with 47 CFR 68.

9. Audible Alarm: Manufacturer's standard.

10. Printers:

a. Provide a dedicated, minimum resolution 600 dpi, color laser printer, connected to the ECC through a USB interface.

1) If a network printer is used instead of this dedicated printer, it shall have a 100Base-T interface with an RJ45 connection and shall have a firmware print spooler compatible with the Operating System print spooler.

2) RAM: 512 MB, minimum.

3) Printing Speed: Minimum twenty-six pages per minute (color); minimum 30 pages per minute (black/white).

4) Paper Handling: Automatic sheet feeder with 250-sheet x 8.5 inch x 11 inch paper cassette and with automatic feed.

b. Provide a dedicated black/white tractor-feed dot matrix printer for status/alarm message printing, minimum 10 characters per inch, minimum 160 characters per second, connected to the ECC through a USB interface.

1) Paper: One box of 2000 sheets of 8-1/2x11 multi-fold type printer paper.

11. RS-232 ASCII Interface

a. ASCII interface shall allow RS-232 connections to be made between a meter or circuit monitor operating as the host PC and any equipment that will accept RS-232 ASCII command strings, such as local display panels, dial-up modems, and alarm transmitters.

b. Pager System Interface: Alarms shall be able to activate a pager system with customized message for each input alarm.

c. Alarm System Interface: RS-232 output shall be capable of transmitting alarms from other monitoring and alarm systems to workstation software.

d. RS-232 output shall be capable of connection to a pager interface that can be used to call a paging system or service and send a signal to a portable pager. System shall allow an individual alphanumeric message per alarm input to be sent to paging system. This interface shall support both numeric and alphanumeric pagers.

e. Cables: provide Plenum-Type, RS-232 Cable: Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, plastic insulation, and individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage; plastic jacket. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.

1) NFPA 70, Type CMP.

2) Flame Resistance: NFPA 262, Flame Test.

12. Self-contained uninterruptible power supply (UPS):

a. Size: Provide a minimum of six hours of operation of ECC equipment, including two hours of alarm printer operation.

b. Batteries: Sealed, valve regulated, recombinant, lead calcium.

c. Accessories:

1) Transient voltage suppression.
2) Input-harmonics reduction.
3) Rectifier/charger.
4) Battery disconnect device.
5) Static bypass transfer switch.
6) Internal maintenance bypass/isolation switch.
7) External maintenance bypass/isolation switch.
8) Output isolation transformer.
9) Remote UPS monitoring.
10) Battery monitoring.
11) Remote battery monitoring.

D. ECC Software:

1. Provide for automatic system database save and restore on the ECC's hard disk a copy of the current database of each Controller. This database shall be updated whenever a change is made in any system panel. In the event of a database loss in a building management panel, the ECC shall automatically restore the database for that panel. This capability may be disabled by the operator.
2. Provide for manual database save and restore. An operator with proper clearance shall be able to save the database from any system panel. The operator also shall be able to clear a panel database and manually initiate a download of a specified database to any panel in the system.
3. Provide a method of configuring the system. This shall allow for future system changes or additions by users with proper clearance.
4. Operating System. Furnish a concurrent multi-tasking operating system. The operating system also shall support the use of other common software applications. Acceptable operating systems are Windows Server 2019, Linux, and UNIX.
5. System Graphics. The operator workstation software shall be graphically oriented. The system shall allow display of up to 10 graphic screens at once for comparison and monitoring of system status. Provide a method for the operator to easily move between graphic displays and change the size and location of graphic displays on the screen. The system graphics shall be able to be modified while on-line. An operator with the proper password level shall be able to add, delete, or change dynamic objects on a

graphic. Dynamic objects shall include analog and binary values, dynamic text, static text, and animation files. Graphics shall have the ability to show animation by shifting image files based on the status of the object.

6. Custom Graphics. Custom graphic files shall be created with the use of a graphics generation package furnished with the system. The graphics generation package shall be a graphically based system that uses the mouse to create and modify graphics that are saved in industry standard formats such as PCX, TIFF, and GEM. The graphics generation package also shall provide the capability of capturing or converting graphics from other programs such as Designer or AutoCAD.
7. Graphics Library. Furnish a complete library of standard HVAC equipment graphics such as chillers, boilers, air handlers, terminals, fan coils, and unit ventilators. This library also shall include standard symbols for other equipment including fans, pumps, coils, valves, piping, dampers, and ductwork. The library shall be furnished in a file format compatible with the graphics generation package program.
8. The Controls Systems Operator Interfaces shall be user friendly, readily understood and shall make maximum use of colors, graphics, icons, embedded images, animation, text based information and data visualization techniques to enhance and simplify the use and understanding of the displays by authorized users at the ECC. The operating system shall be Windows XP or better, and shall support the third party software.
9. Provide graphical user software, which shall minimize the use of keyboard through the use of the mouse and "point and click" approach to menu selection.
10. The software shall provide a multi-tasking type environment that will allow the user to run several applications simultaneously. The mouse or Alt-Tab keys shall be used to quickly select and switch between multiple applications. The operator shall be able automatically export data to and work in Microsoft Word, Excel, and other Windows based software programs, while concurrently on-line system alarms and monitoring information.
11. On-Line Help. Provide a context-sensitive, on-line help system to assist the operator in operating and editing the system. On-line

help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext.

12. User access shall be protected by a flexible and Owner re-definable software-based password access protection. Password protection shall be multi-level and partition able to accommodate the varied access requirements of the different user groups to which individual users may be assigned. Provide the means to define unique access privileges for each individual authorized user. Provide the means to on-line manage password access control under the control of a project specific Master Password. Provide an audit trail of all user activity on the Controls Systems including all actions and changes.
13. The system shall be completely field-programmable from the common operator’s keyboard thus allowing hard disk storage of all data automatically. All programs for the CUs shall be able to be downloaded from the hard disk. The software shall provide the following functionality as a minimum:
    a. Point database editing, storage and downloading of controller databases.
    b. Scheduling and override of building environmental control systems.
    c. Collection and analysis of historical data.
    d. Alarm reporting, routing, messaging, and acknowledgement.
    e. Definition and construction of dynamic color graphic displays.
    f. Real-time graphical viewing and control of environment.
    g. Scheduling trend reports.
    h. Program editing.
    i. Operating activity log and system security.
    j. Transfer data to third party software.
14. Provide functionality such that using the least number of steps to initiate the desired event may perform any of the following simultaneously:
    a. Dynamic color graphics and graphic control.
    b. Alarm management.
    c. Event scheduling.
    d. Dynamic trend definition and presentation.
    e. Program and database editing.

f. Each operator shall be required to log on to the system with a username and password to view, edit or delete the data. System security shall be selectable for each operator, and the password shall be able to restrict the operator's access for viewing and changing the system programs. Each operator shall automatically be logged off the system if no keyboard or mouse activity is detected for a selected time.

15. Graphic Displays:

a. The workstation shall allow the operator to access various system schematics and floor plans via a graphical penetration scheme, menu selection, or text-based commands. Graphic software shall permit the importing of AutoCAD or scanned pictures in the industry standard format (such as PCX, BMP, GIF, and JPEG) for use in the system.

b. System Graphics shall be project specific and schematically correct for each system. (ie: coils, fans, dampers located per equipment supplied with project.) Standard system graphics that do not match equipment or system configurations are not acceptable. Operator shall have capability to manually operate the entire system from each graphic screen at the ECC. Each system graphic shall include a button/tab to a display of the applicable sequence of operation.

c. Dynamic temperature values, humidity values, flow rates, and status indication shall be shown in their locations and shall automatically update to represent current conditions without operator intervention and without pre-defined screen refresh values.

d. Color shall be used to indicate status and change in status of the equipment. The state colors shall be user definable.

e. A clipart library of HVAC equipment, such as chillers, boilers, air handling units, fans, terminal units, pumps, coils, standard ductwork, piping, valves and laboratory symbols shall be provided in the system. The operator shall have the ability to add custom symbols to the clipart library.

f. A dynamic display of the site-specific architecture showing status of the controllers, the ECC and network shall be provided.

g. The windowing environment of the workstation shall allow the user to simultaneously view several applications at a time to analyze total building operation or to allow the display of graphic associated with an alarm to be viewed without interrupting work in progress. The graphic system software shall also have the capability to split screen, half portion of the screen with graphical representation and the other half with sequence of operation of the same HVAC system.

16. Trend reports shall be generated on demand or pre-defined schedule and directed to monitor display, printers or disk. As a minimum, the system shall allow the operator to easily obtain the following types of reports:
    a. A general list of all selected points in the network.
    b. List of all points in the alarm.
    c. List of all points in the override status.
    d. List of all disabled points.
    e. List of all points currently locked out.
    f. List of user accounts and password access levels.
    g. List of weekly schedules.
    h. List of holiday programming.
    i. List of limits and dead bands.
    j. Custom reports.
    k. System diagnostic reports, including, list of digital controllers on the network.
    l. List of programs.
17. ASHRAE Standard 147 Report: Provide a daily report that shows the operating condition of each chiller as recommended by ASHRAE Standard 147. At a minimum, this report shall include:
    a. Chilled water (or other secondary coolant) inlet and outlet temperature
    b. Chilled water (or other secondary coolant) flow
    c. Chilled water (or other secondary coolant) inlet and outlet pressures
    d. Evaporator refrigerant pressure and temperature
    e. Condenser refrigerant pressure and liquid temperature
    f. Condenser water inlet and outlet temperatures
    g. Condenser water flow

h. Refrigerant levels
i. Oil pressure and temperature
j. Oil level
k. Compressor refrigerant discharge temperature
l. Compressor refrigerant suction temperature
m. Addition of refrigerant
n. Addition of oil
o. Vibration levels or observation that vibration is not excessive
p. Motor amperes per phase
q. Motor volts per phase
r. PPM refrigerant monitor level
s. Purge exhaust time or discharge count
t. Ambient temperature (dry-bulb and wet-bulb)
u. Date and time logged

18. Electrical, Gas, and Weather Reports
    a. Electrical Meter Report: Provide a monthly report showing the daily electrical consumption and peak electrical demand with time and date stamp for each building meter.
    b. Provide an annual (12-month) summary report showing the monthly electrical consumption and peak demand with time and date stamp for each meter.
    c. Gas Meter Report: Provide a monthly report showing the daily natural gas consumption for each meter. Provide an annual (12-month) report that shows the monthly consumption for each meter.
    d. Weather Data Report: Provide a monthly report showing the daily minimum, maximum, and average outdoor air temperature, as well as the number of heating and cooling degree-days for each day. Provide an annual (12-month) report showing the minimum, maximum, and average outdoor air temperature for the month, as well as the number of heating and cooling degree-days for the month.
19. Scheduling and Override:
    a. Provide override access through menu selection from the graphical interface and through a function key.
    b. Provide a calendar type format for time-of-day scheduling and overrides of building control systems. Schedules reside in the ECC. The digital controllers shall ensure equipment time scheduling when the ECC is off-line. The ECC shall not be

required to execute time scheduling. Provide the following spreadsheet graphics as a minimum:

1) Weekly schedules.
2) Zone schedules, minimum of 100 zones.
3) Scheduling up to 365 days in advance.
4) Scheduled reports to print at workstation.

20. Collection and Analysis of Historical Data:
    a. Provide trending capabilities that will allow the operator to monitor and store records of system activity over an extended period. Points may be trended automatically on time-based intervals or change of value, both of which shall be user definable. The trend interval could be five (5) minutes to 120 hours. Trend data may be stored on hard disk for future diagnostic and reporting. Additionally trend data may be archived to network drives or removable disk media for off-site retrieval.
    b. Reports may be customized to include individual points or predefined groups of at least six points. Provide additional functionality to allow pre-defined groups of up to 250 trended points to be easily accessible by other industry standard word processing and spreadsheet packages. The reports shall be time and date stamped and shall contain a report title and the name of the facility.
    c. System shall have the set up to generate spreadsheet reports to track energy usage and cost based on weekly or monthly interval, equipment run times, equipment efficiency, and/or building environmental conditions.
    d. Provide additional functionality that will allow the operator to view real time trend data on trend graph displays. A minimum of 20 points may be graphed regardless of whether they have been predefined for trending. In addition, the user may pause the graph and take snapshots of the screens to be stored on the workstation disk for future reference and trend analysis. Exact point values may be viewed, and the graph may be printed. Operator shall be able to command points directly on the trend plot by double clicking on the point.
21. Alarm Management:

a. Alarm routing shall allow the operator to send alarm notification to selected printers or operator workstation based on time of day, alarm severity, or point type.
b. Alarm notification shall be provided via two alarm icons, to distinguish between routine, maintenance type alarms and critical alarms. The critical alarms shall display on the screen at the time of its occurrence, while others shall display by clicking on their icon.
c. Alarm display shall list the alarms with highest priority at the top of the display. The alarm display shall provide selector buttons for display of the associated point graphic and message in English language. The operator shall be able to sort out the alarms.
d. Alarm messages shall be customized for each point to display detailed instructions to the operator regarding actions to take in the event of an alarm.
e. An operator with proper security level access may acknowledge and clear the alarm. All that have not been cleared shall be archived at workstation disk.

22. Remote Communications: The system shall have the ability to dial out in the event of an alarm. Receivers shall include operator workstations, e-mail addresses, and alpha-numeric pagers. The alarm message shall include the name of the calling location, the device that generated the alarm, and the alarm message itself.
23. System Configuration:
    a. Network control strategies shall not be restricted to a single digital controller but shall be able to include data from all other network devices to allow the development of global control strategies.
    b. Provide automatic backup and restore of all digital controller databases on the workstation hard disk. In addition to all backup data, all databases shall be performed while the workstation is on-line without disturbing other system operations.

**2.5 PORTABLE OPERATOR'S TERMINAL (POT)**

A. Provide a portable operator's terminal (POT) that shall be capable of accessing all system data. POT may be connected to any point on the system network or may be connected directly to any controller for

programming, setup, and troubleshooting. POT shall communicate using BACnet protocol. POT may be connected to any point on the system network or it may be connected directly to controllers using the BACnet PTP (Point-To-Point) Data Link/ Physical layer protocol. The terminal shall use the Read (Initiate) and Write (Execute) BACnet Services. POT shall be an IBM-compatible notebook-style PC including all software and hardware required.

B. Hardware: POT shall conform to the BACnet Advanced Workstation (B-AWS) Profile and shall be BTL-Listed as a B-AWS device.

1. POT shall be commercial standard with supporting 32- or 64-bit hardware (as limited by the direct-digital control system software) and software enterprise server. Internet Explorer v6.0 SP1 or higher, Windows Script Hosting version 5.6 or higher, Windows Message Queuing, Windows Internet Information Services (IIS) v5.0 or higher, minimum 2.8 GHz processor, minimum 500 GB 7200 rpm SATA hard drive with 16 MB cache, minimum 2GB DDR3 SDRAM (minimum 1333 Mhz) memory, 512 MB video card, minimum 16 inch (diagonal) screen, 10-100-1000 Base-TX Ethernet NIC with an RJ45 connector or a 100Base-FX Ethernet NIC with an SC/ST connector, 56,600 bps modem, an ASCII RS-232 interface, and a 16 speed high density DVD-RW+/- optical drive.

C. Software: POT shall include software equal to the software on the ECC.

**2.6 BACNET PROTOCOL ANALYZER**

A. For ease of troubleshooting and maintenance, provide a BACnet protocol analyzer. Provide its associated fittings, cables and appurtenances, for connection to the communications network. The BACnet protocol analyzer shall be able to, at a minimum: capture and store to a file all data traffic on all network levels; measure bandwidth usage; filter out (ignore) selected traffic.

**2.7 NETWORK AND DEVICE NAMING CONVENTION**

A. Network Numbers

1. BACnet network numbers shall be based on a "facility code, network" concept. The "facility code" is the VAMC’s or VA campus’ assigned numeric value assigned to a specific facility or building. The "network" typically corresponds to a "floor" or other logical configuration within the building. BACnet allows 65535 network numbers per BACnet internet work.

2. The network numbers are thus formed as follows: "Net #" = "FFFNN" where:
   a. FFF = Facility code (see below)
   b. NN = 00-99  This allows up to 100 networks per facility or building

B. Device Instances
1. BACnet allows 4194305 unique device instances per BACnet internet work. Using Agency's unique device instances are formed as follows: "Dev #" = "FFFNNDD" where
   a. FFF and N are as above and
   b. DD = 00-99, this allows up to 100 devices per network.
2. Note Special cases, where the network architecture of limiting device numbering to DD causes excessive subnet works. The device number can be expanded to DDD and the network number N can become a single digit. In NO case shall the network number N and the device number D exceed 4 digits.
3. Facility code assignments:
4. 000-400  Building/facility number
5. Note that some facilities have a facility code with an alphabetic suffix to denote wings, related structures, etc. The suffix will be ignored. Network numbers for facility codes above 400 will be assigned in the range 000-399.

C. Device Names
1. Name the control devices based on facility name, location within a facility, the system or systems that the device monitors and/or controls, or the area served. The intent of the device naming is to be easily recognized. Names can be up to 254 characters in length, without embedded spaces. Provide the shortest descriptive, but unambiguous, name. For example, in building #123 prefix the number with a “B” followed by the building number, if there is only one chilled water pump "CHWP-1", a valid name would be "B123.CHWP.1.STARTSTOP". If there are two pumps designated "CHWP-1", one in a basement mechanical room (Room 0001) and one in a penthouse mechanical room (Room PH01), the names could be "B123.R0001.CHWP.1.STARTSTOP" or "B123.RPH01.CHWP.1.STARTSTOP". In the case of unitary controllers, for example a VAV box controller, a name might be "B123.R101.VAV". These names should be used for the value of the

"Object_Name" property of the BACnet Device objects of the controllers involved so that the BACnet name and the EMCS name are the same.

**2.8 BACNET DEVICES**

A. All BACnet Devices – controllers, gateways, routers, actuators, Operator Displays, and sensors shall conform to BACnet Device Profiles and shall be BACnet Testing Laboratories (BTL) -Listed as conforming to those Device Profiles. Protocol Implementation Conformance Statements (PICSs), describing the BACnet capabilities of the Devices shall be published and available for the Devices through links in the BTL website.

1. BACnet Building Controllers, shall conform to the BACnet B-BC Device Profile, and shall be BTL-Listed as conforming to the B-BC Device Profile. The Device's PICS shall be submitted.
2. BACnet Advanced Application Controllers shall conform to the BACnet B-AAC Device Profile and shall be BTL-Listed as conforming to the B-AAC Device Profile. The Device's PICS shall be submitted.
3. BACnet Application Specific Controllers shall conform to the BACnet B-ASC Device Profile and shall be BTL-Listed as conforming to the B-ASC Device Profile. The Device's PICS shall be submitted.
4. BACnet Smart Actuators shall conform to the BACnet B-SA Device Profile and shall be BTL-Listed as conforming to the B-SA Device Profile. The Device's PICS shall be submitted.
5. BACnet Smart Sensors shall conform to the BACnet B-SS Device Profile and shall be BTL-Listed as conforming to the B-SS Device Profile. The Device's PICS shall be submitted.
6. BACnet routers and gateways shall conform to the BACnet B-OTH Device Profile, and shall be BTL-Listed as conforming to the B-OTH Device Profile. The Device's PICS shall be submitted.

**2.9 CONTROLLERS**

A. General. Provide an adequate number of BTL listed B-BC building controllers, BTL listed B-AAC, BTL listed B-ASC, BTL listed B-SA, and BTL listed B-SS's to achieve the performance specified in the Part 1 Article on "System Performance." Each of these controllers shall meet the following requirements.

1. Communication.

a. Each B-BC controller shall reside on a BACnet network using the ISO 8802-3 (Ethernet) Data Link/Physical layer protocol for its communications.

b. Each B-BC controller shall provide a service communication port using BACnet Data Link/Physical layer protocol for connection to a portable operator's terminal. If this port is not available built into the controller, contractor is to install a 4 port unmanaged switch inside the B-BC control cabinet.

2. Keypad. A local keypad and display shall be provided for each controller. The keypad shall be provided for interrogating and editing data. Provide a system security password shall be available to prevent unauthorized use of the keypad and display.

3. Serviceability. Provide diagnostic LEDs for power, communication, and processor. All wiring connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.

4. Memory. The controller shall maintain all BIOS and programming information in the event of a power loss for at least 72 hours.

5. The controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage. Controller operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m (3 ft).

6. Transformer. Power supply for the ASC must be rated at a minimum of 125% of B-ASC power consumption and shall be of the fused or current limiting type.

terminal units, for example.

B. Provide BTL-Listed B-ASC application specific controllers for each piece of equipment for which they are constructed. Application specific controllers shall communicate with other BACnet devices on the internetwork using the BACnet Read (Execute) Property service.

1. Each B-ASC shall be capable of stand-alone operation and shall continue to provide control functions without being connected to the network.

2. Each B-ASC will contain sufficient I/O capacity to control the target system.

3. Communication.

a. Each controller shall reside on a BACnet network using the ISO 8802-3 (Ethernet) Data Link/Physical layer protocol for its communications. Each building controller also shall perform BACnet routing if connected to a network of custom application and application specific controllers.

b. Each controller shall have a BACnet Data Link/Physical layer compatible connection for a laptop computer or a portable operator’s tool. This connection shall be extended to a space temperature sensor port where shown.

4. Serviceability. Provide diagnostic LEDs for power, communication, and processor. All wiring connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.

5. Memory. The application specific controller shall use nonvolatile memory and maintain all BIOS and programming information in the event of a power loss.

6. Immunity to power and noise. Controllers shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80%. Operation shall be protected against electrical noise of 5-120 Hz and from keyed radios up to 5 W at 1 m (3 ft).

C. Direct Digital Controller Software

1. The software programs specified in this section shall be commercially available, concurrent, multi-tasking operating system and support the use of software application that operates under DOS Linuxor Microsoft Windows.

2. All points shall be identified by up to 30-character point name and 16-character point descriptor. The same names shall be used at the ECC.

3. All control functions shall execute within the stand-alone control units. All new controllers installed will also include all software and/or hardware required to program, commission, or alter the sequence of operation of said controller(s). Controllers requiring software or hardware that is not commercially available will not be allowed. Installation of software and/or hardware for controller configuration will be the responsibility of the DDC contractor. COR will direct to install said hardware and/or software on either the B-AWS or portable operator terminal. The VA shall be able to

customize control strategies and sequences of operations defining the appropriate control loop algorithms and choosing the optimum loop parameters without requiring the services of a DDC contractor.

4. All controllers shall be capable of being programmed to utilize stored default values for assured fail-safe operation of critical processes. Default values shall be invoked upon sensor failure or, if the primary value is normally provided by the central or another CU, or by loss of bus communication. Individual application software packages shall be structured to assume a fail-safe condition upon loss of input sensors. Loss of an input sensor shall result in output of a sensor-failed message at the ECC. Each ACU and RCU shall have capability for local readouts of all functions. The UCUs shall be read remotely.
5. All DDC control loops shall be able to utilize any of the following control modes:
   a. Two position (on-off, slow-fast) control.
   b. Proportional control.
   c. Proportional plus integral (PI) control.
   d. Proportional plus integral plus derivative (PID) control. All PID programs shall automatically invoke integral wind up prevention routines whenever the controlled unit is off, under manual control of an automation system or time-initiated program.
   e. Automatic tuning of control loops.
6. System Security: Operator access shall be secured using individual password and operator’s name. Passwords shall restrict the operator to the level of object, applications, and system functions assigned to him. A minimum of three (3)or a maximum of six (6) levels of security for operator access shall be provided.
7. Application Software: The controllers shall provide the following programs as a minimum for the purpose of optimizing energy consumption while maintaining comfortable environment for occupants. All application software shall reside and run in the system digital controllers. Editing of the application shall occur at the ECC or via a portable operator’s terminal, when it is necessary, to access directly the programmable unit.
   a. Power Demand Limiting (PDL): Power demand limiting program shall monitor the building power consumption and limit the consumption

of electricity to prevent peak demand charges. PDL shall continuously track the electricity consumption from a pulse input generated at the kilowatt-hour/demand electric meter. PDL shall sample the meter data to continuously forecast the electric demand likely to be used during successive time intervals. If the forecast demand indicates that electricity usage will likely to exceed a user preset maximum allowable level, then PDL shall automatically shed electrical loads. Once the demand load has met, loads that have been shed shall be restored and returned to normal mode. Control system shall be capable of demand limiting by resetting the HVAC system set points to reduce load while maintaining indoor air quality.

b. Economizer: An economizer program shall be provided for VAV systems. This program shall control the position of air handler relief, return, and outdoors dampers. If the outdoor air dry bulb temperature falls outdoor air dry bulb temperature and humidity fall below changeover set point the energy control center will modulate the dampers to provide 100 percent outdoor air. The operator shall be able to override the economizer cycle and return to minimum outdoor air operation at any time.

c. Night Setback/Morning Warm up Control: The system shall provide the ability to automatically adjust set points for this mode of operation.

d. Optimum Start/Stop (OSS): Optimum start/stop program shall automatically be coordinated with event scheduling. The OSS program shall start HVAC equipment at the latest possible time that will allow the equipment to achieve the desired zone condition by the time of occupancy, and it shall also shut down HVAC equipment at the earliest possible time before the end of the occupancy period and still maintain desired comfort conditions. The OSS program shall consider both outside weather conditions and inside zone conditions. The program shall automatically assign longer lead times for weekend and holiday shutdowns. The program shall poll all zones served by the associated AHU and shall select the warmest and coolest zones. These shall be used in the start time calculation. It shall be possible to assign occupancy start times on a per air handler

unit basis. The program shall meet the local code requirements for minimum outdoor air while the building is occupied. Modification of assigned occupancy start/stop times shall be possible via the ECC.

e. Event Scheduling: Provide a comprehensive menu driven program to automatically start and stop designated points or a group of points according to a stored time. This program shall provide the capability to individually command a point or group of points. When points are assigned to one common load group it shall be possible to assign variable time advances/delays between each successive start or stop within that group. Scheduling shall be calendar based and advance schedules may be defined up to one year in advance. Advance schedule shall override the day-to-day schedule. The operator shall be able to define the following information:

   1) Time, day.
   2) Commands such as on, off, auto.
   3) Time delays between successive commands.
   4) Manual overriding of each schedule.
   5)Allow operator intervention.

f. Alarm Reporting: The operator shall be able to determine the action to be taken in the event of an alarm. Alarms shall be routed to the ECC based on time and events. An alarm shall be able to start programs, login the event, print and display the messages. The system shall allow the operator to prioritize the alarms to minimize nuisance reporting and to speed operator’s response to critical alarms. A minimum of six (6) priority levels of alarms shall be provided for each point.

g. Remote Communications: The system shall have the ability to dial out in the event of an alarm to the ECC and alpha-numeric pagers. The alarm message shall include the name of the calling location, the device that generated the alarm, and the alarm message itself. The operator shall be able to remotely access and operate the system using dial up communications. Remote access shall allow the operator to function the same as local access.

h. Maintenance Management (PM): The program shall monitor equipment status and generate maintenance messages based upon the operators

defined equipment run time, starts, and/or calendar date limits. A preventative maintenance alarm shall be printed indicating maintenance requirements based on pre-defined run time. Each preventive message shall include point description, limit criteria and preventative maintenance instruction assigned to that limit. A minimum of 480-character PM shall be provided for each component of units such as air handling units.

i. Chilled water Plant Operation: This program shall have the ability to sequence the multiple chillers to minimize energy consumption. The program shall provide sequence of operation as described on the drawings and include the following as a minimum:
   1) Automatic start/stop of chillers and auxiliaries in accordance with the sequence of operation shown on the drawings, while incorporating requirements and restraints, such as starting frequency of the equipment imposed by equipment manufacturers.
   2) Secondary chilled water pumps and controls.
   3) Generate chilled water plant load profiles for different seasons for use in forecasting efficient operating schedule.
   4) Cooling Tower Operation Program: The objective of cooling tower control is to optimize chiller/tower energy use within the equipment restraints and minimum condenser water temperature limit recommended by the equipment manufacturer. Maintain chilled water plant performance records and print reports at intervals selected by the operator. It shall be possible for the operator to change the set points and the operating schedule.
   5) The chilled water plant program shall display the following as a minimum:
      a) Secondary chilled flow rate.
      b) Secondary chilled water supply and return temperature.
      c) Condenser water supply and return temperature.
      d) Outdoor air dry bulb temperature.
      e) Outdoor air wet bulb temperature.
      f) Ton-hours of chilled water per day/month/year.
      g) On-off status for each chiller.
      h) Chilled water flow rate.
      i) Chilled water supply and return temperature.

j) Operating set points-temperature and pressure.

k) Kilowatts and power factor.

l) Current limit set point.

m) Date and time.

n) Operating or alarm status.

o) Operating hours.

**2.10 SPECIAL CONTROLLERS**

A. Laboratory rooms and the fume hoods in those rooms shall be controlled to allow for a variable flow of conditioned air into the room, general exhaust from the room, and exhaust through the fume hood while maintaining a safe face velocity at the hood sash opening and proper space pressurization.

B. Fume Hood Exhaust Air Controller: The air flow through the open face of the hood, regardless of sash position, shall be controlled at a face velocity between 30 to 36 meter per minute (100 fpm and 120 fpm). A velocity sensor controller located in a sampling tube in the side wall of the hood shall control a damper in the hood discharge to maintain the face velocity.

C. Room Differential Pressure Controller: The differential pressure in laboratory rooms, operating rooms, in the SPS area, Chemo compounding rooms, and isolation rooms shall be maintained by controlling the quantity of air exhausted from or supplied to the room. A sensor-controller shall measure and control the velocity of air flowing into or out of the room through a sampling tube installed in the wall separating the room from the adjacent space and display the value on its monitor. The sensor-controller shall meet the following as a minimum:

1. Operating range: -0.25 to +0.25 inches of water column
2. Resolution: 5 percent of reading
3. Accuracy: +/- 10 percent of reading +/- 0.005 inches of water column
4. Analog output: 4-20 ma
5. Operating temperature range: 32°F-120°F

**2.11 SENSORS (AIR, WATER AND STEAM)**

A. Sensors' measurements shall be read back to the DDC system, and shall be visible by the ECC.

B. Temperature and Humidity Sensors shall be electronic, vibration and corrosion resistant for wall, immersion, and/or duct mounting. Provide all remote sensors as required for the systems.

1. Temperature Sensors: thermistor type for terminal units and Resistance Temperature Device (RTD) with an integral 4-20 mA transmitter type for all other sensors.
   a. Duct sensors shall be rigid or averaging type as shown on drawings. Averaging sensor shall be a minimum of 1 linear ft of sensing element for each sq ft of cooling/heating coil face area.
   b. Immersion sensors shall be provided with a separable well made of stainless steel, bronze or monel material. Pressure rating of well is to be consistent with the system pressure in which it is to be installed. Temperature well shall be filled with a thermal compound compatible with installed sensor.
   c. All space sensors shall be equipped with in-space User set-point adjustment, override switch, numerical temperature display on sensor cover, and BACNet communication port. Match room thermostats. Provide a tooled-access cover.
      1) Public space sensor: setpoint adjustment shall be only through the ECC or through the DDC system's diagnostic device/laptop. Do not provide in-space User set-point adjustment. Provide an opaque keyed-entry cover if needed to restrict in-space User set-point adjustment.
      2) Psychiatric patient room sensor: sensor shall be flush with wall or on the return duct, shall not include an override switch, numerical temperature display on sensor cover, shall not include a communication port and shall not allow in-space User set-point adjustment. Setpoint adjustment shall be only through the ECC or through the DDC system's diagnostic device/laptop. Provide a stainless-steel cover plate with an insulated back and security screws.
   d. Outdoor air temperature sensors shall have watertight inlet fittings and be shielded from direct sunlight.
   e. Room security sensors shall have stainless steel cover plate with insulated back and security screws.
   f. Wire: Twisted, shielded-pair cable.
   g. Output Signal: 4-20 mA.

2. Humidity Sensors: Bulk polymer sensing element type.
   a. Duct and room sensors shall have a sensing range of 20 to 80 percent with accuracy of ± 2 to ± 5 percent RH, including hysteresis, linearity, and repeatability.
   b. Outdoor humidity sensors shall be furnished with element guard and mounting plate and have a sensing range of 0 to 100 percent RH.
   c. Continuous Output Signal: 4-20 mA

C. Static Pressure Sensors: Non-directional, temperature compensated.
   1. 4-20 mA output signal.
   2. 0 to 5 inches wg for duct static pressure range.
   3. 0 to 0.25 inch wg for Building static pressure range.

D. Vortex Water flow sensors:
   1. Type: Insertion vortex type with retractable probe assembly and 2 inch full port gate valve.
      a. Pipe size: up to 24 inches.
      b. Retractor: ASME threaded, non-rising stem type with hand wheel.
      c. Mounting connection: 2 inch 150 PSI flange.
      d. Sensor assembly: Design for expected water flow and pipe size.
      e. Seal: Teflon (PTFE).
   2. Controller:
      a. Integral to unit.
      b. Locally display flow rate and total.
      c. Output flow signal to BAS/EMS/BES/BMCS: Digital pulse or BACNet type.
   3. Performance:
      a. Turndown: 20:1
      b. Response time: Adjustable from 1 to 100 seconds.
      c. Power: 24 volt DC or -- VDC
   4. Install flow meters according to manufacturer’s recommendations. Where recommended by manufacturer because of mounting conditions, provide flow rectifier.

E. Turbine Water Flow Sensors: shall be insertion turbine type with turbine element, retractor and preamplifier/transmitter mounted on a two-inch full port isolation valve; assembly easily removed or installed as a single unit under line pressure through the isolation valve without interference with process flow; calibrated scale shall

allow precise positioning of the flow element to the required insertion depth within plus or minute 1 mm (0.05 inch); wetted parts shall be constructed of stainless steel. Operating power shall be nominal 24 VDC or 24 Volt DC. Local instantaneous flow indicator shall be LED type in NEMA 4 enclosure with 3-1/2 digital display, for wall or panel mounting.

1. Performance characteristics:
   a. Ambient conditions: -40°C to 60°C (-40°F to 140°F), 5 to 100% humidity.
   b. Operating conditions: 850 kPa (125 psig), 0°C to 120°C (30°F to 250°F), 0.15 to 12 m per second (0.5 to 40 feet per second) velocity.
   c. Nominal range (turn down ratio): 10 to 1.
   d. Preamplifier mounted on meter shall provide 4-20 mA, a divided pulse output or switch closure signal for units of volume or mass per a time base. Signal transmission distance shall be a minimum of 1,800 meters (6,000 feet). Preamplifier for bi-directional flow measurement shall provide a directional contact closure from a relay mounted in the preamplifier .
   e. Pressure Loss: Maximum 1 percent of the line pressure in line sizes above 100 mm (4 inches).
   f. Ambient temperature effects, less than 0.005 percent calibrated span per °C (°F) temperature change.
   g. RFI effect - flow meter shall not be affected by RFI.
   h. Power supply effect less than 0.02 percent of span for a variation of plus or minus 10 percent power supply.

F. Steam Flow Sensor/Transmitter:
   1. Sensor: Vortex shedder incorporating wing type sensor and amplification technology for high signal-to-noise ratio, carbon steel body with 316 stainless steel working parts, 24 VDC power, NEMA 4 enclosure.
      a. Ambient conditions, -40°C to 80°C (-40°F to 175°F).
      b. Process conditions, 900 kPa (125 psig) saturated steam.
      c. Turn down ratio, 20 to 1.
      d. Output signal, 4-20 ma DC.

e. Processor/Transmitter, NEMA 4 enclosure with keypad program selector and six digit LCD output display of instantaneous flow rate or totalized flow, solid state switch closure signal shall be provided to the nearest DDC panel for totalization.

1) Ambient conditions, -20°C to 50°C (0°F-120°F), 0 95 percent non-condensing RH.

2) Power supply, 120 VAC, 60 hertz or 24 VDC.

3) Internal battery, provided for 24-month retention of RAM contents when all other power sources are removed.

f. Sensor on all steam lines shall be protected by pigtail siphons installed between the sensor and the line, and shall have an isolation valve installed between the sensor and pressure source.

G. Flow switches:

1. Shall be either paddle or differential pressure type.

a. Paddle-type switches (liquid service only) shall be UL Listed, SPDT snap-acting, adjustable sensitivity with NEMA 4 enclosure.

b. Differential pressure type switches (air or water service) shall be UL listed, SPDT snap acting, NEMA 4 enclosure, with scale range and differential suitable for specified application.

H. Current Switches: Current operated switches shall be self powered, solid state with adjustable trip current as well as status, power, and relay command status LED indication. The switches shall be selected to match the current of the application and output requirements of the DDC systems.

**2.12 CONTROL CABLES**

A. General:

1. Ground cable shields, drain conductors, and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments. Comply with Sections 27 05 26 and 26 05 26.

2. Cable conductors to provide protection against induction in circuits. Crosstalk attenuation within the System shall be in excess of -80 dB throughout the frequency ranges specified.

3. Minimize the radiation of RF noise generated by the System equipment so as not to interfere with any audio, video, data, computer main distribution frame (MDF), telephone customer service unit (CSU), and

electronic private branch exchange (EPBX) equipment the System may service.

4. The as-installed drawings shall identify each cable as labeled, used cable, and bad cable pairs.
5. Label system's cables on each end. Test and certify cables in writing to the VA before conducting proof-of-performance testing. Minimum cable test requirements are for impedance compliance, inductance, capacitance, signal level compliance, opens, shorts, cross talk, noise, and distortion, and split pairs on all cables in the frequency ranges used. Make available all cable installation and test records at demonstration to the VA. All changes (used pair, failed pair, etc.) shall be posted in these records as the change occurs.
6. Power wiring shall not be run in conduit with communications trunk wiring or signal or control wiring operating at 100 volts or less.

B. Analogue control cabling shall be not less than No. 18 AWG solid or stranded, with thermoplastic insulated conductors as specified in Section 26 05 21.

C. Copper digital communication cable between the ECC and the B-BC and B-AAC controllers shall be 100BASE-TX Ethernet, Category 5e or 6, not less than minimum 24 American Wire Gauge (AWG) solid, Shielded Twisted Pair (STP) or Unshielded Twisted Pair (UTP), with thermoplastic insulated conductors, enclosed in a thermoplastic outer jacket, as specified in Section 27 15 00.

1. Other types of media commonly used within IEEE Std 802.3 LANs (e.g., 10Base-T and 10Base-2) shall be used only in cases to interconnect with existing media.

D. All MS/TP communications cables for devices utilizing the EIA-485 standard must be listed for use on EIA-485 networks by the manufacturer of the cable. This requirement overrides any cable recommendation by the controller manufacturer. The use of EIA-485 communication cables shall not affect the warranty from the installing DDC contractor. Cables shall have the following characteristic:

1. Nominal Impedance: 100-130 Ohms
2. Twisted/shielded construction of 1, 1.5, or 2 pairs depending on controller requirements.
3. Be plenum rated when required

4. Cables designated for use by the cable manufacturer for use in PA or Speaker systems shall not be allowed, regardless of recommendations by the controller manufacturer.

E. Optical digital communication fiber, if used, shall be Multimode or Singlemode fiber, 62.5/125 micron for multimode or 10/125 micron for singlemode micron with SC or ST connectors as specified in TIA-568-C.1. Terminations, patch panels, and other hardware shall be compatible with the specified fiber and shall be as specified in Section 27 15 00. Fiber-optic cable shall be suitable for use with the 100Base-FX or the 100Base-SX standard (as applicable) as defined in IEEE Std 802.3.

**2.13 THERMOSTATS AND HUMIDISTATS**

A. Room thermostats controlling unitary standalone heating and cooling devices not connected to the DDC system shall have three modes of operation (heating - null or dead band - cooling). Thermostats for patient bedrooms shall have capability of being adjusted to eliminate null or dead band. Wall mounted thermostats shall have polished or brushed aluminum satin chrome manufacturer's recommendation finish, setpoint range and temperature display and external adjustment:

1. Electronic Thermostats: Solid-state, microprocessor based, programmable to daily, weekend, and holiday schedules.
   a. Public Space Thermostat: Public space thermostat shall have a thermistor sensor and shall not have a visible means of set point adjustment. Adjustment shall be via the digital controller to which it is connected.
   b. Patient Room Thermostats: thermistor with in-space User set point adjustment and an on-casing room temperature numerical temperature display.
   c. Psychiatric Patient Room Sensors: Electronic duct sensor as noted under Article 2.4.
   d. Battery replacement without program loss.

B. Strap-on thermostats shall be enclosed in a dirt-and-moisture proof housing with fixed temperature switching point and single pole, double throw switch.

C. Freezestats shall have a minimum of 300 mm (one linear foot) of sensing element for each 0.093 square meter (one square foot) of coil area. A freezing condition at any increment of 300 mm (one foot) anywhere along

the sensing element shall be sufficient to operate the thermostatic element. Freezestats shall be manually-reset.

D. Room Humidistats: Provide fully proportioning humidistat with adjustable throttling range for accuracy of settings and conservation. The humidistat shall have set point scales shown in percent of relative humidity located on the instrument. Systems showing moist/dry or high/low are not acceptable.

**2.14 FINAL CONTROL ELEMENTS AND OPERATORS**

A. Fail Safe Operation: Control valves and dampers shall provide "fail safe" operation in either the normally open or normally closed position as required for freeze, moisture, and smoke or fire protection.

B. Spring Ranges: Range as required for system sequencing and to provide tight shut-off.

C. Power Operated Control Dampers (other than VAV Boxes): Factory fabricated, balanced type dampers. All modulating dampers shall be opposed blade type and gasketed. Blades for two-position, duct-mounted dampers shall be parallel, airfoil (streamlined) type for minimum noise generation and pressure drop.

1. Leakage: Except as specified in subparagraph 2 below, maximum leakage in closed position shall not exceed 7 L/S (15 CFMs) differential pressure for outside air and exhaust dampers and 200 L/S/ square meter (40 CFM/sq. ft.) at 50 mm (2 inches) differential pressure for other dampers.
2. Frame shall be galvanized steel channel with seals as required to meet leakage criteria.
3. Blades shall be galvanized steel or aluminum, 200 mm (8 inch) maximum width, with edges sealed as required.
4. Bearing shall be nylon, bronze sleeve or ball type.
5. Hardware shall be zinc-plated steel. Connected rods and linkage shall be non-slip. Working parts of joints shall be brass, bronze, nylon or stainless steel.
6. Maximum air velocity and pressure drop through free area the dampers:
   a. Smoke damper in air handling unit: 305 meter per minute (1000 fpm).
   b. Duct mounted damper: 600 meter per minute (2000 fpm).
   c. Maximum static pressure loss: 50 Pascal (0.20 inches water gage).

D. Smoke Dampers and Combination Fire/Smoke Dampers: Dampers and operators are specified in Section 23 31 00, HVAC DUCTS AND CASINGS. Control of these dampers is specified under this Section.

E. Control Valves:

1. Valves shall be rated for a minimum of 150 percent of system operating pressure at the valve location but not less than 900 kPa (125 psig).
2. Valves 50 mm (2 inches) and smaller shall be bronze body with threaded or flare connections.
3. Valves 60 mm (2 1/2 inches) and larger shall be bronze or iron body with flanged connections.
4. Brass or bronze seats except for valves controlling media above 100 degrees C (210 degrees F), which shall have stainless steel seats.
5. Flow characteristics:
   a. Three way modulating valves shall be globe pattern. Position versus flow relation shall be linear relation for steam or equal percentage for water flow control.
   b. Two-way modulating valves shall be globe pattern. Position versus flow relation shall be linear for steam and equal percentage for water flow control.
   c. Two-way 2-position valves shall be ball, gate or butterfly type.
6. Maximum pressure drop:
   a. Two position steam control: 20 percent of inlet gauge pressure.
   b. Modulating Steam Control: 80 percent of inlet gauge pressure (acoustic velocity limitation).
   c. Modulating water flow control, greater of 3 meters (10 feet) of water or the pressure drop through the apparatus.
7. Two position water valves shall be line size.

F. Damper and Valve Operators and Relays:

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1. Pneumatic operators, spring return type with non-ferrous metal bellows or diaphragm of neoprene or other elastomer. Bellows or diaphragm shall be of right size so that a change in operating pressure of not more than two (2) percent of the total motor operating pressure range will be required to start the valve or damper moving. Provide positive positioning or sequencing relays with adjustable operating range and starting point for operators

sequenced with other operators to permit adjustment of control sequences, except for control valves in confined spaces in terminal units, which may use springs with range selected to provide necessary sequencing. Metal parts shall be aluminum, mill finish galvanized steel, or zinc plated steel or stainless steel.

2. Electric operator shall provide full modulating control of dampers and valves. For dampers a linkage and pushrod shall be furnished for mounting the actuator on the damper frame internally in the duct, externally in the duct, externally on the duct wall, or shall be furnished with a direct-coupled design. Metal parts shall be aluminum, mill finish galvanized steel, or zinc plated steel or stainless steel. Provide actuator heads which allow for electrical conduit attachment. The motor(s) shall have sufficient closure torque to allow for complete closure of valve or damper under pressure. Provide multiple motors as required to achieve sufficient close-off torque.
   a. Minimum valve close-off pressure shall be equal to the system pump’s dead-head pressure, minimum 50 psig for valves smaller than 4 inches.
3. Electronic damper operators: Metal parts shall be aluminum, mill finish galvanized steel, or zinc plated steel or stainless steel. Provide actuator heads which allow for electrical conduit attachment. The motors shall have sufficient closure torque to allow for complete closure of valve or damper under pressure. Provide multiple motors as required to achieve sufficient close-off torque.
   a. VAV Box actuator shall be mounted on the damper axle or shall be of the air valve design, and shall provide complete modulating control of the damper. The motor shall have a closure torque of 35-inch pounds minimum with full torque applied at close off to attain minimum leakage.
4. See and coordinate drawings for required control operation.

**2.15 AIR FLOW CONTROL**

A. Airflow and static pressure shall be controlled via digital controllers with inputs from airflow control measuring stations and static pressure inputs as specified. Controller outputs shall be analog or pulse width modulating output signals. The controllers shall include the capability to control via simple proportional (P) control, proportional

plus integral (PI), proportional plus integral plus derivative (PID), and on-off. The airflow control programs shall be factory-tested programs that are documented in the literature of the control manufacturer.

B. Air Flow Measuring Station -- Pneumatic Type:

1. Airflow measuring stations shall measure airflow by the pitot tube traverse method. Each unit shall consist of a network of static and total pressure sensors, factory positioned and connected in parallel, to produce an equalized velocity pressure. The measured velocity pressure converted to airflow (cfm) shall have accuracy within 2 percent of the full scale throughout the velocity range from 200 to 1,200 meter per minute (700 to 4,000 fpm).
2. Airflow measuring stations shall consist of 16-gauge sheet metal casing, an aluminum air velocity treatment and air straightening section with an open face area not less than 97 percent and a total and static pressure sensing manifold made of copper. Each station shall contain noncombustible sensors which shall be incapable of producing toxic gases or fumes in the event of elevated duct temperatures. All interconnecting tubing shall be internal to the unit with the exception of one total pressure and one static pressure meter connection.
3. Each air flow measuring station shall be installed to meet at least the manufacturer’s minimum installation conditions and shall not amplify the sound level within the duct. The maximum resistance to airflow shall not exceed 0.3 times the velocity head for the duct stations and 0.6 times the velocity head for the fan stations. The unit shall be suitable for continuous operation up to a temperature of 120°C (250°F).
4. Differential pressure transducers shall measure and transmit pressure signals to the direct digital controller. .

C. Air Flow Measuring Station -- Electronic Thermal Type:

1. Air Flow Sensor Probe:
   a. Each air flow sensor shall contain two individual thermal sensing elements. One element shall determine the velocity of the air stream while the other element shall compensate for changes in temperature. Each thermal flow sensor and its associated control circuit and signal conditioning circuit shall be factory

calibrated and be interchangeable to allow replacement of a sensor without recalibration of the entire flow station. The sensor in the array shall be located at the center of equal area segment of the duct or fan inletand the number of sensors shall be adequate to accommodate the expected velocity profile and variation in flow and temperature. The airflow station shall be of the insertion type in which sensor support structures are inserted from the outside of the ducts to make up the complete electronic velocity array.

b. Thermal flow sensor shall be constructed of hermetically sealed thermistors or nickel chromium or reference grade platinum wire, wound over an epoxy, stainless steel or ceramic mandrel and coated with a material suitable for the conditions to be encountered. Each dual sensor shall be mounted in an extruded aluminum alloy strut.

2. Air Flow Sensor Grid Array:

a. Each sensor grid shall consist of a lattice network of temperature sensors and linear integral controllers (ICs) situated inside an aluminum casing suitable for mounting in a duct or fan inlet. Each sensor shall be mounted within a strut facing downstream of the airflow and located so that it is protected on the upstream side. All wiring shall be encased (out of the air stream) to protect against mechanical damage.

b. The casing shall be made of welded aluminum of sufficient strength to prevent structural bending and bowing. Steel or iron composite shall not be acceptable in the casing material.

c. Pressure drop through the flow station shall not exceed 4 Pascal (0.015" W.G.) at 1,000 meter per minute (3,000 FPM).

3. Electronics Panel:

a. Electronics Panel shall consist of a surface mounted enclosure complete with solid-state microprocessor and software.

b. Electronics Panel shall be A/C powered 120 VAC 24 VAC and shall have the capability to transmit signals of 4-20 ma type or PWM type for use in control of the HVAC Systems. The electronic panel shall have the capability to accept user defined scaling parameters for all output signals.

c. Electronics Panel shall have the capability to digitally display airflow in CFM LPS and temperature in degrees F degrees C . The displays shall be provided as an integral part of the electronics panel. The electronic panel shall have the capability to totalize the output flow in CFM for two or more systems, as required. A single output signal shall be provided which will equal the sum of the systems totalized. Output signals shall be provided for temperature and airflow. Provide remote mounted air flow or temperature displays where indicated on the plans.

d. Electronics Panel shall have the following:

1) Minimum of 12-bit A/D conversion.

2) Field adjustable digital primary output offset and gain.

3) Airflow analog output scaling of 100 to 10,000 FPM.

4) Temperature analog output scaling from -45°C to 70°C (-50°F to 160°F).

5) Analog output resolution (full scale output) of 0.025%.

e. All readings shall be in I.P. S.I. units.

4. Thermal flow sensors and its electronics shall be installed as per manufacturer's instructions. The required probe sensor density shall be as follows:

| Probe Sensor Density | |
|---|---|
| Area (sq.ft.) | Qty. Sensors |
| <=1 | 2 |
| >1 to <4 | 4 |
| 4 to <8 | 6 |
| 8 to <12 | 8 |
| 12 to <16 | 12 |
| >=16 | 16 |

a. Complete installation shall not exhibit more than ± 2.0% error in airflow measurement output for variations in the angle of flow of up to 10 percent in any direction from its calibrated orientation. Repeatability of readings shall be within ± 0.25%.

D. Static Pressure Measuring Station: shall consist of one or more static pressure sensors and transmitters along with relays or auxiliary devices as required for a complete functional system. The span of the transmitter shall not exceed two times the design static pressure at

the point of measurement. The output of the transmitter shall be true representation of the input pressure with plus or minus 25 Pascal (0.1 inch) W.G. of the designrequired input pressure:

1. Static pressure sensors shall have the same requirements as Airflow Measuring Devices except that total pressure sensors are optional, and only multiple static pressure sensors positioned on an equal area basis connected to a network of headers are required.
2. For systems with multiple major or main trunk supply ducts, furnish a static pressure transmitter for each trunk duct. The transmitter signal representing the lowest static pressure shall be selected and this shall be the input signal to the controller.
3. The controller shall receive the static pressure transmitter signal and Control Unit (CU) shall provide a control output signal to the supply fan capacity control device. The control mode shall be proportional plus integral (PI) (automatic reset) and where required shall also include derivative mode.
4. In systems with multiple static pressure transmitters, provide a switch located near the fan discharge to prevent excessive pressure during abnormal operating conditions. High-limit switches shall be manually reset.

E. Constant Volume Control Systems shall consist of an air flow measuring station along with such relays and auxiliary devices as required to produce a complete functional system. The transmitter shall receive its air flow signal or static differential pressure signal from the flow measuring station and shall have a span not exceeding three times the design flow rate. The CU shall receive the transmitter signal and shall provide an output to the fan volume control device to maintain a constant flow rate. The CU shall provide proportional plus integral (PI) (automatic reset) control mode and where required also inverse derivative mode. Overall system accuracy shall be plus or minus the equivalent of 2 Pascal (0.008 inch) velocity pressure as measured by the flow station.

F. Airflow Synchronization:

1. Systems shall consist of an air flow measuring station for each main supply and return duct, the CU and such relays, as required to provide a complete functional system that will maintain a constant flow rate difference between supply and return air to an accuracy of

±10%. In systems where there is no suitable location for a flow measuring station that will sense total supply or return flow, provide multiple flow stations with a differential pressure transmitter for each station. Signals from the multiple transmitters shall be added through the CU such that the resultant signal is a true representation of total flow.

2. The total flow signals from supply and return air shall be the input signals to the CU. This CU shall track the return air fan capacity in proportion to the supply air flow under all conditions.

**2.16 SAFETY**

A. Provide hard-wired interlocked connections for such all safety devices, such as freeze stats, smoke detectors, smoke dampers, and refrigerant leak detection devices. All safety devises shall be provided with additional dry contacts and shall be connected to the DDC system for monitoring and sequencing.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

A. General:

1. Examine project plans for control devices and equipment locations; and report any discrepancies, conflicts, or omissions to COR for resolution before proceeding for installation.
2. Install equipment, piping, wiring /conduit parallel to or at right angles to building lines.
3. Install all equipment and piping in readily accessible locations. Do not run tubing and conduit concealed under insulation or inside ducts.
4. Mount control devices, tubing and conduit located on ducts and apparatus with external insulation on standoff support to avoid interference with insulation.
5. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.
6. Run tubing and wire connecting devices on or in control cabinets parallel with the sides of the cabinet neatly racked to permit tracing.
7. Install equipment level and plumb.

B. Electrical Wiring Installation:

1. All wiring and cabling shall be installed in conduits. Install conduits and wiring in accordance with Specification Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS. Conduits carrying control wiring and cabling shall be dedicated to the control wiring and cabling: these conduits shall not carry power wiring. Provide plastic end sleeves at all conduit terminations to protect wiring from burrs.
2. Install analog signal and communication cables in conduit and in accordance with Specification Division 27 – COMMINICATIONS. Install digital communication cables in conduit and in accordance with Specification Section 27 15 00, COMMINICATIONS STRUCTURED CABLING.
3. Install conduit and wiring between operator workstation(s), digital controllers, electrical panels, indicating devices, instrumentation, miscellaneous alarm points, thermostats, and relays as shown on the drawings or as required under this section.
4. Install all electrical work required for a fully functional system and not shown on electrical plans or required by electrical specifications. Where low voltage (less than 50 volt) power is required, provide suitable Class B transformers.
5. Install all system components in accordance with local Building Code and National Electric Code.
   a. Splices: Splices in shielded and coaxial cables shall consist of terminations and the use of shielded cable couplers. Terminations shall be in accessible locations. Cables shall be harnessed with cable ties.
   b. Equipment: Fit all equipment contained in cabinets or panels with service loops, each loop being at least 300 mm (12 inches) long. Equipment for fiber optics system shall be rack mounted, as applicable, in ventilated, self-supporting, code gauge steel enclosure. Cables shall be supported for minimum sag.
   c. Cable Runs: Keep cable runs as short as possible. Allow extra length for connecting to the terminal board. Do not bend flexible coaxial cables in a radius less than ten times the cable outside diameter.
   d. Use vinyl tape, sleeves, or grommets to protect cables from vibration at points where they pass around sharp corners, through walls, panel cabinets, etc.

6. Conceal cables, except in mechanical rooms and areas where other conduits and piping are exposed.
7. Permanently label or code each point of all field terminal strips to show the instrument or item served. Color-coded cable with cable diagrams may be used to accomplish cable identification.
8. Grounding: ground electrical systems per manufacturer’s written requirements for proper and safe operation.

C. Install Sensors and Controls:

1. Temperature Sensors:
   a. Install all sensors and instrumentation according to manufacturer’s written instructions. Temperature sensor locations shall be readily accessible, permitting quick replacement and servicing of them without special skills and tools.
   b. Calibrate sensors to accuracy specified, if not factory calibrated.
   c. Use of sensors shall be limited to its duty, e.g., duct sensor shall not be used in lieu of room sensor.
   d. Install room sensors permanently supported on wall frame. They shall be mounted at 1.5 meter (5.0 feet) above the finished floor unless otherwise noted on the plans or drawings.
   e. Mount sensors rigidly and adequately for the environment within which the sensor operates. Separate extended-bulb sensors form contact with metal casings and coils using insulated standoffs.
   f. Sensors used in mixing plenum, and hot and cold decks shall be of the averaging of type. Averaging sensors shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip.
   g. All pipe mounted temperature sensors shall be installed in wells.
   h. All wires attached to sensors shall be air sealed in their conduits or in the wall to stop air transmitted from other areas affecting sensor reading.
   i. Permanently mark terminal blocks for identification. Protect all circuits to avoid interruption of service due to short-circuiting or other conditions. Line-protect all wiring that comes from external sources to the site from lightning and static electricity.
2. Pressure Sensors:

a. Install duct static pressure sensor tips facing directly downstream of airflow.
b. Install high-pressure side of the differential switch between the pump discharge and the check valve.
c. Install snubbers and isolation valves on steam pressure sensing devices.

3. Actuators:
a. Mount and link damper and valve actuators according to manufacturer’s written instructions.
b. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed position.
c. Check operation of valve/actuator combination to confirm that actuator modulates valve smoothly in both open and closed position.

4. Flow Switches:
a. Install flow switch according to manufacturer’s written instructions.
b. Mount flow switch a minimum of 5 10 pipe diameters up stream and 5 10 pipe diameters downstream or 600 mm (2 feet) whichever is greater, from fittings and other obstructions.
c. Assure correct flow direction and alignment.
d. Mount in horizontal piping-flow switch on top of the pipe.

D. Installation of network:

1. Ethernet:
a. The network shall employ Ethernet LAN architecture, as defined by IEEE 802.3. The Network Interface shall be fully Internet Protocol (IP) compliant allowing connection to currently installed IEEE 802.3, Compliant Ethernet Networks.
b. The network shall directly support connectivity to a variety of cabling types. As a minimum provide the following connectivity: 100 Base TX (Category 5e cabling) for the communications between the ECC and the B-BC and the B-AAC controllers.

2. Third party interfaces: Contractor shall integrate real-time data from building systems by other trades and databases originating from other manufacturers as specified and required to make the system work as one system.

E. Installation of digital controllers and programming:

1. Provide a separate digital control panel for each major piece of equipment, such as air handling unit, chiller, pumping unit etc. Points used for control loop reset such as outdoor air, outdoor humidity, or space temperature could be located on any of the remote control units.
2. Provide sufficient internal memory for the specified control sequences and trend logging. There shall be a minimum of 25 percent of available memory free for future use.
3. System point names shall be human readable, permitting easy operator interface without the use of a written point index.
4. Provide software programming for the applications intended for the systems specified, and adhere to the strategy algorithms provided.
5. Provide graphics for each piece of equipment and floor plan in the building. This includes each chiller, cooling tower, air handling unit, fan, terminal unit, boiler, pumping unit etc. These graphics shall show all points dynamically as specified in the point list.

**3.2 SYSTEM VALIDATION AND DEMONSTRATION**

A. As part of final system acceptance, a system demonstration is required (see below). Prior to start of this demonstration, the contractor is to perform a complete validation of all aspects of the controls and instrumentation system.

B. Validation

1. Prepare and submit for approval a validation test plan including test procedures for the performance verification tests. Test Plan shall address all specified functions of the ECC and all specified sequences of operation. Explain in detail actions and expected results used to demonstrate compliance with the requirements of this specification. Explain the method for simulating the necessary conditions of operation used to demonstrate performance of the system. Test plan shall include a test check list to be used by the Installer’s agent to check and initial that each test has been successfully completed. Deliver test plan documentation for the performance verification tests to the owner’s representative 30 days prior to start of performance verification tests. Provide draft copy of operation and maintenance manual with performance verification test.

2. After approval of the validation test plan, installer shall carry out all tests and procedures therein. Installer shall completely check out, calibrate, and test all connected hardware and software to insure that system performs in accordance with approved specifications and sequences of operation submitted. Installer shall complete and submit Test Check List.

C. Demonstration

1. System operation and calibration to be demonstrated by the installer in the presence of the Architect, Cx Agent or COR on random samples of equipment as dictated by the COR. Should random sampling indicate improper work, the owner reserves the right to subsequently witness complete calibration of the system at no addition cost to the VA.
2. Demonstrate to authorities that all required safeties and life safety functions are fully functional and complete. PG-18-10 Safety DM
3. Make accessible, personnel to provide necessary adjustments and corrections to systems as directed by balancing agency.
4. The following witnessed demonstrations of field control equipment shall be included:
   a. Observe HVAC systems in shut down condition. Check dampers and valves for normal position.
   b. Test application software for its ability to communicate with digital controllers, operator workstation, and uploading and downloading of control programs.
   c. Demonstrate the software ability to edit the control program off-line.
   d. Demonstrate reporting of alarm conditions for each alarm and ensure that these alarms are received at the assigned location, including operator workstations.
   e. Demonstrate ability of software program to function for the intended applications-trend reports, change in status etc.
   f. Demonstrate via graphed trends to show the sequence of operation is executed in correct manner, and that the HVAC systems operate properly through the complete sequence of operation, e.g., seasonal change, occupied/unoccupied mode, and warm-up condition.

g. Demonstrate hardware interlocks and safeties functions, and that the control systems perform the correct sequence of operation after power loss and resumption of power loss.
h. Prepare and deliver to the VA graphed trends of all control loops to demonstrate that each control loop is stable and the set points are maintained.
i. Demonstrate that each control loop responds to set point adjustment and stabilizes within one (1) (5) minute(s). Control loop trend data shall be instantaneous and the time between data points shall not be greater than one (1) minute.

5. Witnessed demonstration of ECC functions shall consist of:
   a. Running each specified report.
   b. Display and demonstrate each data entry to show site specific customizing capability. Demonstrate parameter changes.
   c. Step through penetration tree, display all graphics, demonstrate dynamic update, and direct access to graphics.
   d. Execute digital and analog commands in graphic mode.
   e. Demonstrate DDC loop precision and stability via trend logs of inputs and outputs (6 loops minimum).
   f. Demonstrate Energy Management System (EMS) performance via trend logs and command trace.
   g. Demonstrate scan, update, and alarm responsiveness.
   h. Demonstrate spreadsheet/curve plot software, and its integration with database.
   i. Demonstrate on-line user guide, and help function and mail facility.
   j. Demonstrate digital system configuration graphics with interactive upline and downline load, and demonstrate specified diagnostics.
   k. Demonstrate multitasking by showing dynamic curve plot, and graphic construction operating simultaneously via split screen.
   l. Demonstrate class programming with point options of beep duration, beep rate, alarm archiving, and color banding.

**3.3 STARTUP AND TESTING**

A. Perform tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the

various items of equipment shall be performed simultaneously with the system of which each item is an integral part.

B. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.

C. The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and Commissioning Agent. Provide a minimum notice of 10 working days prior to startup and testing.

**3.4 COMMISSIONING**

A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

B. Components provided under this section of the specification will be tested as part of a larger system.

**3.5 DEMONSTRATION AND TRAINING**

A. Provide services of manufacturer’s technical representative for 4 -- hours to instruct each VA personnel responsible in the operation and maintenance of the system.

B. Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

**3.6 CONSTRUCTION WASTE MANAGEMENT**

A. General: Comply with Contractor’s Waste Management Plan and Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT.

B. To the greatest extent possible, separate reusable and recyclable products from contaminated waste and debris in accordance with the Contractor’s Waste Management Plan. Place recyclable and reusable products in designated containers and protect from moisture and contamination.

----- END ----

**SECTION 23 21 13**
**HYDRONIC PIPING**

## PART 1 - GENERAL

### 1.1 DESCRIPTION

A. Water piping to connect HVAC equipment, including the following:
   1. Heating hot water.

B. A complete listing of common acronyms and abbreviations are included in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

### 1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.

B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

D. 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.

E. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

F. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC: Temperature and pressure sensors and valve operators.

### 1.3 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. Where conflicts occur these specifications and the VHA standard will govern.

B. American Society of Mechanical Engineers (ASME):

B1.20.1-2013 .....Pipe Threads, General Purpose (Inch)

B16.3-2016 .....Malleable Iron Threaded Fittings: Classes 150 and 300

B16.4-2016 .....Gray Iron Threaded Fittings: (Classes 125 and 250)

B16.5-2017 .....Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard

B16.9-2018 .....Factory Made Wrought Buttwelding Fittings

B16.11-2016 .....Forged Fittings, Socket-Welding and Threaded

B16.18-2018 .....Cast Copper Alloy Solder Joint Pressure Fittings

B16.22-2018 .....Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings

B16.24-2016 .....Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 600, 900, 1500, and 2500

B16.39-2014 .....Malleable Iron Threaded Pipe Unions: Classes 150, 250, and 300

B16.42-2016 .....Ductile Iron Pipe Flanges and Flanged Fittings

B31.9-2014 .....Building Services Piping

B40.100-2013 .....Pressure Gauges and Gauge Attachments

ASME Boiler and Pressure Vessel Code:

BPVC Section VIII-2015 .Rules for Construction of Pressure Vessels

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

A47/A47M-2018 .....Standard Specification for Ferritic Malleable Iron Castings

A53/A53M-2018 .....Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

A106/A106M-2019 .....Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service

A126-2004(R2019) .....Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings

A183-2014 .....Standard Specification for Carbon Steel Track Bolts and Nuts

A216/A216M-2018 .....Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service

A307-2016 .....Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength

A536-1984(R2019) .....Standard Specification for Ductile Iron Castings

B62-2017 .....Standard Specification for Composition Bronze or Ounce Metal Castings

B88-2016 .....Standard Specification for Seamless Copper Water Tube

F439-2019 .....Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80

F441/F441M-2015 .....Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80

D. American Welding Society (AWS):

B2.1/B2.1M-2014 .....Standard for Welding Procedure and Performance Specification

E. Expansion Joint Manufacturer's Association, Inc. (EJMA):

EJMA 2017 .....Expansion Joint Manufacturer's Association Standards, Tenth Edition

F. Manufacturers Standardization Society (MSS) of the Valve and Fitting Industry, Inc.:

SP-67-2017 .....Butterfly Valves

SP-70-2014 .....Gray Iron Gate Valves, Flanged and Threaded Ends

SP-71-2014 .....Gray Iron Swing Check Valves, Flanged and Threaded Ends

SP-80-2014 .....Bronze Gate, Globe, Angle, and Check Valves

SP-85-2014 .....Gray Iron Globe and Angle Valves, Flanged and Threaded Ends

SP-110-2014 .....Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

SP-125-2018 .....Gray Iron and Ductile Iron In-line, Spring-Loaded, Center-Guided Check Valves

G. Tubular Exchanger Manufacturers Association (TEMA):

TEMA Standards2015 .....9th Edition

**1.4 SUBMITTALS**

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 23 21 13, HYDRONIC PIPING", with applicable paragraph identification.

C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.
   1. Pipe and tubing, with specification, class or type, and schedule.
   2. Pipe fittings, including miscellaneous adapters and special fittings.
   3. Flanges, gaskets and bolting.
   4. Couplings and fittings.
   5. Valves of all types.
   6. Strainers.
   7. Flexible connectors for water service.
   8. All specified hydronic system components.
   9. Water flow measuring devices.

D. Submit the welder’s qualifications in the form of a current (less than one-year old) and formal certificate.

E. Coordination Drawings: Refer to paragraph, SUBMITTALS of Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

F. As-Built Piping Diagrams: Provide drawing as follows for heating hot water system and other piping systems and equipment.
   1. One wall-mounted stick file with complete set of prints. Mount stick file in the chiller plant or control room along with control diagram stick file.
   2. One complete set of reproducible drawings.
   3. One complete set of drawings in electronic AutoCAD and pdf format.

G. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replacement parts, and troubleshooting guide:
   1. Include complete list indicating all components of the systems.
   2. Include complete diagrams of the internal wiring for each item of equipment.
   3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

H. Completed System Readiness Checklist provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician

and dated on the date of completion, in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

I. Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

**1.5 QUALITY ASSURANCE**

A. Section 23 05 11, COMMON WORK RESULTS FOR HVAC, which includes welding qualifications.

B. Submit prior to welding of steel piping a certificate of Welder's certification. The certificate shall be current and not more than one-year old.

C. All couplings, fittings, valves, and specialties shall be the products of a single manufacturer.

1. All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped for quality assurance and traceability.

**1.6 AS-BUILT DOCUMENTATION**

A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.

B. Submit operation and maintenance data updated to include submittal review comments, VA approved substitutions and construction revisions shall be in electronic version on CD or DVD inserted into a three-ring binder. All aspects of system operation and maintenance procedures, including applicable piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices shall be included. A List of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.

C. The installing contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. Should the installing contractor engage the testing company to provide as-built or

any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement. Provide record drawings as follows:

1. As-built drawings are to be provided, with a copy of them on AutoCAD version 14 provided on CD or DVD. The CAD drawings shall use multiple line layers with a separate individual layer for each system.

D. The as-built drawings shall indicate the location and type of all lockout/tagout points for all energy sources for all equipment and pumps to include breaker location and numbers, valve tag numbers, etc. Coordinate lockout/tagout procedures and practices with local VA requirements.

E. Certification documentation shall be provided to COR 21 working days prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and provide documentation/certification that all results of tests were within limits specified. Test results shall contain written sequence of test procedure with written test results annotated at each step along with the expected outcome or setpoint. The results shall include all readings, including but not limited to data on device (make, model and performance characteristics), normal pressures, switch ranges, trip points, amp readings, and calibration data to include equipment serial numbers or individual identifications, etc.

F.

**PART 2 - PRODUCTS**

**2.1 PIPE AND EQUIPMENT SUPPORTS, PIPE SLEEVES, AND WALL AND CEILING PLATES**

A. Provide in accordance with Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

**2.2 PIPE AND TUBING**

A. Heating Hot Water:

1. Copper water tube option: ASTM B88, Type K or L, hard drawn.

B. Pipe supports, including insulation shields, for above ground piping: Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

**2.3 FITTINGS FOR COPPER TUBING**

A. Joints:

1. Solder Joints: Joints shall be made up in accordance with recommended practices of the materials applied. Apply 95/5 tin and antimony on all copper piping.
2. Mechanically formed tee connection in water and drain piping: Form mechanically extracted collars in a continuous operation by drilling pilot hole and drawing out tube surface to form collar, having a height of not less than three times the thickness of tube wall. Adjustable collaring device shall ensure proper tolerance and complete uniformity of the joint. Notch and dimple joining branch tube in a single process to provide free flow where the branch tube penetrates the fitting.

B. Bronze Flanges and Flanged Fittings: ASME B16.24.

C. Fittings: ASME B16.18 cast copper or ASME B16.22 solder wrought copper.

**2.4 DIELECTRIC FITTINGS**

A. Provide where copper tubing and ferrous metal pipe are joined.

B. 50 mm (2 inches) and Smaller: Threaded dielectric union, ASME B16.39.

C. 65 mm (2-1/2 inches) and Larger: Flange union with dielectric gasket and bolt sleeves, ASME B16.42. Dielectric gasket material shall be compatible with hydronic medium.

D. Temperature Rating, 99 degrees C (210 degrees F).

E. Contractor’s option: On pipe sizes 50 mm (2 inch) and smaller, screwed end brass ball valves or dielectric nipples may be used in lieu of dielectric unions.

**2.5 SCREWED JOINTS**

A. Pipe Thread: ASME B1.20.1.

B. Lubricant or Sealant: Oil and graphite or other compound approved for the intended service.

**2.6 VALVES**

A. Asbestos packing is not acceptable.

B. All valves of the same type shall be products of a single manufacturer.

C. Provide chain operators for valves 150 mm (6 inches) and larger when the centerline is located 2.4 m (8 feet) or more above the floor or operating platform.

D. Shut-Off Valves:

1. Ball Valves (Pipe sizes 50 mm (2 inch) and smaller): MSS SP-110, screwed or solder connections, brass or bronze body with chrome-plated ball with full port and Teflon seat at 2758 kPa (400 psig) 4137 kPa (600 psig) working pressure rating. Provide stem extension to allow operation without interfering with pipe insulation.
   a. .

E. Water Flow Balancing Valves: For flow regulation and shut-off. Valves shall be line size rather than reduced to control valve size.

1. Ball  style valve.
2. A dual-purpose flow balancing valve and adjustable flow meter, with bronze or cast-iron body, calibrated position pointer, valved pressure taps or quick disconnects with integral check valves and preformed polyurethane insulating enclosure.
3. Provide a readout kit including flow meter, readout probes, hoses, flow charts or calculator, and carrying case.

F.

**2.7 STRAINERS**

A. Basket Y Type.

1. Screens: Bronze, Monel metal or 18-8 stainless steel, free area not less than 2-1/2 times pipe area, with perforations as follows: 1.1 mm (0.045 inch) diameter perforations for 100 mm (4 inches) and larger: 3.2 mm (1/8 inch) diameter perforations.

**2.8 PRESSURE/TEMPERATURE TEST PROVISIONS**

A. Pete's Plug: 6 mm (1/4 inch) MPT by 75 mm (3 inches) long, brass body and cap, with retained safety cap, nordel self-closing valve cores, permanently installed in piping where shown, or in lieu of pressure gauge test connections shown on the drawings.

B. Provide one each of the following test items to the COR:

1. 6 mm (1/4 inch) FPT by 3.2 mm (1/8 inch) diameter stainless steel pressure gauge adapter probe for extra-long test plug.
2. 90 mm (3-1/2 inch) diameter, one percent accuracy, compound gauge, 101 kPa (30 inches Hg) to 690 kPa (100 psig) range.
3. 0 to 104 degrees C (32 to 220 degrees F) pocket thermometer one-half degree accuracy, 25 mm (1 inch) dial, 125 mm (5 inch) long stainless-steel stem, plastic case.

**2.9 FIRESTOPPING MATERIAL**

A. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

**2.10**

**PART 3 - EXECUTION**

**3.1 GENERAL**

A. If an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no additional cost or time to the Government.

B. The drawings show the general arrangement of pipe and equipment but do not show all required fittings and offsets that may be necessary to connect pipes to equipment, fan-coils, coils, radiators, etc., and to coordinate with other trades. Provide all necessary fittings, offsets and pipe runs based on field measurements and at no additional cost or time to the Government. Coordinate with other trades for space available and relative location of HVAC equipment and accessories to be connected on ceiling grid. Pipe location on the drawings shall be altered by contractor where necessary to avoid interferences and clearance difficulties.

C. Store materials to avoid excessive exposure to weather or foreign materials. Keep inside of piping relatively clean during installation and protect open ends when work is not in progress.

D. Support piping securely. Refer to PART 3, Section 23 05 11, COMMON WORK RESULTS FOR HVAC. Install heat exchangers at height sufficient to provide gravity flow of condensate to the flash tank and condensate pump.

E. Install piping generally parallel to walls and column center lines, unless shown otherwise on the drawings. Space piping, including insulation, to provide 25 mm (1 inch) minimum clearance between adjacent piping or other surface. Unless shown otherwise, slope drain piping down in the direction of flow not less than 25 mm (1 inch) in 12 m (40 feet). Provide eccentric reducers to keep bottom of sloped piping flat.

F. Locate and orient valves to permit proper operation and access for maintenance of packing, seat and disc. Generally, locate valve stems in overhead piping in horizontal position. Provide a union adjacent to one end of all threaded end valves. Control valves usually require reducers

to connect to pipe sizes shown on the drawing. Install butterfly valves with the valve open as recommended by the manufacturer to prevent binding of the disc in the seat.

G. Offset equipment connections to allow valving off for maintenance and repair with minimal removal of piping. Provide flexibility in equipment connections and branch line take-offs with 3-elbow swing joints where noted on the drawings.

H. Tee water piping runouts or branches into the side of mains or other branches. Avoid bull-head tees, which are two return lines entering opposite ends of a tee and exiting out the common side.

I. Provide manual or automatic air vent at all piping system high points and drain valves at all low points. Install piping to floor drains from all automatic air vents.

J. Connect piping to equipment as shown on the drawings. Install components furnished by others such as:

1. Water treatment pot feeders and condenser water treatment systems.
2. Flow elements (orifice unions), control valve bodies, flow switches, pressure taps with valve, and wells for sensors.

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K. Firestopping: Fill openings around uninsulated piping penetrating floors or fire walls, with firestop material. For firestopping insulated piping refer to Section 23 07 11, HVAC AND BOILER PLANT INSULATION.

L. Where copper piping is connected to steel piping, provide dielectric connections.

**3.2 PIPE JOINTS**

A. Welded: Beveling, spacing and other details shall conform to ASME B31.9 and AWS B2.1/B2.1M. See Welder’s qualification requirements under "Quality Assurance" in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. Screwed: Threads shall conform to ASME B1.20.1; joint compound shall be applied to male threads only and joints made up so no more than three threads show. Coat exposed threads on steel pipe with joint compound, or red lead paint for corrosion protection.

C. 125 Pound Cast Iron Flange (Plain Face): Mating flange shall have raised face, if any, removed to avoid overstressing the cast iron flange.

D. Solvent Welded Joints: As recommended by the manufacturer.

**3.3 LEAK TESTING ABOVEGROUND PIPING**

A. Inspect all joints and connections for leaks and workmanship and make corrections as necessary, to the satisfaction of the COR. Tests may be either of those below, or a combination, as approved by the COR.

B. An operating test at design pressure, and for hot systems, design maximum temperature.

C. A hydrostatic test at 1.5 times design pressure. For water systems, the design maximum pressure would usually be the static head, or expansion tank maximum pressure, plus pump head. Factory tested equipment (convertors, exchangers, coils, etc.) need not be field tested. Isolate equipment where necessary to avoid excessive pressure on mechanical seals and safety devices.

**3.4 FLUSHING AND CLEANING PIPING SYSTEMS**

A. Water Piping: Clean systems as recommended by the suppliers of chemicals specified in Section 23 25 00, HVAC WATER TREATMENT.

B. Initial Flushing: Remove loose dirt, mill scale, metal chips, weld beads, rust, and like deleterious substances without damage to any system component. Provide temporary piping or hose to bypass coils, control valves, exchangers and other factory cleaned equipment unless acceptable means of protection are provided and subsequent inspection of hide-out areas takes place. Isolate or protect clean system components, including pumps and pressure vessels, and remove any component which may be damaged. Open all valves, drains, vents and strainers at all system levels. Remove plugs, caps, spool pieces, and components to facilitate early debris discharge from system. Sectionalize system to obtain debris carrying velocity of 1.8 m/s (5.9 f/s), if possible. Connect dead-end supply and return headers as necessary. Flush bottoms of risers. Install temporary strainers where necessary to protect down-stream equipment. Supply and remove flushing water and drainage by various type hose, temporary and permanent piping and Contractor's booster pumps. Flush until clean as approved by the COR.

C. Cleaning: Using products supplied in Section 23 25 00, HVAC WATER TREATMENT, circulate systems at normal temperature to remove adherent organic soil, hydrocarbons, flux, pipe mill varnish, pipe joint compounds, iron oxide, and like deleterious substances not removed by

flushing, without chemical or mechanical damage to any system component. Removal of tightly adherent mill scale is not required. Keep isolated equipment which is "clean" and where dead-end debris accumulation cannot occur. Sectionalize system if possible, to circulate at velocities not less than 1.8 m/s (5.9 f/s). Circulate each section for not less than 4 hours. Blow-down all strainers, or remove and clean as frequently as necessary. Drain and prepare for final flushing.

D. Final Flushing: Return systems to conditions required by initial flushing after all cleaning solution has been displaced by clean make-up. Flush all dead ends and isolated clean equipment. Gently operate all valves to dislodge any debris in valve body by throttling velocity. Flush for not less than one hour.

**3.5 STARTUP AND TESTING**

A. Perform tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.

B. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.

C. The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with COR and Commissioning Agent. Provide a minimum notice of 10 working days prior to startup and testing.

D. Adjust red set hand on pressure gauges to normal working pressure.

**3.6 COMMISSIONING**

A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

B. Components provided under this section of the specification will be tested as part of a larger system.

**3.7 DEMONSTRATION AND TRAINING**

A. Provide services of manufacturer’s technical representative for 4 hours to instruct each VA personnel responsible in operation and maintenance of the system.

B. Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

- - - E N D - -

**SECTION 23 31 00**
**HVAC DUCTS AND CASINGS**

## PART 1 - GENERAL

### 1.1 DESCRIPTION

A. Ductwork and accessories for HVAC including the following:

1. Supply air, return air, exhaust.

B. Definitions:

1. SMACNA Standards as used in this specification means the HVAC Duct Construction Standards, Metal and Flexible.
2. Seal or Sealing: Use of liquid or mastic sealant, with or without compatible tape overlay, or gasketing of flanged joints, to keep air leakage at duct joints, seams and connections to an acceptable minimum.
3. Duct Pressure Classification: SMACNA HVAC Duct Construction Standards, Metal and Flexible.
4. Exposed Duct: Exposed to view in a finished room,

### 1.2 RELATED WORK

A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

B. Section 07 84 00, FIRESTOPPING: Fire Stopping Material.

H. Section 23 05 11, COMMON WORK RESULTS FOR HVAC: General Mechanical Requirements.

J. Section 23 05 93, TESTING, ADJUSTING, and BALANCING FOR HVAC: Testing and Balancing of Air Flows.

L. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC: Duct Mounted Instrumentation.

N. Section 23 36 00, AIR TERMINAL UNITS: Air Flow Control Valves and Terminal Units.

P. Section 23 40 00, HVAC AIR CLEANING DEVICES: Air Filters and Filters' Efficiencies.

**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.

C. Duct System Construction and Installation: Referenced SMACNA Standards are the minimum acceptable quality.

D. Duct Sealing, Air Leakage Criteria, and Air Leakage Tests: Ducts shall be sealed as per duct sealing requirements of SMACNA HVAC Air Duct Leakage Test Manual for duct pressure classes shown on the drawings.

E. Duct accessories exposed to the air stream, such as dampers of all types (except smoke dampers) and access openings, shall be of the same material as the duct or provide at least the same level of corrosion resistance.

**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. Rectangular ducts:
   a. Schedules of duct systems, materials and selected SMACNA construction alternatives for joints, sealing, gage and reinforcement.

   c. Sealants and gaskets.
   d. Access doors.
2. Round and flat oval duct construction details:
   a. Manufacturer's details for duct fittings.
   c. Sealants and gaskets.
   d. Access sections.
   e. Installation instructions.
3. Volume dampers, back draft dampers.
4. Upper hanger attachments.
5. Fire dampers, fire doors, and smoke dampers with installation instructions.
7. Flexible ducts and clamps, with manufacturer's installation instructions.

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C. Coordination Drawings: Refer to article, SUBMITTALS, in Section 23 05 11-COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

**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 Civil Engineers (ASCE):

ASCE7-2017 .....Minimum Design Loads for Buildings and Other Structures

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

A167-2009 .....Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

A653-2019 .....Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy coated (Galvannealed) by the Hot-Dip process

A1011-2018 .....Standard Specification for Steel, Sheet and Strip, Hot rolled, Carbon, structural, High-Strength Low-Alloy, High Strength Low-Alloy with Improved Formability, and Ultra-High Strength

B209-2014 .....Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

C1071-2019 .....Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)

E84-2014 .....Standard Test Method for Surface Burning Characteristics of Building Materials

D. National Fire Protection Association (NFPA):

90A-2018 .....Standard for the Installation of Air Conditioning and Ventilating Systems

96-2018 .....Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations

E. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):

3rd Edition -/2006 .....HVAC Duct Construction Standards, Metal and Flexible

2nd Edition -2012 .....HVAC Air Duct Leakage Test Manual

6th Edition –2016 .....Fibrous Glass Duct Construction Standards

F. Underwriters Laboratories, Inc. (UL):

181-2013 .....Factory-Made Air Ducts and Air Connectors

555-2006 .....Standard for Fire Dampers

555S-2014 .....Standard for Smoke Dampers

**PART 2 - PRODUCTS**

**2.1 DUCT MATERIALS AND SEALANTS**

A. General: Except for systems specified otherwise, construct ducts, casings, and accessories of galvanized sheet steel, ASTM A653, coating G90; or, aluminum sheet, ASTM B209, alloy 1100, 3003 or 5052.

D. Joint Sealing: Refer to SMACNA HVAC Duct Construction Standards.

1. Sealant: Elastomeric compound, gun or brush grade, maximum 25 flame spread, and 50 smoke developed (dry state) compounded specifically for sealing ductwork as recommended by the manufacturer. Generally, provide liquid sealant, with or without compatible tape, for low clearance slip joints and heavy, permanently elastic, mastic type where clearances are larger. Oil base caulking and glazing compounds are not acceptable because they do not retain elasticity and bond.
2. Tape: Use only tape specifically designated by the sealant manufacturer and apply only over wet sealant. Pressure sensitive tape shall not be used on bare metal or on dry sealant.
3. Gaskets in Flanged Joints: Soft neoprene.

E. Approved factory-made joints may be used.

**2.2 DUCT CONSTRUCTION AND INSTALLATION**

A. Regardless of the pressure classifications outlined in the SMACNA Standards, fabricate and seal the ductwork in accordance with the following pressure classifications:

B. Duct Pressure Classification:

0 to 50 mm (2 inch)

> 50 mm to 75 mm (2 inch to 3 inch)

> 75 mm to 100 mm (3 inch to 4 inch)

Show pressure classifications on the floor plans.

C. Seal Class: All ductwork shall receive Class A Seal

M. Round and Flat Oval Ducts: Furnish duct and fittings made by the same manufacturer to insure good fit of slip joints. When submitted and approved in advance, round and flat oval duct, with size converted on the basis of equal pressure drop, may be furnished in lieu of rectangular duct design shown on the drawings.

1. Elbows: Diameters 80 through 200 mm (3 through 8 inches) shall be two sections die stamped, all others shall be gored construction, maximum 18 degree angle, with all seams continuously welded or standing seam. Coat galvanized areas of fittings damaged by welding with corrosion resistant aluminum paint or galvanized repair compound.
2. Provide bell mouth, conical tees or taps, laterals, reducers, and other low loss fittings as shown in SMACNA HVAC Duct Construction Standards.
3. Ribbed Duct Option: Lighter gage round/oval duct and fittings may be furnished provided certified tests indicating that the rigidity and performance is equivalent to SMACNA standard gage ducts are submitted.
   a. Ducts: Manufacturer's published standard gage, G90 coating, spiral lock seam construction with an intermediate standing rib.
   b. Fittings: May be manufacturer's standard as shown in published catalogs, fabricated by spot welding and bonding with neoprene base cement or machine formed seam in lieu of continuous welded seams.
4. Provide flat side reinforcement of oval ducts as recommended by the manufacturer and SMACNA HVAC Duct Construction Standard S3.13. Because of high pressure loss, do not use internal tie-rod reinforcement unless approved by the Resident Engineer.

N.

O. Casings and Plenums: Construct in accordance with SMACNA HVAC Duct Construction Standards Section 6, including curbs, access doors, pipe penetrations, eliminators and drain pans. Access doors shall be hollow metal, insulated, with latches and door pulls, 500 mm (20 inches) wide by 1200 - 1350 mm (48 - 54 inches) high. Provide view port in the doors where shown. Provide drain for outside air louver plenum. Outside air plenum shall have exterior insulation. Drain piping shall be routed to the nearest floor drain.

P. Volume Dampers: Single blade or opposed blade, multi-louver type as detailed in SMACNA Standards. Refer to SMACNA for Single Blade and Figure 2.13 for Multi-blade Volume Dampers.

Q. Duct Hangers and Supports: Refer to SMACNA Standards Section IV. Avoid use of trapeze hangers for round duct.

**2.4 DUCT ACCESS DOORS, PANELS AND SECTIONS**

A. Provide access doors, sized and located for maintenance work, upstream, in the following locations:
   1. Each duct mounted coil and humidifier.
   2. Each fire damper (for link service), smoke damper and automatic control damper.
   3. Each duct mounted smoke detector.
   4. For cleaning operating room supply air duct and kitchen hood exhaust duct, locate access doors at 6 m (20 feet) intervals and at each change in duct direction.

B. Openings shall be as large as feasible in small ducts, 300 mm by 300 mm (12 inch by 12 inch) minimum where possible. Access sections in insulated ducts shall be double-wall, insulated. Transparent shatterproof covers are preferred for uninsulated ducts.
   1. For rectangular ducts: Refer to SMACNA HVAC Duct Construction Standards (Figure 2-12).
   2. For round and flat oval duct: Refer to SMACNA HVAC duct Construction Standards (Figure 2-11).

**2.9 FLEXIBLE AIR DUCT**

A. General: Factory fabricated, complying with NFPA 90A for connectors not passing through floors of buildings. Flexible ducts shall not penetrate any fire or smoke barrier which is required to have a fire resistance rating of one hour or more. Flexible duct length shall not exceed 1.5 m (5 feet). Provide insulated acoustical air duct connectors in supply air duct systems and elsewhere as shown.

B. Flexible ducts shall be listed by Underwriters Laboratories, Inc., complying with UL 181. Ducts larger than 200 mm (8 inches) in diameter shall be Class 1. Ducts 200 mm (8 inches) in diameter and smaller may be Class 1 or Class 2.

C. Insulated Flexible Air Duct: Factory made including mineral fiber insulation with maximum C factor of 0.25 at 24 degrees C (75 degrees F) mean temperature, encased with a low permeability moisture barrier outer jacket, having a puncture resistance of not less than 50 Beach Units.

D. Application Criteria:

1. Temperature range: -18 to 93 degrees C (0 to 200 degrees F) internal.
2. Maximum working velocity: 1200 m/min (4000 feet per minute).
3. Minimum working pressure, inches of water gage: 2500 Pa (10 inches) positive, 500 Pa (2 inches) negative.

E. Duct Clamps: 100 percent nylon strap, 80 kg (175 pounds) minimum loop tensile strength manufactured for this purpose or stainless-steel strap with cadmium plated worm gear tightening device. Apply clamps with sealant and as approved for UL 181, Class 1 installation.

**2.10 FLEXIBLE DUCT CONNECTIONS**

Where duct connections are made to fans, air terminal units, and air handling units, install a non-combustible flexible connection of 822 g (29 ounce) neoprene coated fiberglass fabric approximately 150 mm (6 inches) wide. For connections exposed to sun and weather provide hypalon coating in lieu of neoprene. Burning characteristics shall conform to NFPA 90A. Securely fasten flexible connections to round ducts with stainless steel or zinc-coated iron draw bands with worm gear fastener. For rectangular connections, crimp fabric to sheet metal and fasten sheet metal to ducts by screws 50 mm (2 inches) on center.

Fabric shall not be stressed other than by air pressure. Allow at least 25 mm (one inch) slack to ensure that no vibration is transmitted.

**2.13 FIRESTOPPING MATERIAL**

Refer to Section 07 84 00, FIRESTOPPING.

**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. Fabricate and install ductwork and accessories in accordance with referenced SMACNA Standards:

1. Drawings show the general layout of ductwork and accessories but do not show all required fittings and offsets that may be necessary to connect ducts to equipment, boxes, diffusers, grilles, etc., and to coordinate with other trades. Fabricate ductwork based on field measurements. Provide all necessary fittings and offsets at no additional cost to the government. Coordinate with other trades for space available and relative location of HVAC equipment and accessories on ceiling grid. Duct sizes on the drawings are inside dimensions which shall be altered by Contractor to other dimensions with the same air handling characteristics where necessary to avoid interferences and clearance difficulties.
2. Provide duct transitions, offsets and connections to dampers, coils, and other equipment in accordance with SMACNA Standards. Provide streamliner, when an obstruction cannot be avoided and must be taken in by a duct. Repair galvanized areas with galvanizing repair compound.
3. Provide bolted construction and tie-rod reinforcement in accordance with SMACNA Standards.
4. Construct casings, eliminators, and pipe penetrations in accordance with SMACNA Standards, Chapter 6. Design casing access doors to swing against air pressure so that pressure helps to maintain a tight seal.

C. Install duct hangers and supports in accordance with SMACNA Standards.

D. Install fire dampers, smoke dampers and combination fire/smoke dampers in accordance with the manufacturer's instructions to conform to the

installation used for the rating test. Install fire dampers, smoke dampers and combination fire/smoke dampers at locations indicated and where ducts penetrate fire rated and/or smoke rated walls, shafts and where required by the Resident Engineer. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges per UL and NFPA. Demonstrate re-setting of fire dampers and operation of smoke dampers to the Resident Engineer.

E. Seal openings around duct penetrations of floors and fire rated partitions with fire stop material as required by NFPA 90A.

F. Flexible duct installation: Refer to SMACNA Standards, Chapter 3. Ducts shall be continuous, single pieces not over 1.5 m (5 feet) long (NFPA 90A), as straight and short as feasible, adequately supported. Centerline radius of bends shall be not less than two duct diameters. Make connections with clamps as recommended by SMACNA. Clamp per SMACNA with one clamp on the core duct and one on the insulation jacket. Flexible ducts shall not penetrate floors, or any chase or partition designated as a fire or smoke barrier, including corridor partitions fire rated one hour or two hours. Support ducts SMACNA Standards.

G. Where diffusers, registers and grilles cannot be installed to avoid seeing inside the duct, paint the inside of the duct with flat black paint to reduce visibility.

H. Control Damper Installation:

1. Provide necessary blank-off plates required to install dampers that are smaller than duct size. Provide necessary transitions required to install dampers larger than duct size.
2. Assemble multiple sections dampers with required interconnecting linkage and extend required number of shafts through duct for external mounting of damper motors.
3. Provide necessary sheet metal baffle plates to eliminate stratification and provide air volumes specified. Locate baffles by experimentation, and affix and seal permanently in place, only after stratification problem has been eliminated.
4. Install all damper control/adjustment devices on stand-offs to allow complete coverage of insulation.

K. 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 and ducts during construction against entry of foreign matter to the inside and clean both inside and outside before operation and painting. When new ducts are connected to existing ductwork, clean both new and existing ductwork by mopping and vacuum cleaning inside and outside before operation.

**3.4 TESTING, ADJUSTING AND BALANCING (TAB)**

Refer to Section 23 05 93, TESTING, ADJUSTING, and BALANCING FOR HVAC.

**3.5 OPERATING AND PERFORMANCE TESTS**

Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

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**SECTION 23 36 00**
**AIR TERMINAL UNITS**

## PART 1 - GENERAL

### 1.1 DESCRIPTION

Air terminal units, air flow control valves.

### 1.2 RELATED WORK

A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

B. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

F. Section 23 05 93, TESTING, ADJUSTING, and BALANCING FOR HVAC.

E. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

D. Section 23 31 00, HVAC DUCTS and CASINGS.

G. Section 23 82 16, AIR COILS.

### 1.3 QUALITY ASSURANCE

Refer to Article, QUALITY ASSURANCE, in Section 23 05 11, COMMON WORK RESULTS FOR.

### 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 Terminal Units: Submit test data.

D. Certificates:

1. Compliance with Article, QUALITY ASSURANCE.
2. Compliance with specified standards.

E. Operation and Maintenance Manuals: Submit in accordance with paragraph, INSTRUCTIONS, in Section 01 00 00, GENERAL REQUIREMENTS.

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### 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 and Refrigeration Institute (AHRI)/(ARI):

880-2017 .....Performance Rating of Air Terminals

C. National Fire Protection Association (NFPA):

90A-2018 .....Standard for the Installation of Air Conditioning and Ventilating Systems

D. Underwriters Laboratories, Inc. (UL):

181-2013 .....Standard for Factory-Made Air Ducts and Air Connectors

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

C 665-2006 .....Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing

**1.6 GUARANTY**

In accordance with the GENERAL CONDITIONS

**PART 2 - PRODUCTS**

**2.1 GENERAL**

A. Coils:

1.

3. Water Heating Coils:

a. ARI certified, continuous plate or spiral fin type, leak tested at 2070 kPa (300 PSI).

b. Capacity: As indicated, based on scheduled entering water temperature.

c. Headers: Copper or Brass.

d. Fins: Aluminum, maximum 315 fins per meter (8 fins per inch).

e. Tubes: Copper, arrange for counter-flow of heating water.

f. Water Flow Rate: Minimum 0.032 Liters/second (0.5 GPM).

g. Provide vent and drain connection at high and low point, respectively of each coil.

h. Coils shall be guaranteed to drain.

B. Labeling: Control box shall be clearly marked with an identification label that lists such information as nominal CFM, maximum and minimum factory-set airflow limits, coil type and coil connection orientation, where applicable.

C. Factory calibrate air terminal units to air flow rate indicated. All settings including maximum and minimum air flow shall be field adjustable.

**2.2 AIR TERMINAL UNITS (BOXES)**

A. General: Factory built, pressure independent units, factory set-field adjustable air flow rate, suitable for single duct applications. Use of dual-duct air terminal units is not permitted. Clearly show on each unit the unit number and factory set air volumes corresponding to the contract drawings. Section 23 05 93, TESTING, ADJUSTING, and BALANCING FOR HVAC work assumes factory set air volumes. Coordinate flow controller sequence and damper operation details with the drawings and Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC. All air terminal units shall be brand new products of the same manufacturer.

B. Capacity and Performance: The Maximum Capacity of a single terminal unit shall not exceed 566 Liters/second (1,200 CFM) with the exception of operating rooms and Cystoscopy rooms, which shall be served by a single air terminal unit at a maximum of 1,250 Liters/second (3,000 CFM).

C. Sound Power Levels:

Acoustic performance of the air terminal units shall be based on the design noise levels for the spaces stipulated in Section 23 05 41 (Noise and Vibration Control for HVAC Piping and Equipment). Equipment schedule shall show the sound power levels in all octave bands. Terminal sound attenuators shall be provided, as required, to meet the intent of the design.

D. Casing: Unit casing shall be constructed of galvanized steel no lighter than 0.85 mm (22 Gauge). Air terminal units serving the operating rooms and Cystoscopy rooms shall be fabricated without lining. Provide hanger brackets for attachment of supports.

1. Lining material: Suitable to provide required acoustic performance, thermal insulation and prevent sweating. Meet the requirements of NFPA 90A and comply with UL 181 for erosion as well as ASTMC 665 antimicrobial requirements. Insulation shall consist of 13 mm (1/2 IN) thick non-porous foil faced rigid fiberglass insulation of 4-lb/cu.ft, secured by full length galvanized steel z-strips which enclose and seal all edges. Tape and adhesives shall not be used. Materials shall be non-friable and with surfaces, including all edges, fully encapsulated and faced with perforated metal or coated

so that the air stream will not detach material. No lining material is permitted in the boxes serving operating rooms and Cystoscopy rooms.

2. Access panels (or doors): Provide panels large enough for inspection, adjustment and maintenance without disconnecting ducts, and for cleaning heating coils attached to unit, even if there are no moving parts. Panels shall be insulated to same standards as the rest of the casing and shall be secured and gasketed airtight. It shall require no tool other than a screwdriver to remove.
3. Total leakage from casing: Not to exceed 2 percent of the nominal capacity of the unit when subjected to a static pressure of 750 Pa (3 inch WG), with all outlets sealed shut and inlets fully open.
4. Octopus connector: Factory installed, lined air distribution terminal. Provide where flexible duct connections are shown on the drawings connected directly to terminals. Provide butterfly-balancing damper, with locking means in connectors with more than one outlet. Octopus connectors and flexible connectors are not permitted in the Surgical Suite.

E. Construct dampers and other internal devices of corrosion resisting materials which do not require lubrication or other periodic maintenance.
   1. Damper Leakage: Not greater than 2 percent of maximum rated capacity, when closed against inlet static pressure of 1 kPa (4 inch WG).

F. Provide multi-point velocity pressure sensors with external pressure taps.
   1. Provide direct reading air flow rate table pasted to box.

G. Provide static pressure tubes.

H. Externally powered DDC variable air volume controller and damper actuator to be furnished under Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC for factory mounting on air terminal units. The DDC controller shall be electrically actuated.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Work shall be installed as shown and according to the manufacturer’s diagrams and recommendations.

B. Handle and install units in accordance with manufacturer's written instructions.

C. Support units rigidly so they remain stationary at all times. Cross-bracing or other means of stiffening shall be provided as necessary. Method of support shall be such that distortion and malfunction of units cannot occur.

D. Locate air terminal units to provide a straight section of inlet duct for proper functioning of volume controls. See VA Standard Detail.

### 3.2 OPERATIONAL TEST

Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

- - - E N D - -

**SECTION 23 37 00**
**AIR OUTLETS AND INLETS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

B. Air Outlets and Inlets: Diffusers, Registers, and Grilles.

**1.2 RELATED WORK**

A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

B.

C.

F. Section 23 05 93, TESTING, ADJUSTING, and BALANCING FOR HVAC.

G.

**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.

2. 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-2015 .....Certification, Rating, and Test Manual 4th Edition

C. American Society of Civil Engineers (ASCE):

ASCE7-2017 .....Minimum Design Loads for Buildings and Other Structures

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

A167-99 2009 .....Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip

B209- 2014 .....Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

E. National Fire Protection Association (NFPA):

90A-2018 .....Standard for the Installation of Air Conditioning and Ventilating Systems

F. Underwriters Laboratories, Inc. (UL):

181-2013 .....UL Standard for Safety Factory-Made Air Ducts and Connectors

**PART 2 - PRODUCTS**

.

**2.3 AIR OUTLETS AND INLETS**

A. Materials:

1. Use aluminum air outlets and inlets for facilities located in high-humidity areas. Exhaust air registers located in combination toilets and shower stalls shall be constructed from aluminum.
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.

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4. Supply 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. Supply 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.
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.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

A. Comply with provisions of Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION, particularly regarding coordination with other trades and work in existing buildings.

B. Protection and Cleaning: 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.

**3.3 TESTING, ADJUSTING AND BALANCING (TAB)**

Refer to Section 23 05 93, TESTING, ADJUSTING, and BALANCING FOR HVAC.

**3.4 OPERATING AND PERFORMANCE TESTS**

Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

- - - E N D - -

**SECTION 26 05 11**
**REQUIREMENTS FOR ELECTRICAL INSTALLATIONS**

## PART 1 - GENERAL

### 1.1 DESCRIPTION

A. This section applies to all sections of Division 26.

B. Furnish and install electrical systems, materials, equipment, and accessories in accordance with the specifications and drawings. C. Conductor ampacities specified or shown on the drawings are based on copper conductors, with the conduit and raceways sized per NEC. Aluminum conductors are prohibited.

### 1.2 MINIMUM REQUIREMENTS

A. The latest International Building Code (IBC), Underwriters Laboratories, Inc. (UL), Institute of Electrical and Electronics Engineers (IEEE), and National Fire Protection Association (NFPA) codes and standards are the minimum requirements for materials and installation.

B. The drawings and specifications shall govern in those instances where requirements are greater than those stated in the above codes and standards.

### 1.3 TEST STANDARDS

A. All materials and equipment shall be listed, labeled, or certified by a Nationally Recognized Testing Laboratory (NRTL) to meet Underwriters Laboratories, Inc. (UL), standards where test standards have been established. Materials and equipment which are not covered by UL standards will be accepted, providing that materials and equipment are listed, labeled, certified or otherwise determined to meet the safety requirements of a NRTL. Materials and equipment which no NRTL accepts, certifies, lists, labels, or determines to be safe, will be considered if inspected or tested in accordance with national industrial standards, such as ANSI, NEMA, and NETA. Evidence of compliance shall include certified test reports and definitive shop drawings.

B. Definitions:

1. Listed: Materials and equipment included in a list published by an organization that is acceptable to the Authority Having Jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production or listed materials and

equipment or periodic evaluation of services, and whose listing states that the materials and equipment either meets appropriate designated standards or has been tested and found suitable for a specified purpose.

2. Labeled: Materials and equipment to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the Authority Having Jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled materials and equipment, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.
3. Certified: Materials and equipment which:
   a. Have been tested and found by a NRTL to meet nationally recognized standards or to be safe for use in a specified manner.
   b. Are periodically inspected by a NRTL.
   c. Bear a label, tag, or other record of certification.
4. Nationally Recognized Testing Laboratory: Testing laboratory which is recognized and approved by the Secretary of Labor in accordance with OSHA regulations.

**1.4 QUALIFICATIONS (PRODUCTS AND SERVICES)**

A. Manufacturer’s Qualifications: The manufacturer shall regularly and currently produce, as one of the manufacturer's principal products, the materials and equipment specified for this project, and shall have manufactured the materials and equipment for at least three years.

B. Product Qualification:
   1. Manufacturer's materials and equipment shall have been in satisfactory operation, on three installations of similar size and type as this project, for at least three years.
   2. The Government reserves the right to require the Contractor to submit a list of installations where the materials and equipment have been in operation before approval.

C. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within four hours of receipt of notification that service is needed. Submit name and address of service organizations.

**1.5 APPLICABLE PUBLICATIONS**

A. Applicable publications listed in all Sections of Division 26 shall be the latest issue, unless otherwise noted.

B. Products specified in all sections of Division 26 shall comply with the applicable publications listed in each section.

**1.6 MANUFACTURED PRODUCTS**

A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, and for which replacement parts shall be available. Materials and equipment furnished shall be new, and shall have superior quality and freshness.

B. When more than one unit of the same class or type of materials and equipment is required, such units shall be the product of a single manufacturer.

C. Equipment Assemblies and Components:

1. Components of an assembled unit need not be products of the same manufacturer.
2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
3. Components shall be compatible with each other and with the total assembly for the intended service.
4. Constituent parts which are similar shall be the product of a single manufacturer.

D. Factory wiring and terminals shall be identified on the equipment being furnished and on all wiring diagrams.

E. When Factory Tests are specified, Factory Tests shall be performed in the factory by the equipment manufacturer, and witnessed by the contractor. In addition, the following requirements shall be complied with:

1. The Government shall have the option of witnessing factory tests. The Contractor shall notify the Government through the Resident Engineera minimum of thirty (30) days prior to the manufacturer’s performing of the factory tests.
2. When factory tests are successful, contractor shall furnish four (4) copies of the equipment manufacturer’s certified test reports to the Resident Engineerfourteen (14) days prior to shipment of the

equipment, and not more than ninety (90) days after completion of the factory tests.

3. When factory tests are not successful, factory tests shall be repeated in the factory by the equipment manufacturer, and witnessed by the Contractor. The Contractor shall be liable for all additional expenses for the Government to witness factory re-testing.

**1.7 VARIATIONS FROM CONTRACT REQUIREMENTS**

A. Where the Government or the Contractor requests variations from the contract requirements, the connecting work and related components shall include, but not be limited to additions or changes to branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels and installation methods.

**1.8 MATERIALS AND EQUIPMENT PROTECTION**

A. Materials and equipment shall be protected during shipment and storage against physical damage, vermin, dirt, corrosive substances, fumes, moisture, cold and rain.

1. Store materials and equipment indoors in clean dry space with uniform temperature to prevent condensation.
2. During installation, equipment shall be protected against entry of foreign matter, and be vacuum-cleaned both inside and outside before testing and operating. Compressed air shall not be used to clean equipment. Remove loose packing and flammable materials from inside equipment.
3. Damaged equipment shall be repaired or replaced, as determined by the Resident Engineer.
4. Painted surfaces shall be protected with factory installed removable heavy kraft paper, sheet vinyl or equal.
5. Damaged paint on equipment shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious.

**1.9 WORK PERFORMANCE**

A. All electrical work shall comply with requirements of the latest NFPA 70 (NEC), NFPA 70B, NFPA 70E, NFPA 99, NFPA 110, OSHA Part 1910 subpart J – General Environmental Controls, OSHA Part 1910 subpart K – Medical and First Aid, and OSHA Part 1910 subpart S – Electrical, in addition to other references required by contract.

B. Job site safety and worker safety is the responsibility of the Contractor.

C. Electrical work shall be accomplished with all affected circuits or equipment de-energized. However, energized electrical work may be performed only for the non-destructive and non-invasive diagnostic testing(s), or when scheduled outage poses an imminent hazard to patient care, safety, or physical security. In such case, all aspects of energized electrical work, such as the availability of appropriate/correct personal protective equipment (PPE) and the use of PPE, shall comply with the latest NFPA 70E, as well as the following requirements:

1. Only Qualified Person(s) shall perform energized electrical work. Supervisor of Qualified Person(s) shall witness the work of its entirety to ensure compliance with safety requirements and approved work plan.
2. At least two weeks before initiating any energized electrical work, the Contractor and the Qualified Person(s) who is designated to perform the work shall visually inspect, verify and confirm that the work area and electrical equipment can safely accommodate the work involved.
3. At least two weeks before initiating any energized electrical work, the Contractor shall develop and submit a job specific work plan, and energized electrical work request to the Resident Engineer, and Medical Center’s Chief Engineer or his/her designee. At the minimum, the work plan must include relevant information such as proposed work schedule, area of work, description of work, name(s) of Supervisor and Qualified Person(s) performing the work, equipment to be used, procedures to be used on and near the live electrical equipment, barriers to be installed, safety equipment to be used, and exit pathways.
4. Energized electrical work shall begin only after the Contractor has obtained written approval of the work plan, and the energized electrical work request from the Resident Engineer, and Medical Center’s Chief Engineer or his/her designee. The Contractor shall make these approved documents present and available at the time and place of energized electrical work.

5. Energized electrical work shall begin only after the Contractor has invited and received acknowledgment from the Resident Engineer, and Medical Center's Chief Engineer or his/her designee to witness the work.

D. For work that affects existing electrical systems, arrange, phase and perform work to assure minimal interference with normal functioning of the facility. Refer to Article OPERATIONS AND STORAGE AREAS under Section 01 00 00, GENERAL REQUIREMENTS.

E. New work shall be installed and connected to existing work neatly, safely and professionally. Disturbed or damaged work shall be replaced or repaired to its prior conditions, as required by Section 01 00 00, GENERAL REQUIREMENTS.

F. Coordinate location of equipment and conduit with other trades to minimize interference.

**1.10 EQUIPMENT INSTALLATION AND REQUIREMENTS**

A. Equipment location shall be as close as practical to locations shown on the drawings.

B. Working clearances shall not be less than specified in the NEC.

C. Inaccessible Equipment:

1. Where the Government determines that the Contractor has installed equipment not readily accessible for operation and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to the Government.

2. "Readily accessible" is defined as being capable of being reached quickly for operation, maintenance, or inspections without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.

**1.11 EQUIPMENT IDENTIFICATION**

A. In addition to the requirements of the NEC, install an identification sign which clearly indicates information required for use and maintenance of items such as panelboards, motor controllers, fused and non-fused safety switches, separately enclosed circuit breakers, individual breakers and controllers in switchboards, switchgear and motor control assemblies, control devices and other significant equipment.

B. Identification signs for Normal Power System equipment shall be laminated black phenolic resin with a white core with engraved lettering. Identification signs for Essential Electrical System (EES) equipment, as defined in the NEC, shall be laminated red phenolic resin with a white core with engraved lettering. Lettering shall be a minimum of 12 mm (1/2 inch) high. Identification signs shall indicate equipment designation, rated bus amperage, voltage, number of phases, number of wires, and type of EES power branch as applicable. Secure nameplates with screws.

C. Install adhesive arc flash warning labels on all equipment as required by the latest NFPA 70E. Label shall show specific and correct information for specific equipment based on its arc flash calculations. Label shall show the followings:

1. Nominal system voltage.
2. Equipment/bus name, date prepared, and manufacturer name and address.
3. Arc flash boundary.
4. Available arc flash incident energy and the corresponding working distance.
5. Minimum arc rating of clothing.
6. Site-specific level of PPE.

**1.12 SUBMITTALS**

A. Submit to the Resident Engineerin accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. The Government's approval shall be obtained for all materials and equipment before delivery to the job site. Delivery, storage or installation of materials and equipment which has not had prior approval will not be permitted.

C. All submittals shall include six copies of adequate descriptive literature, catalog cuts, shop drawings, test reports, certifications, samples, and other data necessary for the Government to ascertain that the proposed materials and equipment comply with drawing and specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify specific materials and equipment being submitted.

D. Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system

or assembly as a whole. Partial submittals will not be considered for approval.

1. Mark the submittals, "SUBMITTED UNDER SECTION_____".
2. Submittals shall be marked to show specification reference including the section and paragraph numbers.
3. Submit each section separately.

E. The submittals shall include the following:

1. Information that confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, manuals, pictures, nameplate data, and test reports as required.

3. Elementary and interconnection wiring diagrams for communication and signal systems, control systems, and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.
4. Parts list which shall include information for replacement parts and ordering instructions, as recommended by the equipment manufacturer.

F. Maintenance and Operation Manuals:

1. Submit as required for systems and equipment specified in the technical sections. Furnish in hardcover binders or an approved equivalent.
2. Inscribe the following identification on the cover: the words "MAINTENANCE AND OPERATION MANUAL," the name and location of the system, material, equipment, building, name of Contractor, and contract name and number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the material or equipment.
3. Provide a table of contents and assemble the manual to conform to the table of contents, with tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in.
4. The manuals shall include:
   a. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.
   b. A control sequence describing start-up, operation, and shutdown.
   c. Description of the function of each principal item of equipment.

d. Installation instructions.

e. Safety precautions for operation and maintenance.

f. Diagrams and illustrations.

g. Periodic maintenance and testing procedures and frequencies, including replacement parts numbers.

h. Performance data.

i. Pictorial "exploded" parts list with part numbers. Emphasis shall be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare and replacement parts, and name of servicing organization.

j. List of factory approved or qualified permanent servicing organizations for equipment repair and periodic testing and maintenance, including addresses and factory certification qualifications.

G. Approvals will be based on complete submission of shop drawings, manuals, test reports, certifications, and samples as applicable.

**1.13 SINGULAR NUMBER**

A. Where any device or part of equipment is referred to in these specifications in the singular number (e.g., "the switch"), this reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the drawings.

Coordinate with the applicable sections of Division 01 and 02.

**1.15 ACCEPTANCE CHECKS AND TESTS**

A. The Contractor shall furnish the instruments, materials, and labor for tests.

B. Where systems are comprised of components specified in more than one section of Division 26, the Contractor shall coordinate the installation, testing, and adjustment of all components between various manufacturer’s representatives and technicians so that a complete, functional, and operational system is delivered to the Government.

C. When test results indicate any defects, the Contractor shall repair or replace the defective materials or equipment, and repeat the tests for the equipment. Repair, replacement, and re-testing shall be accomplished at no additional cost to the Government.

**1.16 WARRANTY**

A. All work performed and all equipment and material furnished under this Division shall be free from defects and shall remain so for a period of one year from the date of acceptance of the entire installation by the Contracting Officer for the Government.

**1.17 INSTRUCTION**

A. Instruction to designated Government personnel shall be provided for the particular equipment or system as required in each associated technical specification section.

B. Furnish the services of competent and factory-trained instructors to give full instruction in the adjustment, operation, and maintenance of the specified equipment and system, including pertinent safety requirements. Instructors shall be thoroughly familiar with all aspects of the installation, and shall be factory-trained in operating theory as well as practical operation and maintenance procedures.

C. A training schedule shall be developed and submitted by the Contractor and approved by the Resident Engineer at least 30 days prior to the planned training.

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

**PART 3 - EXECUTION (NOT USED)**

---END--

**SECTION 26 05 19**
**LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES**

## PART 1 - GENERAL

### 1.1 DESCRIPTION

A. This section specifies the furnishing, installation, connection, and testing of the electrical conductors and cables for use in electrical systems rated 600 V and below, indicated as cable(s), conductor(s), wire, or wiring in this section.

### 1.2 RELATED WORK

A. Section 07 84 00, FIRESTOPPING: Sealing around penetrations to maintain the integrity of fire-resistant rated construction.

B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.

C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.

D. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits for conductors and cables.

### 1.3 QUALITY ASSURANCE

A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

### 1.4 SUBMITTALS

A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:

1. Shop Drawings:
   a. Submit sufficient information to demonstrate compliance with drawings and specifications.
   b. Submit the following data for approval:
      1) Electrical ratings and insulation type for each conductor and cable.
      2) Splicing materials and pulling lubricant.
2. Certifications: Two weeks prior to final inspection, submit the following.

a. Certification by the manufacturer that the conductors and cables conform to the requirements of the drawings and specifications.

b. Certification by the Contractor that the conductors and cables have been properly installed, adjusted, and tested.

**1.5 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 reference in the text by designation only.

B. American Society of Testing Material (ASTM):

D2301-10 .....Standard Specification for Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape

D2304-10 .....Test Method for Thermal Endurance of Rigid Electrical Insulating Materials

D3005-10 .....Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape

C. National Electrical Manufacturers Association (NEMA):

WC 70-09 .....Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy

D. National Fire Protection Association (NFPA):

70-17 .....National Electrical Code (NEC)

E. Underwriters Laboratories, Inc. (UL):

44-14 .....Thermoset-Insulated Wires and Cables

83-14 .....Thermoplastic-Insulated Wires and Cables

467-13 .....Grounding and Bonding Equipment

486A-486B-13 .....Wire Connectors

486C-13 .....Splicing Wire Connectors

486D-15 .....Sealed Wire Connector Systems

486E-15 .....Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors

493-07 .....Thermoplastic-Insulated Underground Feeder and Branch Circuit Cables

514B-12 .....Conduit, Tubing, and Cable Fittings

**PART 2 - PRODUCTS**

**2.1 CONDUCTORS AND CABLES**

A. Conductors and cables shall be in accordance with ASTM, NEMA, NFPA, UL, as specified herein, and as shown on the drawings.

B. All conductors shall be copper.

C. Single Conductor and Cable:

1. No. 12 AWG: Minimum size, except where smaller sizes are specified herein or shown on the drawings.
2. No. 8 AWG and larger: Stranded.
3. No. 10 AWG and smaller: Solid; except shall be stranded for final connection to motors, transformers, and vibrating equipment.
4. Insulation: THHN-THWN and XHHW-2. XHHW-2 shall be used for isolated power systems.

E. Color Code:

1. No. 10 AWG and smaller: Solid color insulation or solid color coating.
2. No. 8 AWG and larger: Color-coded using one of the following methods:
   a. Solid color insulation or solid color coating.
   b. Stripes, bands, or hash marks of color specified.
   c. Color using 19 mm (0.75 inches) wide tape.
4. For modifications and additions to existing wiring systems, color coding shall conform to the existing wiring system.
5. Conductors shall be color-coded as follows:

| 208/120 V | Phase | 480/277 V |
|---|---|---|
| Black | A | Brown |
| Red | B | Orange |
| Blue | C | Yellow |
| White | Neutral | Gray * |
| * or white with colored (other than green) tracer. | | |

6. Lighting circuit “switch legs”, and 3-way and 4-way switch “traveling wires,” shall have color coding that is unique and distinct (e.g., pink and purple) from the color coding indicated above. The unique color codes shall be solid and in accordance with

the NEC. Coordinate color coding in the field with the Resident Engineer.

7. Color code for isolated power system wiring shall be in accordance with the NEC.

**2.2 SPLICES**

A. Splices shall be in accordance with NEC and UL.

B. Above Ground Splices for No. 10 AWG and Smaller:

1. Solderless, screw-on, reusable pressure cable type, with integral insulation, approved for copper and aluminum conductors.
2. The integral insulator shall have a skirt to completely cover the stripped conductors.
3. The number, size, and combination of conductors used with the connector, as listed on the manufacturer's packaging, shall be strictly followed.

C. Plastic electrical insulating tape: Per ASTM D2304, flame-retardant, cold and weather resistant.

**2.3 CONNECTORS AND TERMINATIONS**

A. Mechanical type of high conductivity and corrosion-resistant material, listed for use with copper and aluminum conductors.

B. Long barrel compression type of high conductivity and corrosion-resistant material, with minimum of two compression indents per wire, listed for use with copper and aluminum conductors.

C. All bolts, nuts, and washers used to connect connections and terminations to bus bars or other termination points shall be zinc-plated steel.

**2.4 CONTROL WIRING**

A. Unless otherwise specified elsewhere in these specifications, control wiring shall be as specified herein, except that the minimum size shall be not less than No. 14 AWG.

B. Control wiring shall be sized such that the voltage drop under in-rush conditions does not adversely affect operation of the controls.

**2.5 WIRE LUBRICATING COMPOUND**

A. Lubricating compound shall be suitable for the wire insulation and conduit, and shall not harden or become adhesive.

B. Shall not be used on conductors for isolated power systems.

## PART 3 - EXECUTION

### 3.1 GENERAL

A. Installation shall be in accordance with the NEC, as shown on the drawings, and manufacturer's instructions.

B. Install all conductors in raceway systems.

C. Splice conductors only in outlet boxes, junction boxes, pullboxes, manholes, or handholes.

D. Conductors of different systems (e.g., 120 V and 277 V) shall not be installed in the same raceway.

E. Install cable supports for all vertical feeders in accordance with the NEC. Provide split wedge type which firmly clamps each individual cable and tightens due to cable weight.

F. In panelboards, cabinets, wireways, switches, enclosures, and equipment assemblies, neatly form, train, and tie the conductors with non-metallic ties.

G. For connections to motors, transformers, and vibrating equipment, stranded conductors shall be used only from the last fixed point of connection to the motors, transformers, or vibrating equipment.

H. Use expanding foam or non-hardening duct-seal to seal conduits entering a building, after installation of conductors.

I. Conductor and Cable Pulling:

1. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling. Use lubricants approved for the cable.
2. Use nonmetallic pull ropes.
3. Attach pull ropes by means of either woven basket grips or pulling eyes attached directly to the conductors.
4. All conductors in a single conduit shall be pulled simultaneously.
5. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

J. No more than three branch circuits shall be installed in any one conduit.

K. When stripping stranded conductors, use a tool that does not damage the conductor or remove conductor strands.

**3.2 SPLICE AND TERMINATION INSTALLATION**

A. Splices and terminations shall be mechanically and electrically secure, and tightened to manufacturer’s published torque values using a torque screwdriver or wrench.

B. Where the Government determines that unsatisfactory splices or terminations have been installed, replace the splices or terminations at no additional cost to the Government.

**3.3 CONDUCTOR IDENTIFICATION**

A. When using colored tape to identify phase, neutral, and ground conductors larger than No. 8 AWG, apply tape in half-overlapping turns for a minimum of 75 mm (3 inches) from terminal points, and in junction boxes, pullboxes, and manholes. Apply the last two laps of tape with no tension to prevent possible unwinding. Where cable markings are covered by tape, apply tags to cable, stating size and insulation type.

**3.4 CONTROL WIRING INSTALLATION**

A. Unless otherwise specified in other sections, install control wiring and connect to equipment to perform the required functions as specified or as shown on the drawings.

B. Install a separate power supply circuit for each system, except where otherwise shown on the drawings.

**3.5 CONTROL WIRING IDENTIFICATION**

A. Install a permanent wire marker on each wire at each termination.

B. Identifying numbers and letters on the wire markers shall correspond to those on the wiring diagrams used for installing the systems.

C. Wire markers shall retain their markings after cleaning.

**3.6 ACCEPTANCE CHECKS AND TESTS**

A. Perform in accordance with the manufacturer's recommendations. In addition, include the following:

1. Visual Inspection and Tests: Inspect physical condition.
2. Electrical tests:
   a. After installation but before connection to utilization devices, such as fixtures, motors, or appliances, test conductors phase-to-phase and phase-to-ground resistance with an insulation resistance tester. Existing conductors to be reused shall also be tested.

b. Applied voltage shall be 500 V DC for 300 V rated cable, and 1000 V DC for 600 V rated cable. Apply test for one minute or until reading is constant for 15 seconds, whichever is longer. Minimum insulation resistance values shall not be less than 25 megohms for 300 V rated cable and 100 megohms for 600 V rated cable.

c. Perform phase rotation test on all three-phase circuits.

---END--

**SECTION 26 05 26**
**GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**

## PART 1 - GENERAL

### 1.1 DESCRIPTION

A. This section specifies the furnishing, installation, connection, and testing of grounding and bonding equipment, indicated as grounding equipment in this section.

B. "Grounding electrode system" refers to grounding electrode conductors and all electrodes required or allowed by NEC, as well as made, supplementary, and lightning protection system grounding electrodes.

C. The terms "connect" and "bond" are used interchangeably in this section and have the same meaning.

### 1.2 RELATED WORK

A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.

B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.

C. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduit and boxes.

D. Section 26 24 16, PANELBOARDS: Low-voltage panelboards.

### 1.3 QUALITY ASSURANCE

A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

### 1.4 SUBMITTALS

A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:

1. Shop Drawings:
   a. Submit sufficient information to demonstrate compliance with drawings and specifications.
   b. Submit plans showing the location of system grounding electrodes and connections, and the routing of aboveground and underground grounding electrode conductors.
2. Test Reports:

a. Two weeks prior to the final inspection, submit ground resistance field test reports to the Resident Engineer.

3. Certifications:

a. Certification by the Contractor that the grounding equipment has been properly installed and tested.

**1.5 APPLICABLE PUBLICATIONS**

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

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

B1-13 .....Standard Specification for Hard-Drawn Copper Wire

B3-13 .....Standard Specification for Soft or Annealed Copper Wire

B8-11 .....Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

C. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

81-12 .....IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System Part 1: Normal Measurements

D. National Fire Protection Association (NFPA):

70-17 .....National Electrical Code (NEC)

70E-15 .....National Electrical Safety Code

99-15 .....Health Care Facilities

E. Underwriters Laboratories, Inc. (UL):

44-14 .....Thermoset-Insulated Wires and Cables

83-14 .....Thermoplastic-Insulated Wires and Cables

467-13 .....Grounding and Bonding Equipment

**PART 2 - PRODUCTS**

**2.1 GROUNDING AND BONDING CONDUCTORS**

A. Equipment grounding conductors shall be insulated stranded copper, except that sizes No. 10 AWG and smaller shall be solid copper. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes No. 4 AWG and larger shall be identified per NEC.

B. Bonding conductors shall be bare stranded copper, except that sizes No. 10 AWG and smaller shall be bare solid copper. Bonding conductors shall be stranded for final connection to motors, transformers, and vibrating equipment.

C. Conductor sizes shall not be less than shown on the drawings, or not less than required by the NEC, whichever is greater.

D. Insulation: THHN-THWN and XHHW-2.

**2.2 GROUND CONNECTIONS**

A. Above Grade:

1. Bonding Jumpers: Listed for use with aluminum and copper conductors. For wire sizes No. 8 AWG and larger, use compression-type connectors. For wire sizes smaller than No. 8 AWG, use mechanical type lugs. Connectors or lugs shall use zinc-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.
2. Connection to Building Steel: Exothermic-welded type connectors.
3. Connection to Grounding Bus Bars: Listed for use with aluminum and copper conductors. Use mechanical type lugs, with zinc-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.

**2.3 GROUND TERMINAL BLOCKS**

A. At any equipment mounting location (e.g., backboards and hinged cover enclosures) where rack-type ground bars cannot be mounted, provide mechanical type lugs, with zinc-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.

**PART 3 - EXECUTION**

**3.1 GENERAL**

A. Installation shall be in accordance with the NEC, as shown on the drawings, and manufacturer’s instructions.

B. Equipment Grounding: Metallic piping, building structural steel, electrical enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits, shall be bonded and grounded.

D. For patient care area electrical power system grounding, conform to the latest NFPA 70 and 99.

### 3.2 INACCESSIBLE GROUNDING CONNECTIONS

A. Make grounding connections, which are normally buried or otherwise inaccessible, by exothermic weld.

### 3.3 RACEWAY

A. Conduit Systems:
   1. Ground all metallic conduit systems. All metallic conduit systems shall contain an equipment grounding conductor.
   2. Non-metallic conduit systems, except non-metallic feeder conduits that carry a grounded conductor from exterior transformers to interior or building-mounted service entrance equipment, shall contain an equipment grounding conductor.
   3. Metallic conduit that only contains a grounding conductor, and is provided for its mechanical protection, shall be bonded to that conductor at the entrance and exit from the conduit.
   4. Metallic conduits which terminate without mechanical connection to an electrical equipment housing by means of locknut and bushings or adapters, shall be provided with grounding bushings. Connect bushings with a equipment grounding conductor to the equipment ground bus.

B. Feeders and Branch Circuits: Install equipment grounding conductors with all feeders, and power and lighting branch circuits.

C. Boxes, Cabinets, Enclosures, and Panelboards:
   1. Bond the equipment grounding conductor to each pullbox, junction box, outlet box, device box, cabinets, and other enclosures through which the conductor passes (except for special grounding systems for intensive care units and other critical units shown).
   2. Provide lugs in each box and enclosure for equipment grounding conductor termination.

D. Receptacles shall not be grounded through their mounting screws. Ground receptacles with a jumper from the receptacle green ground terminal to the device box ground screw and a jumper to the branch circuit equipment grounding conductor.

E. Ground lighting fixtures to the equipment grounding conductor of the wiring system. Fixtures connected with flexible conduit shall have a green ground wire included with the power wires from the fixture through the flexible conduit to the first outlet box.

F. Fixed electrical appliances and equipment shall be provided with a ground lug for termination of the equipment grounding conductor.

**3.4 GROUND RESISTANCE**

A. Grounding system resistance to ground shall not exceed 5 ohms. Make any modifications or additions to the grounding electrode system necessary for compliance without additional cost to the Government. Final tests shall ensure that this requirement is met.

---END--

**SECTION 26 05 33**
**RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS**

## PART 1 - GENERAL

### 1.1 DESCRIPTION

A. This section specifies the furnishing, installation, and connection of conduit, fittings, and boxes, to form complete, coordinated, grounded raceway systems. Raceways are required for all wiring unless shown or specified otherwise.

B. Definitions: The term conduit, as used in this specification, shall mean any or all of the raceway types specified.

### 1.2 RELATED WORK

A. Section 07 84 00, FIRESTOPPING: Sealing around penetrations to maintain the integrity of fire rated construction.

B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.

C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.

### 1.3 QUALITY ASSURANCE

A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

### 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 designation only.

B. American Iron and Steel Institute (AISI):

S100-12 .....North American Specification for the Design of Cold-Formed Steel Structural Members

C. National Electrical Manufacturers Association (NEMA):

C80.1-15 .....Electrical Rigid Steel Conduit

C80.3-15 .....Steel Electrical Metal Tubing

C80.6-05 .....Electrical Intermediate Metal Conduit

FB1-14 .....Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable

FB2.10-13 .....Selection and Installation Guidelines for Fittings for use with Non-Flexible Conduit or Tubing (Rigid Metal Conduit, Intermediate Metallic Conduit, and Electrical Metallic Tubing)

FB2.20-14 .....Selection and Installation Guidelines for Fittings for use with Flexible Electrical Conduit and Cable

TC-2-13 .....Electrical Polyvinyl Chloride (PVC) Tubing and Conduit

TC-3-13 .....PVC Fittings for Use with Rigid PVC Conduit and Tubing

D. National Fire Protection Association (NFPA):

70-17 .....National Electrical Code (NEC)

E. Underwriters Laboratories, Inc. (UL):

1-05 .....Flexible Metal Conduit

5-16 .....Surface Metal Raceway and Fittings

6-07 .....Electrical Rigid Metal Conduit - Steel

50-15 .....Enclosures for Electrical Equipment

360-13 .....Liquid-Tight Flexible Steel Conduit

467-13 .....Grounding and Bonding Equipment

514A-13 .....Metallic Outlet Boxes

514B-12 .....Conduit, Tubing, and Cable Fittings

514C-14 .....Nonmetallic Outlet Boxes, Flush-Device Boxes and Covers

651-11 .....Schedule 40 and 80 Rigid PVC Conduit and Fittings

651A-11 .....Type EB and A Rigid PVC Conduit and HDPE Conduit

797-07 .....Electrical Metallic Tubing

1242-14 .....Electrical Intermediate Metal Conduit - Steel

**PART 2 - PRODUCTS**

**2.1 MATERIAL**

A. Conduit Size: In accordance with the NEC, but not less than 13 mm (0.5-inch) unless otherwise shown. Where permitted by the NEC, 13 mm (0.5-inch) flexible conduit may be used for tap connections to recessed lighting fixtures.

B. Conduit:

1. Size: In accordance with the NEC, but not less than 13 mm (0.5-inch).
2. Rigid Steel Conduit (RMC): Shall conform to UL 6 and NEMA C80.1.
3. Rigid Intermediate Steel Conduit (IMC): Shall conform to UL 1242 and NEMA C80.6.
4. Electrical Metallic Tubing (EMT): Shall conform to UL 797 and NEMA C80.3. Maximum size not to exceed 105 mm (4 inches) and shall be permitted only with cable rated 600 V or less.
5. Flexible Metal Conduit: Shall conform to UL 1.
6. Liquid-tight Flexible Metal Conduit: Shall conform to UL 360.

C. Conduit Fittings:

1. Rigid Steel and Intermediate Metallic Conduit Fittings:
   a. Fittings shall meet the requirements of UL 514B and NEMA FB1.
   b. Standard threaded couplings, locknuts, bushings, conduit bodies, and elbows: Only steel or malleable iron materials are acceptable. Integral retractable type IMC couplings are also acceptable.
   c. Locknuts: Bonding type with sharp edges for digging into the metal wall of an enclosure.
   d. Bushings: Metallic insulating type, consisting of an insulating insert, molded or locked into the metallic body of the fitting. Bushings made entirely of metal or nonmetallic material are not permitted.
   e. Erickson (Union-Type) and Set Screw Type Couplings: Approved for use in concrete are permitted for use to complete a conduit run where conduit is installed in concrete. Use set screws of case-hardened steel with hex head and cup point to firmly seat in

conduit wall for positive ground. Tightening of set screws with pliers is prohibited.

f. Sealing Fittings: Threaded cast iron type. Use continuous drain-type sealing fittings to prevent passage of water vapor. In concealed work, install fittings in flush steel boxes with blank cover plates having the same finishes as that of other electrical plates in the room.

2. Electrical Metallic Tubing Fittings:
   a. Fittings and conduit bodies shall meet the requirements of UL 514B, NEMA C80.3, and NEMA FB1.
   b. Only steel or malleable iron materials are acceptable.
   c. Compression Couplings and Connectors: Concrete-tight and rain-tight, with connectors having insulated throats.
   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.
3. Flexible Metal Conduit Fittings:
   a. Conform to UL 514B. Only steel or malleable iron materials are acceptable.
   b. Clamp-type, with insulated throat.
4. Liquid-tight Flexible Metal Conduit Fittings:
   a. Fittings shall meet the requirements of UL 514B and NEMA FB1.
   b. Only steel or malleable iron materials are acceptable.
   c. Fittings must incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening. Connectors shall have insulated throats.
5. Surface Metal Raceway Fittings: As recommended by the raceway manufacturer. Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, conduit entry fittings, accessories, and other fittings as required for complete system.
6. Expansion and Deflection Couplings:
   a. Conform to UL 467 and UL 514B.
   b. Accommodate a 19 mm (0.75-inch) deflection, expansion, or contraction in any direction, and allow 30 degree angular deflections.

c. Include internal flexible metal braid, sized to guarantee conduit ground continuity and a low-impedance path for fault currents, in accordance with UL 467 and the NEC tables for equipment grounding conductors.

d. Jacket: Flexible, corrosion-resistant, watertight, moisture and heat-resistant molded rubber material with stainless steel jacket clamps.

D. Conduit Supports:

1. Parts and Hardware: Zinc-coat or provide equivalent corrosion protection.
2. Individual Conduit Hangers: Designed for the purpose, having a pre-assembled closure bolt and nut, and provisions for receiving a hanger rod.
3. Multiple Conduit (Trapeze) Hangers: Not less than 38 mm x 38 mm (1.5 x 1.5 inches), 12-gauge steel, cold-formed, lipped channels; with not less than 9 mm (0.375-inch) diameter steel hanger rods.
4. Solid Masonry and Concrete Anchors: Self-drilling expansion shields, or machine bolt expansion.

E. Outlet, Junction, and Pull Boxes:

1. Comply with UL-50 and UL-514A.
2. Rustproof cast metal where required by the NEC or shown on drawings.
3. Sheet Metal Boxes: Galvanized steel, except where shown on drawings.

F. Metal Wireways: Equip with hinged covers, except as shown on drawings. Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for a complete system.

**PART 3 - EXECUTION**

**3.1 PENETRATIONS**

A. Cutting or Holes:

1. Cut holes in advance where they should be placed in the structural elements, such as ribs or beams. Obtain the approval of the Resident Engineerprior to drilling through structural elements.
2. Cut holes through concrete and masonry in new and existing structures with a diamond core drill or concrete saw. Pneumatic hammers, impact electric, hand, or manual hammer-type drills are not

allowed, except when permitted by the Resident Engineerwhere working space is limited.

B. Firestop: Where conduits, wireways, and other electrical raceways pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING.

C. Waterproofing: At floor, exterior wall, and roof conduit penetrations, completely seal the gap around conduit to render it watertight, as specified in Section 07 92 00, JOINT SEALANTS.

**3.2 INSTALLATION, GENERAL**

A. In accordance with NEC, NEMA, UL, as shown on drawings, and as specified herein.

B. Raceway systems used for Essential Electrical Systems (EES) shall be entirely independent of other raceway systems.

C. Install conduit as follows:

1. In complete mechanically and electrically continuous runs before pulling in cables or wires.
2. Unless otherwise indicated on the drawings or specified herein, installation of all conduits shall be concealed within finished walls, floors, and ceilings.
3. Flattened, dented, or deformed conduit is not permitted. Remove and replace the damaged conduits with new conduits.
4. Assure conduit installation does not encroach into the ceiling height head room, walkways, or doorways.
5. Cut conduits square, ream, remove burrs, and draw up tight.
6. Independently support conduit at 2.4 M (8 feet) on centers with specified materials and as shown on drawings.
7. Do not use suspended ceilings, suspended ceiling supporting members, lighting fixtures, other conduits, cable tray, boxes, piping, or ducts to support conduits and conduit runs.
8. Support within 300 mm (12 inches) of changes of direction, and within 300 mm (12 inches) of each enclosure to which connected.
9. Close ends of empty conduits with plugs or caps at the rough-in stage until wires are pulled in, to prevent entry of debris.
10. Conduit installations under fume and vent hoods are prohibited.

11. Secure conduits to cabinets, junction boxes, pull-boxes, and outlet boxes with bonding type locknuts. For rigid steel and IMC conduit installations, provide a locknut on the inside of the enclosure, made up wrench tight. Do not make conduit connections to junction box covers.
12. Conduit bodies shall only be used for changes in direction, and shall not contain splices.

D. Conduit Bends:
1. Make bends with standard conduit bending machines.
2. Conduit hickey may be used for slight offsets and for straightening stubbed out conduits.
3. Bending of conduits with a pipe tee or vise is prohibited.

E. Layout and Homeruns:
1. Install conduit with wiring, including homeruns, as shown on drawings.
2. Deviations: Make only where necessary to avoid interferences and only after drawings showing the proposed deviations have been submitted and approved by the Resident Engineer.

**3.3 CONCEALED WORK INSTALLATION**

A. Above Furred or Suspended Ceilings and in Walls:

1. Conduit for Conductors 600 V and Below: Rigid steel, IMC, or EMT. Mixing different types of conduits in the same system is prohibited.
2. Align and run conduit parallel or perpendicular to the building lines.
3. Connect recessed lighting fixtures to conduit runs with maximum 1.8 M (6 feet) of flexible metal conduit extending from a junction box to the fixture.
4. Tightening set screws with pliers is prohibited.
5. For conduits running through metal studs, limit field cut holes to no more than 70% of web depth. Spacing between holes shall be at least 457 mm (18 inches). Cuts or notches in flanges or return lips shall not be permitted.

**3.4 EXPOSED WORK INSTALLATION**

A. Unless otherwise indicated on drawings, exposed conduit is only permitted in mechanical and electrical rooms.

B. Conduit for Conductors 600 V and Below: Rigid steel, IMC, or EMT. Mixing different types of conduits in the system is prohibited.

C. Align and run conduit parallel or perpendicular to the building lines.

D. Install horizontal runs close to the ceiling or beams and secure with conduit straps.

E. Support horizontal or vertical runs at not over 2.4 M (8 feet) intervals.

F. Surface Metal Raceways: Use only where shown on drawings.

G. Painting:

1. Paint exposed conduit as specified in Section 09 91 00, PAINTING.

**3.5 WET OR DAMP LOCATIONS**

A. Use rigid steel or IMC conduits unless as shown on drawings.

B. Provide sealing fittings to prevent passage of water vapor where conduits pass from warm to cold locations, i.e., refrigerated spaces, constant-temperature rooms, air-conditioned spaces, building exterior walls, roofs, or similar spaces.

C. Use rigid steel or IMC conduit within 1.5 M (5 feet) of the exterior and below concrete building slabs in contact with soil, gravel, or vapor barriers, unless as shown on drawings. Conduit shall be half-lapped with 10 mil PVC tape before installation. After installation, completely recoat or retape any damaged areas of coating.

D. Conduits run on roof shall be supported with integral galvanized lipped steel channel, attached to UV-inhibited polycarbonate or polypropylene blocks every 2.4 M (8 feet) with 9 mm (3/8-inch) galvanized threaded rods, square washer and locknut. Conduits shall be attached to steel channel with conduit clamps.

**3.6 MOTORS AND VIBRATING EQUIPMENT**

A. Use flexible metal conduit for connections to motors and other electrical equipment subject to movement, vibration, misalignment, cramped quarters, or noise transmission.

B. Use liquid-tight flexible metal conduit for installation in exterior locations, moisture or humidity laden atmosphere, corrosive atmosphere, water or spray wash-down operations, inside airstream of HVAC units, and locations subject to seepage or dripping of oil, grease, or water.

C. Provide a green equipment grounding conductor with flexible and liquid-tight flexible metal conduit.

**3.7 CONDUIT SUPPORTS**

A. Safe working load shall not exceed one-quarter of proof test load of fastening devices.

B. Use pipe straps or individual conduit hangers for supporting individual conduits.

C. Support multiple conduit runs with trapeze hangers. Use trapeze hangers that are designed to support a load equal to or greater than the sum of the weights of the conduits, wires, hanger itself, and an additional 90 kg (200 lbs). Attach each conduit with U-bolts or other approved fasteners.

D. Support conduit independently of junction boxes, pull-boxes, fixtures, suspended ceiling T-bars, angle supports, and similar items.

E. Fasteners and Supports in Solid Masonry and Concrete:

1. New Construction: Use steel or malleable iron concrete inserts set in place prior to placing the concrete.
2. Existing Construction:
   a. Steel expansion anchors not less than 6 mm (0.25-inch) bolt size and not less than 28 mm (1.125 inch) in embedment.
   b. Power set fasteners not less than 6 mm (0.25-inch) diameter with depth of penetration not less than 75 mm (3 inch).
   c. Use vibration and shock-resistant anchors and fasteners for attaching to concrete ceilings.

F. Hollow Masonry: Toggle bolts.

G. Bolts supported only by plaster or gypsum wallboard are not acceptable.

H. Metal Structures: Use machine screw fasteners or other devices specifically designed and approved for the application.

I. Attachment by wood plugs, rawl plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.

J. Chain, wire, or perforated strap shall not be used to support or fasten conduit.

K. Spring steel type supports or fasteners are prohibited for all uses except horizontal and vertical supports/fasteners within walls.

L. Vertical Supports: Vertical conduit runs shall have riser clamps and supports in accordance with the NEC and as shown. Provide supports for cable and wire with fittings that include internal wedges and retaining collars.

**3.8 BOX INSTALLATION**

A. Boxes for Concealed Conduits:
   1. Flush-mounted.
   2. Provide raised covers for boxes to suit the wall or ceiling, construction, and finish.

B. In addition to boxes shown, install additional boxes where needed to prevent damage to cables and wires during pulling-in operations or where more than the equivalent of 4-90 degree bends are necessary.

C. Locate pullboxes so that covers are accessible and easily removed. Coordinate locations with piping and ductwork where installed above ceilings.

D. Remove only knockouts as required. Plug unused openings. Use threaded plugs for cast metal boxes and snap-in metal covers for sheet metal boxes.

E. Outlet boxes mounted back-to-back in the same wall are prohibited. A minimum 600 mm (24 inch) center-to-center lateral spacing shall be maintained between boxes.

F. Flush-mounted wall or ceiling boxes shall be installed with raised covers so that the front face of raised cover is flush with the wall. Surface-mounted wall or ceiling boxes shall be installed with surface-style flat or raised covers.

G. Minimum size of outlet boxes for ground fault circuit interrupter (GFCI) receptacles is 100 mm (4 inches) square x 55 mm (2.125 inches) deep, with device covers for the wall material and thickness involved.

H. Stencil or install phenolic nameplates on covers of the boxes identified on riser diagrams; for example "SIG-FA JB No. 1."

I. On all branch circuit junction box covers, identify the circuits with black marker.

- - - E N D - -

**SECTION 26 08 00**

**COMMISSIONING OF ELECTRICAL SYSTEMS**

## PART 1 – GENERAL

### 1.1 DESCRIPTION

A. The requirements of this Section apply to all sections of Division 26.

B. This project will have selected building systems commissioned. The complete list of equipment and systems to be commissioned is specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. The commissioning process, which the Contractor is responsible to execute, is defined in Section 01 91 00 GENERAL COMMISSIONING REQUIRMENTS. A Commissioning Agent (CxA) appointed by the VA will manage the commissioning process.

### 1.2 RELATED WORK

A. Section 01 00 00 GENERAL REQUIREMENTS.

B. Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

C. Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

### 1.3 SUMMARY

A. This Section includes requirements for commissioning the Facility electrical systems, related subsystems and related equipment. This Section supplements the general requirements specified in Section 01 91 00 General Commissioning Requirements.

B. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for more details regarding processes and procedures as well as roles and responsibilities for all Commissioning Team members.

### 1.4 DEFINITIONS

A. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for definitions.

### 1.5 COMMISSIONED SYSTEMS

A. Commissioning of a system or systems specified in Division 26 is part of the construction process. Documentation and testing of these systems, as well as training of the VA’s Operation and Maintenance personnel in accordance with the requirements of Section 01 91 00 and of Division 26, is required in cooperation with the VA and the Commissioning Agent.

B. The Facility electrical systems commissioning will include the systems listed in Section 01 91 00 General Commissioning Requirements:

**1.6 SUBMITTALS**

A. The commissioning process requires review of selected Submittals that pertain to the systems to be commissioned. The Commissioning Agent will provide a list of submittals that will be reviewed by the Commissioning Agent. This list will be reviewed and approved by the VA prior to forwarding to the Contractor. Refer to Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, and SAMPLES for further details.

B. The commissioning process requires Submittal review simultaneously with engineering review. Specific submittal requirements related to the commissioning process are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

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

**PART 3 - EXECUTION**

**3.1 CONSTRUCTION INSPECTIONS**

A. Commissioning of Electrical systems will require inspection of individual elements of the electrical systems construction throughout the construction period. The Contractor shall coordinate with the Commissioning Agent in accordance with Section 01 91 00 and the Commissioning plan to schedule electrical systems inspections as required to support the Commissioning Process.

**3.2 PRE-FUNCTIONAL CHECKLISTS**

A. The Contractor shall complete Pre-Functional Checklists to verify systems, subsystems, and equipment installation is complete and systems are ready for Systems Functional Performance Testing. The Commissioning Agent will prepare Pre-Functional Checklists to be used to document equipment installation. The Contractor shall complete the checklists. Completed checklists shall be submitted to the VA and to the Commissioning Agent for review. The Commissioning Agent may spot check a sample of completed checklists. If the Commissioning Agent determines that the information provided on the checklist is not accurate, the Commissioning Agent will return the marked-up checklist to the Contractor for correction and resubmission. If the Commissioning Agent determines that a significant number of completed checklists for similar equipment are not accurate, the Commissioning Agent will select a broader sample of checklists for review. If the

Commissioning Agent determines that a significant number of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and resubmission. Refer to SECTION 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for Pre-Functional Checklists, Equipment Startup Reports, and other commissioning documents.

**3.3 CONTRACTORS TESTS**

A. Contractor tests as required by other sections of Division 26 shall be scheduled and documented in accordance with Section 01 00 00 GENERAL REQUIREMENTS. All testing shall be incorporated into the project schedule. Contractor shall provide no less than 7 calendar days' notice of testing. The Commissioning Agent will witness selected Contractor tests at the sole discretion of the Commissioning Agent. Contractor tests shall be completed prior to scheduling Systems Functional Performance Testing.

**3.4 SYSTEMS FUNCTIONAL PERFORMANCE TESTING**

A. The Commissioning Process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions. The Commissioning Agent will prepare detailed Systems Functional Performance Test procedures for review and approval by the Resident Engineer. The Contractor shall review and comment on the tests prior to approval. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The Commissioning Agent will witness and document the testing. The Contractor shall sign the test reports to verify tests were performed. See Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS, for additional details.

**3.5 TRAINING OF VA PERSONNEL**

A. Training of the VA operation and maintenance personnel is required in cooperation with the Resident Engineer and Commissioning Agent. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. Contractor shall submit training agendas and trainer resumes in accordance with the requirements of Section 01 91 00. The instruction shall be

scheduled in coordination with the VA Resident Engineer after submission and approval of formal training plans. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS and Division 26 Sections for additional Contractor training requirements.

----- END ----

**SECTION 26 09 23**
**LIGHTING CONTROLS**

## PART 1 - GENERAL

### 1.1 DESCRIPTION

This section specifies the furnishing, installation and connection of the lighting controls.

### 1.2 RELATED WORK

A. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC: Interface of lighting controls with HVAC control systems.

B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General requirements that are common to more than one section of Division 26.

C. Section 26 05 19, 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.

E. Section 26 24 16, PANELBOARDS: Panelboard enclosure and interior bussing used for lighting control panels.

F. Section 26 27 26, WIRING DEVICES: Wiring devices used for control of the lighting systems.

G. Section 26 51 00, INTERIOR LIGHTING: Luminaire ballast and drivers used in control of lighting systems.

### 1.3 QUALITY ASSURANCE

A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

### 1.4 SUBMITTALS

A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:

1. Shop Drawings:

   a. Submit the following information for each type of lighting controls.

   b. Material and construction details.

   c. Physical dimensions and description.

   d. Wiring schematic and connection diagram.

e. Installation details.

2. Manuals:

a. Submit, simultaneously with the shop drawings, complete maintenance and operating manuals, including technical data sheets, wiring diagrams, and information for ordering replacement parts.

b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.

3. Certifications: Two weeks prior to final inspection, submit the following.

a. Certification by the Contractor that the lighting control systems have been properly installed and tested.

**1.5 APPLICABLE PUBLICATIONS**

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

B. National Electrical Manufacturer's Association (NEMA):

C136.10-10 .....American National Standard for Roadway and Area Lighting Equipment—Locking-Type Photocontrol Devices and Mating Receptacles—Physical and Electrical Interchangeability and Testing

ICS-1-15 .....Standard for Industrial Control and Systems General Requirements

ICS-2-05 .....Standard for Industrial Control and Systems: Controllers, Contractors, and Overload Relays Rated Not More than 2000 Volts AC or 750 Volts DC: Part 8 - Disconnect Devices for Use in Industrial Control Equipment

ICS-6-16 .....Standard for Industrial Controls and Systems Enclosures

C. National Fire Protection Association (NFPA):

70-17 .....National Electrical Code (NEC)

D. Underwriters Laboratories, Inc. (UL):

20-10 .....Standard for General-Use Snap Switches

98-16 .....Enclosed and Dead-Front Switches

773-16 .....Standard for Plug-In Locking Type Photocontrols for Use with Area Lighting

773A-16 .....Nonindustrial Photoelectric Switches for Lighting Control

916-15 .....Standard for Energy Management Equipment Systems

917-06 .....Clock Operated Switches

924-16 .....Emergency Lighting and Power Equipment (for use when controlling emergency circuits).

**PART 2 - PRODUCTS**

**2.1 INDOOR OCCUPANCY SENSORS**

A. Wall- or ceiling-mounting, solid-state units with a power supply and relay unit, suitable for the environmental conditions in which installed.

1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a 1 to 15 minute adjustable time delay for turning lights off.
2. Sensor Output: Contacts rated to operate the connected relay. Sensor shall be powered from the relay unit.
3. Relay Unit: Dry contacts rated for 20A ballast load at 120 volt and 277 volt, for 13A tungsten at 120 volt, and for 1 hp at 120 volt.
4. Mounting:
   a. Sensor: Suitable for mounting in any position on a standard outlet box.
   b. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
6. Bypass Switch: Override the on function in case of sensor failure.
7. Manual/automatic selector switch.
8. Faceplate for Wall-Switch Replacement Type: Refer to wall plate material and color requirements for toggle switches, as specified in Section 26 27 26, WIRING DEVICES.

B. Dual-technology Type: Ceiling mounting; combination PIR and ultrasonic detection methods, field-selectable.

1. Sensitivity Adjustment: Separate for each sensing technology.

2. Detector Sensitivity: Detect occurrences of 150 mm (6-inch) minimum movement of any portion of a human body that presents a target of not less than 232 sq. cm (36 sq. in), and detect a person of average size and weight moving not less than 305 mm (12 inches) in either a horizontal or a vertical manner at an approximate speed of 305 mm/s (12 inches/s).

C. Detection Coverage: Shall be sufficient to provide coverage as required by sensor locations shown on drawing.

**2.2 INDOOR VACANCY SENSOR SWITCH**

A. Wall mounting, solid-state units with integral sensor and switch.

1. Operation: Manually turn lights on with switch and sensor detects vacancy to turn lights off.
2. Switch Rating: 120/277 volt, 1200 watts at 277 volt, 800 watts at 120 volt unit.
3. Mounting:
   a. Sensor: Suitable for mounting in a standard switch box.
   b. Time-Delay and Sensitivity Adjustments: Integral with switch and accessible for reprogramming without removing switch.
4. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
5. Switch: Manual operation to turn lights on and override lights off.
6. Faceplate: Refer to wall plate material and color requirements for toggle switches, as specified in Section 26 27 26, WIRING DEVICES.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

A. Installation shall be in accordance with the NEC, manufacturer's instructions, as shown on the drawings, and as specified.

B. Aim outdoor photoelectric sensor according to manufacturer's recommendations. Set adjustable window slide for 1 footcandle turn-on.

C. Aiming for wall-mounted and ceiling-mounted motion sensor switches shall be per manufacturer’s recommendations.

D. Set occupancy sensor "on" duration to 15 minutes.

E. Locate photoelectric sensors as indicated and in accordance with the manufacturer's recommendations. Adjust sensor for the available light level at the typical work plane for that area.

F. Label time switches and contactors with a unique designation.

G. Program lighting control panels per schedule on drawings.

**3.2 ACCEPTANCE CHECKS AND TESTS**

A. Perform in accordance with the manufacturer's recommendations.

B. Upon completion of installation, conduct an operating test to show that equipment operates in accordance with requirements of this section.

C. Test for full range of dimming ballast and dimming controls capability. Observe for visually detectable flicker over full dimming range.

D. Test occupancy sensors for proper operation. Observe for light control over entire area being covered.

**3.3 FOLLOW-UP VERIFICATION**

Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that the lighting control devices are in good operating condition and properly performing the intended function in the presence of Resident Engineer.

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**SECTION 26 27 26**
**WIRING DEVICES**

## PART 1 - GENERAL

### 1.1 DESCRIPTION

A. This section specifies the furnishing, installation, connection, and testing of wiring devices.

### 1.2 RELATED WORK

A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements that are common to more than one section of Division 26.

B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Cables and wiring.

C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents.

D. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduit and boxes.

E. Section 26 51 00, INTERIOR LIGHTING: Fluorescent ballasts and LED drivers for use with manual dimming controls.

### 1.3 QUALITY ASSURANCE

A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

### 1.4 SUBMITTALS

A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:

1. Shop Drawings:
   a. Submit sufficient information to demonstrate compliance with drawings and specifications.
   b. Include electrical ratings, dimensions, mounting details, construction materials, grade, and termination information.
2. Manuals:
   a. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals, including

technical data sheets and information for ordering replacement parts.

b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.

3. Certifications: Two weeks prior to final inspection, submit the following.

a. Certification by the manufacturer that the wiring devices conform to the requirements of the drawings and specifications.

b. Certification by the Contractor that the wiring devices have been properly installed and adjusted.

**1.5 APPLICABLE PUBLICATIONS**

A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by basic designation only.

B. National Electrical Manufacturers Association (NEMA):

WD 1-99(R2015) .....General Color Requirements for Wiring Devices

WD 6-16 .....Wiring Devices – Dimensional Specifications

C. National Fire Protection Association (NFPA):

70-17 .....National Electrical Code (NEC)

99-18 .....Health Care Facilities

D. Underwriter’s Laboratories, Inc. (UL):

5-16 .....Surface Metal Raceways and Fittings

20-10 .....General-Use Snap Switches

231-16 .....Power Outlets

467-13 .....Grounding and Bonding Equipment

498-17 .....Attachment Plugs and Receptacles

943-16 .....Ground-Fault Circuit-Interrupters

1449-14 .....Surge Protective Devices

1472-15 .....Solid State Dimming Controls

**PART 2 - PRODUCTS**

**2.1 RECEPTACLES**

A. General: All receptacles shall comply with NEMA, NFPA, UL, and as shown on the drawings.

1. Mounting straps shall be nickel plated brass, brass, nickel plated steel or galvanize steel with break-off plaster ears, and shall

include a self-grounding feature. Terminal screws shall be brass, brass plated or a copper alloy metal.

2. Receptacles shall have provisions for back wiring with separate metal clamp type terminals (four minimum) and side wiring from four captively held binding screws.

B. Duplex Receptacles - Hospital-grade: shall be listed for hospital grade, single phase, 20 ampere, 120 volts, 2-pole, 3-wire, NEMA 5-20R, with break-off feature for two-circuit operation.

1. Bodies shall be ivoryin color.
2. Switched duplex receptacles shall be wired so that only the top receptacle is switched. The lower receptacle shall be unswitched.
3. Duplex Receptacles on Emergency Circuit:
   a. In rooms without emergency powered general lighting, the emergency receptacles shall be of the self-illuminated type.
4. Ground Fault Current Interrupter (GFCI) Duplex Receptacles: Shall be an integral unit, hospital-grade, suitable for mounting in a standard outlet box, with end-of-life indication and provisions to isolate the face due to improper wiring. GFCI receptacles shall be self-test receptacles in accordance with UL 943.
   a. Ground fault interrupter shall consist of a differential current transformer, self-test, solid state sensing circuitry and a circuit interrupter switch. Device shall have nominal sensitivity to ground leakage current of 4-6 milliamperes and shall function to interrupt the current supply for any value of ground leakage current above five milliamperes (+ or – 1 milliampere) on the load side of the device. Device shall have a minimum nominal tripping time of 0.025 second.
   b. Self-test function shall be automatically initiated within 5 seconds after power is activated to the receptacles. Self-test function shall be periodically and automatically performed every 3 hours or less.
   c. End-of-life indicator light shall be a persistent flashing or blinking light to indicate that the GFCI receptacle is no longer in service.

B. Receptacles - 20, 30, and 50 ampere, 250 Volts: Shall be complete with appropriate cord grip plug.

**2.2 TOGGLE SWITCHES**

A. Toggle switches shall be totally enclosed tumbler type with nylon bodies. Handles shall be ivoryin color unless otherwise specified or shown on the drawings.

1. Switches installed in hazardous areas shall be explosion-proof type in accordance with the NEC and as shown on the drawings.
2. Shall be single unit toggle, butt contact, quiet AC type, heavy-duty general-purpose use with an integral self grounding mounting strap with break-off plasters ears and provisions for back wiring with separate metal wiring clamps and side wiring with captively held binding screws.
3. Switches shall be rated 20 amperes at 120-277 Volts AC.

**2.3 MANUAL DIMMING CONTROL**

B. Manual dimming controls shall be fully compatible with LED dimming driver and be approved by the driver manufacturer, shall operate over full specified dimming range, and shall not degrade the performance or rated life of the electronic dimming ballast and lamp.

C. Provide single-pole, three-way or four-way, as shown on the drawings.

D. Manual dimming control and faceplates shall be ivoryin color unless otherwise specified.

**2.4 WALL PLATES**

A. Wall plates for switches and receptacles shall be type 302 stainless steel. Oversize plates are not acceptable.

B. For receptacles or switches mounted adjacent to each other, wall plates shall be common for each group of receptacles or switches.

C. In areas requiring tamperproof wiring devices, wall plates shall be type 302 stainless steel, and shall have tamperproof screws and beveled edges.

D. Duplex Receptacles on Emergency Circuit: Wall plates shall be type 302 stainless steel, with the word “EMERGENCY” engraved in 6 mm (1/4 inch) red letters.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

A. Installation shall be in accordance with the NEC and as shown as on the drawings.

B. Install wiring devices after wall construction and painting is complete.

C. The ground terminal of each wiring device shall be bonded to the outlet box with an approved green bonding jumper, and also connected to the branch circuit equipment grounding conductor.

D. Outlet boxes for toggle switches and manual dimming controls shall be mounted on the strike side of doors.

E. Provide barriers in multi-gang outlet boxes to comply with the NEC.

F. Coordinate the electrical work with the work of other trades to ensure that wiring device flush outlets are positioned with box openings aligned with the face of the surrounding finish material. Pay special attention to installations in cabinet work, and in connection with laboratory equipment.

G. Exact field locations of floors, walls, partitions, doors, windows, and equipment may vary from locations shown on the drawings. Prior to locating sleeves, boxes and chases for roughing-in of conduit and equipment, the Contractor shall coordinate exact field location of the above items with other trades.

H. Install wall switches 1.2 M (48 inches) above floor, with the toggle OFF position down.

I. Install wall dimmers 1.2 M (48 inches) above floor.

J. Install receptacles 450 mm (18 inches) above floor, and 152 mm (6 inches) above counter backsplash or workbenches. Install specific-use receptacles at heights shown on the drawings.

K. Install horizontally mounted receptacles with the ground pin to the right.

L. When required or recommended by the manufacturer, use a torque screwdriver. Tighten unused terminal screws.

M. Label device plates with a permanent adhesive label listing panel and circuit feeding the wiring device.

**3.2 ACCEPTANCE CHECKS AND TESTS**

A. Perform manufacturer’s required field checks in accordance with the manufacturer's recommendations, and the latest NFPA 99. In addition, include the following:

1. Visual Inspection and Tests:

   a. Inspect physical and electrical conditions.

   b. Vacuum-clean surface metal raceway interior. Clean metal raceway exterior.

c. Test wiring devices for damaged conductors, high circuit resistance, poor connections, inadequate fault current path, defective devices, or similar problems using a portable receptacle tester. Correct circuit conditions, remove malfunctioning units and replace with new, and retest as specified above.

d. Test GFCI receptacles.

2. Receptacle testing in the Patient Care Spaces, such as retention force of the grounding blade of each receptacle, shall comply with the latest NFPA 99.

---END--

**SECTION 26 29 21**
**ENCLOSED SWITCHES AND CIRCUIT BREAKERS**

## PART 1 - GENERAL

### 1.1 DESCRIPTION

A. This section specifies the furnishing, installation, and connection of fused and unfused disconnect switches (indicated as switches in this section), and separately-enclosed circuit breakers for use in electrical systems rated 600 V and below.

### 1.2 RELATED WORK

A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.

B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.

C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground faults.

D. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits.

E. Section 26 24 16, PANELBOARDS: Molded-case circuit breakers.

### 1.3 QUALITY ASSURANCE

A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

### 1.4 SUBMITTALS

A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:

1. Shop Drawings:
   a. Submit sufficient information to demonstrate compliance with drawings and specifications.
   b. Submit the following data for approval:
      1) Electrical ratings, dimensions, mounting details, materials, required clearances, terminations, weight, fuses, circuit breakers, wiring and connection diagrams, accessories, and device nameplate data.

2. Manuals:

a. Submit complete maintenance and operating manuals including technical data sheets, wiring diagrams, and information for ordering fuses, circuit breakers, and replacement parts.
   1) Include schematic diagrams, with all terminals identified, matching terminal identification in the enclosed switches and circuit breakers.
   2) Include information for testing, repair, troubleshooting, assembly, and disassembly.
b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.

3. Certifications: Two weeks prior to final inspection, submit the following.
   a. Certification by the manufacturer that the enclosed switches and circuit breakers conform to the requirements of the drawings and specifications.
   b. Certification by the Contractor that the enclosed switches and circuit breakers have been properly installed, adjusted, and tested.

**1.5 APPLICABLE PUBLICATIONS**

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

B. International Code Council (ICC):
   IBC-15 .....International Building Code

C. National Electrical Manufacturers Association (NEMA):
   FU l-12 .....Low Voltage Cartridge Fuses
   KS l-13 .....Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum)

D. National Fire Protection Association (NFPA):
   70-17 .....National Electrical Code (NEC)

E. Underwriters Laboratories, Inc. (UL):
   98-16 .....Enclosed and Dead-Front Switches
   248 1-11 .....Low Voltage Fuses
   489-13 .....Molded Case Circuit Breakers and Circuit Breaker Enclosures

## PART 2 - PRODUCTS

### 2.1 FUSED SWITCHES RATED 600 AMPERES AND LESS

A. Switches shall be in accordance with NEMA, NEC, UL, as specified, and as shown on the drawings.

B. Shall be NEMA classified General Duty (GD) for 240 V switches, and NEMA classified Heavy Duty (HD) for 480 V switches.

C. Shall be horsepower (HP) rated.

D. Shall have the following features:

1. Switch mechanism shall be the quick-make, quick-break type.
2. Copper blades, visible in the open position.
3. An arc chute for each pole.
4. External operating handle shall indicate open and closed positions, and have lock-open padlocking provisions.
5. Mechanical interlock shall permit opening of the door only when the switch is in the open position, defeatable to permit inspection.
6. Fuse holders for the sizes and types of fuses specified.
7. Solid neutral for each switch being installed in a circuit which includes a neutral conductor.
8. Ground lugs for each ground conductor.
9. Enclosures:
   a. Shall be the NEMA types shown on the drawings.
   b. Where the types of switch enclosures are not shown, they shall be the NEMA types most suitable for the ambient environmental conditions.
   c. Shall be finished with manufacturer’s standard gray baked enamel paint over pretreated steel.

### 2.2 UNFUSED SWITCHES RATED 600 AMPERES AND LESS

A. Shall be the same as fused switches, but without provisions for fuses.

### 2.3 MOTOR RATED TOGGLE SWITCHES

A. Type 1, general purpose for single-phase motors rated up to 1 horsepower.

B. Quick-make, quick-break toggle switch with external reset button and thermal overload protection matched to nameplate full-load current of actual protected motor.

### 2.4 CARTRIDGE FUSES

A. Shall be in accordance with NEMA FU 1.

D. Motor Branch Circuits: Class RK1, time delay.

E. Other Branch Circuits: Class RK1, time delay.

F. Control Circuits: Class CC, fast acting.

**2.5 SEPARATELY-ENCLOSED CIRCUIT BREAKERS**

A. Provide circuit breakers in accordance with the applicable requirements in Section 26 24 16, PANELBOARDS.

B. Enclosures shall be the NEMA types shown on the drawings. Where the types are not shown, they shall be the NEMA type most suitable for the ambient environmental conditions.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

A. Installation shall be in accordance with the NEC, as shown on the drawings, and manufacturer’s instructions.

B. Fused switches shall be furnished complete with fuses. Arrange fuses such that rating information is readable without removing the fuses.

**3.2 ACCEPTANCE CHECKS AND TESTS**

A. Perform in accordance with the manufacturer's recommendations. In addition, include the following:

1. Visual Inspection and Tests:

a. Compare equipment nameplate data with specifications and approved shop drawings.

b. Inspect physical, electrical, and mechanical condition.

c. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method.

d. Vacuum-clean enclosure interior. Clean enclosure exterior.

**3.3 SPARE PARTS**

A. Two weeks prior to the final inspection, furnish one complete set of spare fuses for each fused disconnect switch installed on the project. Deliver the spare fuses to the Resident Engineer.

---END--

**SECTION 26 51 00**
**INTERIOR LIGHTING**

## PART 1 - GENERAL

### 1.1 DESCRIPTION:

A. This section specifies the furnishing, installation, and connection of the interior lighting systems. The terms “lighting fixture,” “fixture,” and “luminaire” are used interchangeably.

### 1.2 RELATED WORK

A. Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT: Disposal of lamps.

B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.

C. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.

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.

E. Section 26 27 26, WIRING DEVICES: Wiring devices used for control of the lighting systems.

### 1.3 QUALITY ASSURANCE

A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

### 1.4 SUBMITTALS

A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:

1. Shop Drawings:
   a. Submit the following information for each type of lighting fixture designated on the LIGHTING FIXTURE SCHEDULE, arranged in order of lighting fixture designation.
   b. Material and construction details, include information on housing and optics system.
   c. Physical dimensions and description.
   d. Wiring schematic and connection diagram.
   e. Installation details.

f. Energy efficiency data.

g. Photometric data based on laboratory tests complying with IES Lighting Measurements testing and calculation guides.

h. Lamp data including lumen output (initial and mean), color rendition index (CRI), rated life (hours), and color temperature (degrees Kelvin).

i. Ballast data including ballast type, starting method, ambient temperature, ballast factor, sound rating, system watts, and total harmonic distortion (THD).

j. For LED lighting fixtures, submit US DOE LED Lighting Facts label, and IES L70 rated life.

2. Manuals:

a. Submit, simultaneously with the shop drawings, complete maintenance and operating manuals, including technical data sheets, wiring diagrams, and information for ordering replacement parts.

b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.

3. Certifications: Two weeks prior to final inspection, submit the following.

a. Certification by the Contractor that the interior lighting systems have been properly installed and tested.

**1.5 APPLICABLE PUBLICATIONS**

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

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

C635/C635M REV A-13.....Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings

C. Environmental Protection Agency (EPA):

40 CFR 261.....Identification and Listing of Hazardous Waste

D. Federal Communications Commission (FCC):

CFR Title 47, Part 15...Radio Frequency Devices

CFR Title 47, Part 18...Industrial, Scientific, and Medical Equipment

E. Illuminating Engineering Society of North America (IESNA):

LM-79-08.....Electrical and Photometric Measurements of Solid-State Lighting Products

LM-80-15.....Measuring Lumen Maintenance of LED Light Sources

LM-82-12.....Characterization of LED Light Engines and LED Lamps for Electrical and Photometric Properties as a Function of Temperature

F. Institute of Electrical and Electronic Engineers (IEEE):

C62.41-91(R1995).....Surge Voltages in Low Voltage AC Power Circuits

G. International Code Council (ICC):

IBC-15.....International Building Code

H. National Electrical Manufacturer's Association (NEMA):

C78.376-14.....Chromaticity of Fluorescent Lamps

C82.1-04(R2015).....Lamp Ballasts – Line Frequency Fluorescent Lamp Ballasts

C82.2-02(R2016).....Method of Measurement of Fluorescent Lamp Ballasts

C82.4-17.....Lamp Ballasts - Ballasts for High-Intensity Discharge and Low-Pressure Sodium (LPS) Lamps (Multiple-Supply Type)

C82.11-17.....Lamp Ballasts - High Frequency Fluorescent Lamp Ballasts

LL 9-11.....Dimming of T8 Fluorescent Lighting Systems

SSL 1-16.....Electronic Drivers for LED Devices, Arrays, or Systems

I. National Fire Protection Association (NFPA):

70-17.....National Electrical Code (NEC)

101-18.....Life Safety Code

J. Underwriters Laboratories, Inc. (UL):

496-17.....Lampholders

542-05.....Fluorescent Lamp Starters

844-12.....Luminaires for Use in Hazardous (Classified) Locations

924-16.....Emergency Lighting and Power Equipment

935-01.....Fluorescent-Lamp Ballasts

1029-94.....High-Intensity-Discharge Lamp Ballasts

1029A-06.....Ignitors and Related Auxiliaries for HID Lamp Ballasts

1598-08.....Luminaires

1574-04.....Track Lighting Systems

2108-15.....Low-Voltage Lighting Systems

8750-15.....Light Emitting Diode (LED) Light Sources for

**PART 2 - PRODUCTS**

**2.1 LIGHTING FIXTURES**

A. Shall be in accordance with NFPA, UL, as shown on drawings, and as specified.

B. Sheet Metal:

1. Shall be formed to prevent warping and sagging. Housing, trim and lens frame shall be true, straight (unless intentionally curved), and parallel to each other as designed.
2. Wireways and fittings shall be free of burrs and sharp edges, and shall accommodate internal and branch circuit wiring without damage to the wiring.
3. When installed, any exposed fixture housing surface, trim frame, door frame, and lens frame shall be free of light leaks.
4. Hinged door frames shall operate smoothly without binding. Latches shall function easily by finger action without the use of tools.

C. Recessed fixtures mounted in an insulated ceiling shall be listed for use in insulated ceilings.

D. Mechanical Safety: Lighting fixture closures (lens doors, trim frame, hinged housings, etc.) shall be retained in a secure manner by captive screws, chains, aircraft cable, captive hinges, or fasteners such that they cannot be accidentally dislodged during normal operation or routine maintenance.

E. Metal Finishes:

1. The manufacturer shall apply standard finish (unless otherwise specified) over a corrosion-resistant primer, after cleaning to free the metal surfaces of rust, grease, dirt and other deposits. Edges of pre-finished sheet metal exposed during forming, stamping or shearing processes shall be finished in a similar corrosion resistant manner to match the adjacent surface(s). Fixture finish

shall be free of stains or evidence of rusting, blistering, or flaking, and shall be applied after fabrication.

2. Interior light reflecting finishes shall be white with not less than 85 percent reflectances, except where otherwise shown on the drawing.
3. Exterior finishes shall be as shown on the drawings.

F. Lighting fixtures shall have a specific means for grounding metallic wireways and housings to an equipment grounding conductor.

**2.2 LED EXIT LIGHT FIXTURES**

A. Exit light fixtures shall meet applicable requirements of NFPA and UL.
B. Housing and door shall be die-cast aluminum.
C. For general purpose exit light fixtures, door frame shall be hinged, with latch. For vandal-resistant exit light fixtures, door frame shall be secured with tamper-resistant screws.
D. Finish shall be satin or fine-grain brushed aluminum.
E. There shall be no radioactive material used in the fixtures.
F. Fixtures:
1. Inscription panels shall be cast or stamped aluminum a minimum of 2.25 mm (0.090 inch) thick, stenciled with 150 mm (6 inch) high letters, baked with red color stable plastic or fiberglass. Lamps shall be luminous Light Emitting Diodes (LED) mounted in center of letters on red color stable plastic or fiberglass.
2. Double-Faced Fixtures: Provide double-faced fixtures where required or as shown on drawings.
3. Directional Arrows: Provide directional arrows as part of the inscription panel where required or as shown on drawings. Directional arrows shall be the "chevron-type" of similar size and width as the letters and meet the requirements of NFPA 101.

G. Voltage: Multi-voltage (120 – 277V).

**2.3 LED LIGHT FIXTURES**

A. General:
1. LED light fixtures shall be in accordance with IES, NFPA, UL, as shown on the drawings, and as specified.
2. LED light fixtures shall be Reduction of Hazardous Substances (RoHS)-compliant.
3. LED drivers shall include the following features unless otherwise indicated:

a. Minimum efficiency: 85% at full load.
b. Minimum Operating Ambient Temperature: -20˚ C. (-4˚ F.)
c. Input Voltage: 120 - 277V (±10%) at 60 Hz.
d. Integral short circuit, open circuit, and overload protection.
e. Power Factor: ≥ 0.95.
f. Total Harmonic Distortion: ≤ 20%.
g. Comply with FCC 47 CFR Part 15.

4. LED modules shall include the following features unless otherwise indicated:
   a. Comply with IES LM-79 and LM-80 requirements.
   b. Minimum CRI 80 and color temperature 3000˚ K unless otherwise specified in LIGHTING FIXTURE SCHEDULE.
   c. Minimum Rated Life: 50,000 hours per IES L70.
   d. Light output lumens as indicated in the LIGHTING FIXTURE SCHEDULE.

B. LED Downlights:
1. Housing, LED driver, and LED module shall be products of the same manufacturer.

C. LED Troffers:
1. LED drivers, modules, and reflector shall be accessible, serviceable, and replaceable from below the ceiling.
2. Housing, LED driver, and LED module shall be products of the same manufacturer.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

A. Installation shall be in accordance with the NEC, manufacturer's instructions, and as shown on the drawings or specified.
B. Align, mount, and level the lighting fixtures uniformly.
C. Wall-mounted fixtures shall be attached to the studs in the walls, or to a 20 gauge metal backing plate that is attached to the studs in the walls. Lighting fixtures shall not be attached directly to gypsum board.
D. Lighting Fixture Supports:
1. Shall provide support for all of the fixtures. Supports may be anchored to channels of the ceiling construction, to the structural

slab or to structural members within a partition, or above a suspended ceiling.

2. Shall maintain the fixture positions after cleaning and relamping.
3. Shall support the lighting fixtures without causing the ceiling or partition to deflect.

E. Furnish and install the new lamps as specified for all lighting fixtures installed under this project, and for all existing lighting fixtures reused under this project.

F. The electrical and ceiling trades shall coordinate to ascertain that approved lighting fixtures are furnished in the proper sizes and installed with the proper devices (hangers, clips, trim frames, flanges, etc.), to match the ceiling system being installed.

G. Bond lighting fixtures to the grounding system as specified in Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

H. At completion of project, replace all defective components of the lighting fixtures at no cost to the Government.

I. Dispose of lamps per requirements of Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT.

**3.2 ACCEPTANCE CHECKS AND TESTS**

A. Perform the following:

1. Visual Inspection:
   a. Verify proper operation by operating the lighting controls.
   b. Visually inspect for damage to fixtures, lenses, reflectors, diffusers, and louvers. Clean fixtures, lenses, reflectors, diffusers, and louvers that have accumulated dust, dirt, or fingerprints during construction.
2. Electrical tests:
   a. Exercise dimming components of the lighting fixtures over full range of dimming capability by operating the control devices(s) in the presence of the Resident Engineer. Observe for visually detectable flicker over full dimming range, and replace defective components at no cost to the Government.
   b. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Government. Burn-in period to be 40 hours minimum, unless specifically recommended otherwise by the lamp manufacturer. Burn-in dimmed fluorescent and compact

fluorescent lamps for at least 100 hours at full voltage, unless specifically recommended otherwise by the lamp manufacturer. Replace any lamps and ballasts which fail during burn-in.

**3.3 FOLLOW-UP VERIFICATION**

A. Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that the lighting systems are in good operating condition and properly performing the intended function.

---END--

# SECTION 27 05 11
# REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS

## PART 1 - GENERAL

### 1.1 DESCRIPTION

A. This section includes common requirements to communications installations and applies to all sections of Division 27.

B. Provide completely functioning communications systems.

C. Comply with VAAR 852.236.91 and FAR clause 52.236-21 in circumstance of a need for additional detail or conflict between drawings, specifications, reference standards or code.

### 1.2 REFERENCES

A. Abbreviations and Acronyms

1. Refer to http://www.cfm.va.gov/til/sdetail.asp for Division 00, ARCHITECTURAL ABBREVIATIONS.
2. Additional Abbreviations and Acronyms:

| | |
|---|---|
| A | Ampere |
| AC | Alternating Current |
| AE | Architect and Engineer |
| AFF | Above Finished Floor |
| AHJ | Authority Having Jurisdiction |
| ANSI | American National Standards Institute |
| AWG | American Wire Gauge (refer to STP and UTP) |
| AWS | Advanced Wireless Services |
| BCT | Bonding Conductor for Telecommunications (also Telecommunications Bonding Conductor (TBC)) |
| BDA | Bi-Directional Amplifier |
| BICSI | Building Industry Consulting Service International |
| BIM | Building Information Modeling |
| BOM | Bill of Materials |
| BTU | British Thermal Units |
| BUCR | Back-up Computer Room |
| BTS | Base Transceiver Station |
| CAD | AutoCAD |

| | |
|---|---|
| CBOPC | Community Based Out Patient Clinic |
| CBC | Coupled Bonding Conductor |
| CBOC | Community Based Out Patient Clinic (refer to CBOPC, OPC, VAMC) |
| CCS | TIP's Cross Connection System (refer to VCCS and HCCS) |
| CFE | Contractor Furnished Equipment |
| CFM | US Department of Veterans Affairs Office of Construction and Facilities Management |
| CFR | Consolidated Federal Regulations |
| CIO | Communication Information Officer (Facility, VISN or Region) |
| cm | Centimeters |
| CO | Central Office |
| COR | Contracting Officer Representative |
| CPU | Central Processing Unit |
| CSU | Customer Service Unit |
| CUP | Conditional Use Permit(s) - Federal/GSA for VA |
| dB | Decibel |
| dBm | Decibel Measured |
| dBmV | Decibel per milli-Volt |
| DC | Direct Current |
| DEA | United States Drug Enforcement Administration |
| DSU | Data Service Unit |
| EBC | Equipment Bonding Conductor |
| ECC | Engineering Control Center (refer to DCR, EMCR) |
| EDGE | Enhanced Data (Rates) for GSM Evolution |
| EDM | Electrical Design Manual |
| EMCR | Emergency Management Control Room (refer to DCR, ECC) |
| EMI | Electromagnetic Interference (refer to RFI) |
| EMS | Emergency Medical Service |

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|---|---|
| EMT | Electrical Metallic Tubing or thin wall conduit |
| ENTR | Utilities Entrance Location (refer to DEMARC, POTS, LEC) |
| EPBX | Electronic Digital Private Branch Exchange |
| ESR | Vendor’s Engineering Service Report |
| FA | Fire Alarm |
| FAR | Federal Acquisition Regulations in Chapter 1 of Title 48 of Code of Federal Regulations |
| FMS | VA’s Headquarters or Medical Center Facility’s Management Service |
| FR | Frequency (refer to RF) |
| FTS | Federal Telephone Service |
| GFE | Government Furnished Equipment |
| GPS | Global Positioning System |
| GRC | Galvanized Rigid Metal Conduit |
| GSM | Global System (Station) for Mobile |
| HCCS | TIP’s Horizontal Cross Connection System (refer to CCS & VCCS) |
| HDPE | High Density Polyethylene Conduit |
| HDTV | Advanced Television Standards Committee High-Definition Digital Television |
| HEC | Head End Cabinets(refer to HEIC, PA) |
| HEIC | Head End Interface Cabinets(refer to HEC, PA) |
| HF | High Frequency (Radio Band; Re FR, RF, VHF & UHF) |
| HSPA | High Speed Packet Access |
| HZ | Hertz |
| IBT | Intersystem Bonding Termination (NEC 250.94) |
| IC | Intercom |
| ICRA | Infectious Control Risk Assessment |
| IDEN | Integrated Digital Enhanced Network |
| IDC | Insulation Displacement Contact |

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|---|---|
| IDF | Intermediate Distribution Frame |
| ILSM | Interim Life Safety Measures |
| IMC | Rigid Intermediate Steel Conduit |
| IRM | Department of Veterans Affairs Office of Information Resources Management |
| ISDN | Integrated Services Digital Network |
| ISM | Industrial, Scientific, Medical |
| IWS | Intra-Building Wireless System |
| LAN | Local Area Network |
| LBS | Location Based Services, Leased Based Systems |
| LEC | Local Exchange Carrier (refer to DEMARC, PBX & POTS) |
| LED | Light Emitting Diode |
| LMR | Land Mobile Radio |
| LTE | Long Term Evolution, or 4G Standard for Wireless Data Communications Technology |
| M | Meter |
| MAS | Medical Administration Service |
| MATV | Master Antenna Television |
| MCR | Main Computer Room |
| MCOR | Main Computer Operators Room |
| MDF | Main Distribution Frame |
| MH | Manholes or Maintenance Holes |
| MHz | Megaherts ($10^6$ Hz) |
| mm | Millimeter |
| MOU | Memorandum of Understanding |
| MW | Microwave (RF Band, Equipment or Services) |
| NID | Network Interface Device (refer to DEMARC) |
| NEC | National Electric Code |
| NOR | Network Operations Room |
| NRTL | OSHA Nationally Recognized Testing Laboratory |
| NS | Nurse Stations |

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| NTIA | U.S. Department of Commerce National Telecommunications and Information Administration |
| OEM | Original Equipment Manufacturer |
| OI&T | Office of Information and Technology |
| OPC | VA's Outpatient Clinic (refer to CBOC, VAMC) |
| OSH | Department of Veterans Affairs Office of Occupational Safety and Health |
| OSHA | United States Department of Labor Occupational Safety and Health Administration |
| OTDR | Optical Time-Domain Reflectometer |
| PA | Public Address System (refer to HE, HEIC, RPEC) |
| PBX | Private Branch Exchange (refer to DEMARC, LEC, POTS) |
| PCR | Police Control Room (refer to SPCC, could be designated SCC) |
| PCS | Personal Communications Service (refer to UPCS) |
| PE | Professional Engineer |
| PM | Project Manager |
| PoE | Power over Ethernet |
| POTS | Plain Old Telephone Service (refer to DEMARC, LEC, PBX) |
| PSTN | Public Switched Telephone Network |
| PSRAS | Public Safety Radio Amplification Systems |
| PTS | Pay Telephone Station |
| PVC | Poly-Vinyl Chloride |
| PWR | Power (in Watts) |
| RAN | Radio Access Network |
| RBB | Rack Bonding Busbar |
| RE | Resident Engineer or Senior Resident Engineer |
| RF | Radio Frequency (refer to FR) |
| RFI | Radio Frequency Interference (refer to EMI) |
| RFID | RF Identification (Equipment, System or Personnel) |

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|---|---|
| RMC | Rigid Metal Conduit |
| RMU | Rack Mounting Unit |
| RPEC | Radio Paging Equipment Cabinets(refer to HEC, HEIC, PA) |
| RTLS | Real Time Location Service or System |
| RUS | Rural Utilities Service |
| SCC | Security Control Console (refer to PCR, SPCC) |
| SMCS | Spectrum Management and Communications Security (COMSEC) |
| SFO | Solicitation for Offers |
| SME | Subject Matter Experts (refer to AHJ) |
| SMR | Specialized Mobile Radio |
| SMS | Security Management System |
| SNMP | Simple Network Management Protocol |
| SPCC | Security Police Control Center (refer to PCR, SMS) |
| STP | Shielded Balanced Twisted Pair (refer to UTP) |
| STR | Stacked Telecommunications Room |
| TAC | VA’s Technology Acquisition Center, Austin, Texas |
| TCO | Telecommunications Outlet |
| TER | Telephone Equipment Room |
| TGB | Telecommunications Grounding Busbar (also Secondary Bonding Busbar (SBB)) |
| TIP | Telecommunications Infrastructure Plant |
| TMGB | Telecommunications Main Grounding Busbar (also Primary Bonding Busbar (PBB)) |
| TMS | Traffic Management System |
| TOR | Telephone Operators Room |
| TP | Balanced Twisted Pair (refer to STP and UTP) |
| TR | Telecommunications Room (refer to STR) |
| TWP | Twisted Pair |
| UHF | Ultra High Frequency (Radio) |

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| UMTS | Universal Mobile Telecommunications System |
| UPCS | Unlicensed Personal Communications Service (refer to PCS) |
| UPS | Uninterruptible Power Supply |
| USC | United States Code |
| UTP | Unshielded Balanced Twisted Pair (refer to TP and STP) |
| UV | Ultraviolet |
| V | Volts |
| VAAR | Veterans Affairs Acquisition Regulation |
| VACO | Veterans Affairs Central Office |
| VAMC | VA Medical Center (refer to CBOC, OPC, VACO) |
| VCCS | TIP's Vertical Cross Connection System (refer to CCS and HCCS) |
| VHF | Very High Frequency (Radio) |
| VISN | Veterans Integrated Services Network (refers to geographical region) |
| VSWR | Voltage Standing Wave Radio |
| W | Watts |
| WEB | World Electronic Broadcast |
| WiMAX | Worldwide Interoperability (for MW Access) |
| WI-FI | Wireless Fidelity |
| WMTS | Wireless Medical Telemetry Service |
| WSP | Wireless Service Providers |

B. Definitions:

1. Access Floor: Pathway system of removable floor panels supported on adjustable pedestals to allow cable placement in area below.
2. BNC Connector (BNC): United States Military Standard MIL-C-39012/21 bayonet-type coaxial connector with quick twist mating/unmating, and two lugs preventing accidental disconnection from pulling forces on cable.

3. Bond: Permanent joining of metallic parts to form an electrically conductive path to ensure electrical continuity and capacity to safely conduct any currents likely to be imposed to earth ground.
4. Bundled Microducts: All forms of jacketed microducts.
5. Conduit: Includes all raceway types specified.
6. Conveniently Accessible: Capable of being reached without use of ladders, or without climbing or crawling under or over obstacles such as, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.
7. Distributed (in house) Antenna System (DAS): An Emergency Radio Communications System installed for Emergency Responder (or first responders and Government personnel) use while inside facility to maintain contact with each respective control point; refer to Section 27 53 19, DISTRIBUTED RADIO ANTENNA (WITHIN BUILDING) EQUIPMENT AND SYSTEMS.
8. DEMARC, Extended DMARC or ENTR: Service provider's main point of demarcation owned by LEC or service provider and establishes a physical point where service provider's responsibilities for service and maintenance end. This point is called NID, in data networks.
9. Effectively Grounded: Intentionally bonded to earth through connections of low impedance having current carrying capacity to prevent buildup of currents and voltages resulting in hazard to equipment or persons.
10. Electrical Supervision: Analyzing a system’s function and components (i.e. cable breaks / shorts, inoperative stations, lights, LEDs and states of change, from primary to backup) on a 24/7/365 basis; provide aural and visual emergency notification signals to minimum two remote designated or accepted monitoring stations.
11. Electrostatic Interference (ESI) or Electrostatic Discharge Interference: Refer to EMI and RFI.
12. Emergency Call Systems: Wall units (in parking garages and stairwells) and pedestal mounts (in parking lots) typically provided with a strobe, camera and two-way audio communication functions.
13. Project 25 (2014) (P25 (TIA-102 Series)): Set of standards for local, state and Federal public safety organizations and agencies digital LMR services. P25 is applicable to LMR equipment authorized

or licensed under the US Department of Commerce National Telecommunications and Information Administration or FCC rules and regulations, and is a required standard capability for all LMR equipment and systems.

14. Grounding Electrode Conductor: (GEC) Conductor connected to earth grounding electrode.
15. Grounding Electrode System: Electrodes through which an effective connection to earth is established, including supplementary, communications system grounding electrodes and GEC.
16. Grounding Equalizer or Backbone Bonding Conductor (BBC): Conductor that interconnects elements of telecommunications grounding infrastructure.
17. Head End (HE): Equipment, hardware and software, or a master facility at originating point in a communications system designed for centralized communications control, signal processing, and distribution that acts as a common point of connection between equipment and devices connected to a network of interconnected equipment, possessing greatest authority for allowing information to be exchanged, with whom other equipment is subordinate.
18. Microducts: All forms of air blown fiber pathways.
19. Ohm: A unit of restive measurement.
20. Received Signal Strength Indication (RSSI): A measurement of power present in a received RF signal.
21. Service Provider Demarcation Point (SPDP): Not owned by LEC or service provider, but designated by Government as point within facility considered the DEMARC.
22. Sound (SND): Changing air pressure to audible signals over given time span.
23. System: Specific hardware, firmware, and software, functioning together as a unit, performing task for which it was designed.
24. Telecommunications Bonding Backbone (TBB): Conductors of appropriate size (minimum 53.49 mm2 [1/0 AWG]) stranded copper wire, that connect to Grounding Electrode System and route to telecommunications main grounding busbar (TMGB) and circulate to interconnect various TGBs and other locations shown on drawings.

25. Voice over Internet Protocol (VoIP): A telephone system in which voice signals are converted to packets and transmitted over LAN network using Transmission Control Protocol (TCP)/Internet Protocol (IP). VA'S VoIP is not listed or coded for life and public safety, critical, emergency or other protection functions. When VoIP system or equipment is provided instead of PBX system or equipment, each TR (STR) and DEMARC requires increased AC power provided to compensate for loss of PBX's telephone instrument line power; and, to compensate for absence of PBX's UPS capability.
26. Wide Area Network (WAN): A digital network that transcends localized LANs within a given geographic location. VA'S WAN/LAN is not nationally listed or coded for life and public safety, critical, emergency or other safety functions.

**1.3 APPLICABLE PUBLICATIONS**

A. Applicability of Standards: Unless documents include more stringent requirements, applicable construction industry standards have same force and effect as if bound or copied directly into the documents to extent referenced. Such standards are made a part of these documents by reference.
   1. Each entity engaged in construction must be familiar with industry standards applicable to its construction activity.
   2. Obtain standards directly from publication source, where copies of standards are needed to perform a required construction activity.

B. Government Codes, Standards and Executive Orders: Refer to http://www.cfm.va.gov/TIL/cPro.asp:
   1. Federal Communications Commission, (FCC) CFR, Title 47:

| | |
|---|---|
| Part 15 | Restrictions of use for Part 15 listed RF Equipment in Safety of Life Emergency Functions and Equipment Locations |
| Part 47 | Chapter A, Paragraphs 6.1-6.23, Access to Telecommunications Service, Telecommunications Equipment and Customer Premises Equipment |
| Part 58 | Television Broadcast Service |
| Part 73 | Radio and Television Broadcast Rules |
| Part 90 | Rules and Regulations, Appendix C |

| | |
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| Form 854 | Antenna Structure Registration |
| Chapter XXIII | National Telecommunications and Information Administration (NTIA, P/O Commerce, Chapter XXIII) the 'Red Book'- Chapters 7, 8 & 9 compliments CFR, Title 47, FCC Part 15, RF Restriction of Use and Compliance in "Safety of Life" Functions & Locations |

2. US Department of Agriculture, (Title 7, USC, Chapter 55, Sections 2201, 2202 & 2203:RUS 1755 Telecommunications Standards and Specifications for Materials, Equipment and Construction:

| | |
|---|---|
| RUS Bull 1751F-630 | Design of Aerial Cable Plants |
| RUS Bull 1751F-640 | Design of Buried Cable Plant, Physical Considerations |
| RUS Bull 1751F-643 | Underground Plant Design |
| RUS Bull 1751F-815 | Electrical Protection of Outside Plants, |
| RUS Bull 1753F-201 | Acceptance Tests of Telecommunications Plants (PC-4) |
| RUS Bull 1753F-401 | Splicing Copper and Fiber Optic Cables (PC-2) |
| RUS Bull 345-50 | Trunk Carrier Systems (PE-60) |
| RUS Bull 345-65 | Shield Bonding Connectors (PE-65) |
| RUS Bull 345-72 | Filled Splice Closures (PE-74) |
| RUS Bull 345-83 | Gas Tube Surge Arrestors (PE-80) |

3. US Department of Commerce/National Institute of Standards Technology,(NIST):

| | |
|---|---|
| FIPS PUB 1-1 | Telecommunications Information Exchange |
| FIPS PUB 100/1 | Interface between Data Terminal Equipment (DTE) Circuit Terminating Equipment for operation with Packet Switched Networks, or Between Two DTEs, by Dedicated Circuit |
| FIPS PUB 140/2 | Telecommunications Information Security Algorithms |
| FIPS PUB 143 | General Purpose 37 Position Interface between DTE and Data Circuit Terminating Equipment |
| FIPS 160/2 | Electronic Data Interchange (EDI), |
| FIPS 175 | Federal Building Standard for Telecommunications Pathway and Spaces |

| | |
|---|---|
| FIPS 191 | Guideline for the Analysis of Local Area Network Security |
| FIPS 197 | Advanced Encryption Standard (AES) |
| FIPS 199 | Standards for Security Categorization of Federal Information and Information Systems |

4. US Department of Defense, (DoD):

| | |
|---|---|
| MIL-STD-188-110 | Interoperability and Performance Standards for Data Modems |
| MIL-STD-188-114 | Electrical Characteristics of Digital Interface Circuits |
| MIL-STD-188-115 | Communications Timing and Synchronizations Subsystems |
| MIL-C-28883 | Advanced Narrowband Digital Voice Terminals |
| MIL-C-39012/21 | Connectors, Receptacle, Electrical, Coaxial, Radio Frequency, (Series BNC (Uncabled), Socket Contact, Jam Nut Mounted, Class 2) |

5. US Department of Health and Human Services:
   The Health Insurance Portability and Accountability Act of 1996 (HIPAA) Privacy, Security and Breach Notification Rules
6. US Department of Justice:
   2010 Americans with Disabilities Act Standards for Accessible Design (ADAAD).
7. US Department of Labor, (DoL) - Public Law 426-62 – CFR, Title 29, Part 1910, Chapter XVII - Occupational Safety and Health Administration (OSHA), Occupational Safety and Health Standards):

| | |
|---|---|
| Subpart 7 | Approved NRTLs; obtain a copy at https://www.osha.gov/dts/otpca/nrtl/nrtllist.html |
| Subpart 35 | Compliance with NFPA 101, Life Safety Code |
| Subpart 36 | Design and Construction Requirements for Exit Routes |
| Subpart 268 | Telecommunications |
| Subpart 305 | Wiring Methods, Components, and Equipment for General Use |
| Subpart 508 | Americans with Disabilities Act Accessibility Guidelines; technical requirement for |

accessibility to buildings and facilities by individuals with disabilities

8. US Department of Transportation, (DoT):
   a. Public Law 85-625, CFR, Title 49, Part 1, Subpart C – Federal Aviation Administration (FAA):AC 110/460-ID & AC 707 / 460-2E – Advisory Circulars Standards for Construction of Antenna Towers, and 7450 and 7460-2 – Antenna Construction Registration Forms.
9. US Department of Veterans Affairs (VA): Office of Telecommunications (OI&T), MP-6, PART VIII, TELECOMMUNICATIONS, CHAPTER 5, AUDIO, RADIO AND TELEVISION (and COMSEC) COMMUNICATIONS SYSTEMS: Spectrum Management and COMSEC Service (SMCS), AHJ for:
   a. CoG, "Continuance of Government" communications guidelines and compliance.
   b. COMSEC,"VA wide coordination and control of security classified communication assets."
   c. COOP, "Continuance of Operations" emergency communications guidelines and compliance.
   d. FAA, FCC, and US Department of Commerce National Telecommunications and Information Administration, "VA wide RF Co-ordination, Compliance and Licensing."
   e. Handbook 6100 – Telecommunications: Cyber and Information Security Office of Cyber and Information Security, and Handbook 6500 – Information Security Program.
   f. Low Voltage Special Communications Systems "Design, Engineering, Construction Contract Specifications and Drawings Conformity, Proof of Performance Testing, VA Compliance and Life Safety Certifications for CFM and VA Facility Low Voltage Special Communications Projects (except Fire Alarm, Telephone and Data Systems)."
   g. SATCOM, "Satellite Communications" guidelines and compliance, and Security and Law Enforcement Systems – "Coordinates the Design, Engineering, Construction Contract Specifications and Drawings Conformity, Proof of Performance Testing, VA Compliance, DEA and Public Safety Certification(s) for CFM and VA Facility Security Low Voltage Special Communications and Physical Security Projects.

h. VHA's National Center for Patient Safety – Veterans Health Administration (VHA) Warning System, Failure of Medical Alarm Systems using Paging Technology to Notify Clinical Staff, July 2004.

i. VA's CEOSH, concurrence with warning identified in VA Directive 7700.

j. Wireless and Handheld Devices, "Guidelines and Compliance,"

k. Office of Security and Law Enforcement: VA Directive 0730 and Health Special Presidential Directive (HSPD)-12.

C. NRTL Standards: Refer to https://www.osha.gov/laws-regs/regulations/standardnumber/1926

1. Canadian Standards Association (CSA); same tests as presented by UL
2. Communications Certifications Laboratory (CEL); same tests as presented by UL.
3. Intertek Testing Services NA, Inc., (ITSNA), formerly Edison Testing Laboratory (ETL) same tests as presented by UL).
4. Underwriters Laboratory (UL):

| | |
|---|---|
| 1-2005 | Flexible Metal Conduit |
| 5-2011 | Surface Metal Raceway and Fittings |
| 6-2007 | Rigid Metal Conduit |
| 44-010 | Thermoset-Insulated Wires and Cables |
| 50-1995 | Enclosures for Electrical Equipment |
| 65-2010 | Wired Cabinets |
| 83-2008 | Thermoplastic-Insulated Wires and Cables |
| 96-2005 | Lightning Protection Components |
| 96A-2007 | Installation Requirements for Lightning Protection Systems |
| 360-2013 | Liquid-Tight Flexible Steel Conduit |
| 444-2008 | Communications Cables |
| 467-2013 | Grounding and Bonding Equipment |
| 486A-486B-2013 | Wire Connectors |
| 486C-2013 | Splicing Wire Connectors |
| 486D-2005 | Sealed Wire Connector Systems |
| 486E-2009 | Standard for Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors |

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|---|---|
| 493-2007 | Thermoplastic-Insulated Underground Feeder and Branch Circuit Cable |
| 497/497A/497B/497C | |
| 497D/497E | Protectors for Paired Conductors/Communications Circuits/Data Communications and Fire Alarm Circuits/coaxial circuits/voltage protections/Antenna Lead In |
| 510-2005 | Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape |
| 514A-2013 | Metallic Outlet Boxes |
| 514B-2012 | Fittings for Cable and Conduit |
| 514C-1996 | Nonmetallic Outlet Boxes, Flush-Device Boxes and Covers |
| 651-2011 | Schedule 40 and 80 Rigid PVC Conduit |
| 651A-2011 | Type EB and A Rigid PVC Conduit and HDPE Conduit |
| 797-2007 | Electrical Metallic Tubing |
| 884-2011 | Underfloor Raceways and Fittings |
| 1069-2007 | Hospital Signaling and Nurse Call Equipment |
| 1242-2006 | Intermediate Metal Conduit |
| 1449-2006 | Standard for Transient Voltage Surge Suppressors |
| 1479-2003 | Fire Tests of Through-Penetration Fire Stops |
| 1480-2003 | Speaker Standards for Fire Alarm, Emergency, Commercial and Professional use |
| 1666-2007 | Standard for Wire/Cable Vertical (Riser) Tray Flame Tests |
| 1685-2007 | Vertical Tray Fire Protection and Smoke Release Test for Electrical and Fiber Optic Cables |
| 1861-2012 | Communication Circuit Accessories |
| 1863-2013 | Standard for Safety, communications Circuits Accessories |
| 1865-2007 | Standard for Safety for Vertical-Tray Fire Protection and Smoke-Release Test for Electrical and Optical-Fiber Cables |
| 2024-2011 | Standard for Optical Fiber Raceways |

| | |
|---|---|
| 2024-2014 | Standard for Cable Routing Assemblies and Communications Raceways |
| 2196-2001 | Standard for Test of Fire Resistive Cable |
| 60950-1 ed. 2-2014 | Information Technology Equipment Safety |

D. Industry Standards:

1. Advanced Television Systems Committee (ATSC):

| | |
|---|---|
| A/53 Part 1: 2013 | ATSC Digital Television Standard, Part 1, Digital Television System |
| A/53 Part 2: 2011 | ATSC Digital Television Standard, Part 2, RF/Transmission System Characteristics |
| A/53 Part 3: 2013 | ATSC Digital Television Standard, Part 3, Service Multiplex and Transport System Characteristics |
| A/53 Part 4: 2009 | ATSC Digital Television Standard, Part 4, MPEG-2 Video System Characteristics |
| A/53 Part 5: 2014 | ATSC Digital Television Standard, Part 5, AC-3 Audio System Characteristics |
| A/53 Part 6: 2014 | ATSC digital Television Standard, Part 6, Enhanced AC-3 Audio System Characteristics |

2. American Institute of Architects (AIA): 2006 Guidelines for Design & Construction of Health Care Facilities.

3. American Society of Mechanical Engineers (ASME):

| | |
|---|---|
| A17.1 (2013) | Safety Code for Elevators and Escalators Includes Requirements for Elevators, Escalators, Dumbwaiters, Moving Walks, Material Lifts, and Dumbwaiters with Automatic Transfer Devices |
| 17.3 (2011) | Safety Code for Existing Elevators and Escalators |
| 17.4 (2009) | Guide for Emergency Personnel |
| 17.5 (2011) | Elevator and Escalator Electrical Equipment |

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

| | |
|---|---|
| B1 (2001) | Standard Specification for Hard-Drawn Copper Wire |

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|---|---|
| B8 (2004) | Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft |
| D1557 (2012) | Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort 56,000 ft-lbf/ft3 (2,700 kN-m/m3) |
| D2301 (2004) | Standard Specification for Vinyl Chloride Plastic Pressure Sensitive Electrical Insulating Tape |
| B258-02 (2008) | Standard Specification for Standard Nominal Diameters and Cross-Sectional Areas of AWG Sizes of Solid Round Wires Used as Electrical Conductors |
| D709-01(2007) | Standard Specification for Laminated Thermosetting Materials |
| D4566 (2008) | Standard Test Methods for Electrical Performance Properties of Insulations and Jackets for Telecommunications Wire and Cable |

5. American Telephone and Telegraph Corporation (AT&T) - Obtain following AT&T Publications at https://ebiznet.sbc.com/sbcnebs/

| | |
|---|---|
| ATT-TP-76200 (2013) | Network Equipment and Power Grounding, Environmental, and Physical Design Requirements |
| ATT-TP-76300(2012) | Merged AT&T Affiliate Companies Installation Requirements |
| ATT-TP-76305 (2013) | Common Systems Cable and Wire Installation and Removal Requirements - Cable Racks and Raceways |
| ATT-TP-76306 (2009) | Electrostatic Discharge Control |
| ATT-TP-76400 (2012) | Detail Engineering Requirements |
| ATT-TP-76402 (2013) | AT&T Raised Access Floor Engineering and Installation Requirements |
| ATT-TP-76405 (2011) | Technical Requirements for Supplemental Cooling Systems in Network Equipment Environments |
| ATT-TP-76416 (2011) | Grounding and Bonding Requirements for Network Facilities |
| ATT-TP-76440 (2005) | Ethernet Specification |

ATT-TP-76450 (2013) Common Systems Equipment Interconnection Standards for AT&T Network Equipment Spaces

ATT-TP-76461 (2008) Fiber Optic Cleaning

ATT-TP-76900 (2010) AT&T Installation Testing Requirement

ATT-TP-76911 (1999) AT&T LEC Technical Publication Notice

6. British Standards Institution (BSI):

BS EN 50109-2 Hand Crimping Tools - Tools for The Crimp Termination of Electric Cables and Wires for Low Frequency and Radio Frequency Applications – All Parts & Sections. October 1997

7. Building Industry Consulting Service International(BICSI):

ANSI/BICSI 002-2011 Data Center Design and Implementation Best Practices

ANSI/BICSI 004-2012 Information Technology Systems Design and Implementation Best Practices for Healthcare Institutions and Facilities

ANSI/NECA/BICSI 568-2006 Standard for Installing Commercial Building Telecommunications Cabling

NECA/BICSI 607-2011 Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings

ANSI/BICSI 005-2013 Electronic Safety and Security (ESS) System Design and Implementation Best Practices

8. Electronic Components Assemblies and Materials Association,(ECA).

ECA EIA/RS-270 (1973) Tools, Crimping, Solderless Wiring Devices – Recommended Procedures for User Certification

EIA/ECA 310-E (2005) Cabinets, and Associated Equipment

9. Facility Guidelines Institute: 2010 Guidelines for Design and Construction of Health Care Facilities.

10. Insulated Cable Engineers Association (ICEA):

ANSI/ICEA S-80-576-2002 Category 1 & 2 Individually Unshielded Twisted-Pair Indoor Cables for Use in Communications Wiring Systems

ANSI/ICEA

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|---|---|
| S-84-608-2010 | Telecommunications Cable, Filled Polyolefin Insulated Copper Conductor, S-87-640(2011) Optical Fiber Outside Plant Communications Cable |
| ANSI/ICEA | |
| S-90-661-2012 | Category 3, 5, & 5e Individually Unshielded Twisted-Pair Indoor Cable for Use in General Purpose and LAN Communication Wiring Systems |
| S-98-688 (2012) | Broadband Twisted Pair Cable Aircore, Polyolefin Insulated, Copper Conductors |
| S-99-689 (2012) | Broadband Twisted Pair Cable Filled, Polyolefin Insulated, Copper Conductors |
| ICEA S-102-700 | |
| (2004) | Category 6 Individually Unshielded Twisted Pair Indoor Cables (With or Without an Overall Shield) for use in Communications Wiring Systems Technical Requirements |

11. Institute of Electrical and Electronics Engineers (IEEE):

| | |
|---|---|
| ISSN 0739-5175 | March-April 2008 Engineering in Medicine and Biology Magazine, IEEE (Volume: 27, Issue:2) Medical Grade-Mission Critical-Wireless Networks |
| IEEE C2-2012 | National Electrical Safety Code (NESC) |
| C62.41.2-2002/ | |
| Cor 1-2012 IEEE | Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits 4) |
| C62.45-2002 | IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits |
| 81-2012 IEEE | Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System |
| 100-1992 | IEEE the New IEEE Standards Dictionary of Electrical and Electronics Terms |

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|---|---|
| 602-2007 | IEEE Recommended Practice for Electric Systems in Health Care Facilities |
| 1100-2005 | IEEE Recommended Practice for Powering and Grounding Electronic Equipment |

12. International Code Council:

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|---|---|
| AC193 (2014) | Mechanical Anchors in Concrete Elements |

13. International Organization for Standardization (ISO):

| | |
|---|---|
| ISO/TR 21730 (2007) | Use of Mobile Wireless Communication and Computing Technology in Healthcare Facilities - Recommendations for Electromagnetic Compatibility (Management of Unintentional Electromagnetic Interference) with Medical Devices |

14. National Electrical Manufacturers Association (NEMA):

| | |
|---|---|
| NEMA 250 (2008) | Enclosures for Electrical Equipment (1,000V Maximum) |
| ANSI C62.61 (1993) | American National Standard for Gas Tube Surge Arresters on Wire Line Telephone Circuits |
| ANSI/NEMA FB 1 (2012) | Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing EMT) and Cable |
| ANSI/NEMA OS 1 (2009) | Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports |
| NEMA SB 19 (R2007) | NEMA Installation Guide for Nurse Call Systems |
| TC 3 (2004) | Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing |
| NEMA VE 2 (2006) | Cable Tray Installation Guidelines |

15. National Fire Protection Association (NFPA):

| | |
|---|---|
| 70E-2015 | Standard for Electrical Safety in the Workplace |
| 70-2014 | National Electrical Code (NEC) |
| 72-2013 | National Fire Alarm Code |
| 75-2013 | Standard for the Fire Protection of Information Technological Equipment |
| 76-2012 | Recommended Practice for the Fire Protection of Telecommunications Facilities |
| 77-2014 | Recommended Practice on Static Electricity |

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|---|---|
| 90A-2015 | Standard for the Installation of Air Conditioning and Ventilating Systems |
| 99-2015 | Health Care Facilities Code |
| 101-2015 | Life Safety Code |
| 241 | Safeguarding construction, alternation and Demolition Operations |
| 255-2006 | Standard Method of Test of Surface Burning Characteristics of Building Materials |
| 262 - 2011 | Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces |
| 780-2014 | Standard for the Installation of Lightning Protection Systems |
| 1221-2013 | Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems |
| 5000-2015 | Building Construction and Safety Code |

16. Society for Protective Coatings (SSPC):
    SSPC SP 6/NACE No.3 (2007) Commercial Blast Cleaning
17. Society of Cable Telecommunications Engineers (SCTE):

| | |
|---|---|
| ANSI/SCTE 15 2006 | Specification for Trunk, Feeder and Distribution Coaxial Cable |

18. Telecommunications Industry Association (TIA):

| | |
|---|---|
| TIA-120 Series | Telecommunications Land Mobile communications (APCO/Project 25) (January 2014) |
| TIA TSB-140 | Additional Guidelines for Field-Testing Length, Loss and Polarity of Optical Fiber Cabling Systems (2004) |
| TIA-155 | Guidelines for the Assessment and Mitigation of Installed Category 6 Cabling to Support 10GBASE-T (2010) |
| TIA TSB-162-A | Telecommunications Cabling Guidelines for Wireless Access Points (2013) |
| TIA-222-G | Structural Standard for Antenna Supporting Structures and Antennas (2014) |

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|---|---|
| TIA/EIA-423-B | Electrical Characteristics of Unbalanced Voltage Digital Interface Circuits (2012) |
| TIA-455-C | General Requirements for Standard Test Procedures for Optical Fibers, Cables, Transducers, Sensors, Connecting and Terminating Devices, and other Fiber Optic Components (August 2014) |
| TIA-455-53-A | FOTP-53 Attenuation by Substitution Measurements for Multimode Graded-Index Optical Fibers in Fiber Assemblies (Long Length) (September 2001) |
| TIA-455-61-A | FOTP-61 Measurement of Fiber of Cable Attenuation Using an OTDR (July 2003) |
| TIA-472D000-B | Fiber Optic Communications Cable for Outside Plant Use (July 2007) |
| ANSI/TIA-492-B | 62.5-µ Core Diameter/125-um Cladding Diameter Class 1a Graded-Index Multimode Optical Fibers (November 2009) |
| ANSI/TIA-492AAAB-A | 50-um Core Diameter/125-um Cladding Diameter Class IA Graded-Index Multimode Optically Optimized American Standard Fibers (November 2009 |
| TIA-492CAAA | Detail Specification for Class IVa Dispersion-Unshifted Single-Mode Optical Fibers (September 2002) |
| TIA-492E000 | Sectional Specification for Class IVd Nonzero-Dispersion Single-Mode Optical Fibers for the 1,550 nm Window (September 2002) |
| TIA-526-7-B | Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant – OFSTP-7 (December 2008) |
| TIA-526.14-A | Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant – SFSTP-14 (August 1998) |
| TIA-568 | Revision/Edition: C Commercial Building Telecommunications Cabling Standard Set: (TIA- |

| | |
|---|---|
| | 568-C.0-2 Generic Telecommunications Cabling for Customer Premises (2012), TIA-568-C.1-1 Commercial Building Telecommunications Cabling Standard Part 1: General Requirements (2012), TIA-568-C.2 Commercial Building Telecommunications Cabling Standard—Part 2: Balanced Twisted Pair Cabling Components (2009), TIA-568-C.3-1 Optical Fiber Cabling Components Standard, (2011) AND TIA-568-C.4 Broadband Coaxial Cabling and Components Standard (2011) with addendums and erratas |
| TIA-569 | Revision/Edition C Telecommunications Pathways and Spaces (March 2013) |
| TIA-574 | Position Non-Synchronous Interface between Data Terminal equipment and Data Circuit Terminating Equipment Employing Serial Binary Interchange (May 2003) |
| TIA/EIA-590-A | Standard for Physical Location and Protection of Below Ground Fiber Optic Cable Plant (July 2001) |
| TIA-598-D | Optical Fiber Cable Color Coding (January 2005) |
| TIA-604-10-B | Fiber Optic Connector Intermateablility Standard (August 2008) |
| ANSI/TIA-606-B | Administration Standard for Telecommunications Infrastructure (2012) |
| TIA-607-B | Generic Telecommunications Bonding and Grounding (Earthing) For Customer Premises (January 2013) |
| TIA-613 | High Speed Serial Interface for Data Terminal Equipment and Data Circuit Terminal Equipment (September 2005) |
| ANSI/TIA-758-B | Customer-owned Outside Plant Telecommunications Infrastructure Standard (April 2012) |
| ANSI/TIA-854 | A Full Duplex Ethernet Specification for 1000 Mb/s (1000BASE-TX) Operating over Category 6 Balanced Twisted-Pair Cabling (2001) |

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|---|---|
| ANSI/TIA-862-A | Building Automation Systems Cabling Standard (April 2011) |
| TIA-942-A | Telecommunications Infrastructure Standard for Data Centers (March 2014) |
| TIA-1152 | Requirements for Field Testing Instruments and Measurements for Balanced Twisted Pair Cabling (September 2009) |
| TIA-1179 | Healthcare Facility Telecommunications Infrastructure Standard (July 2010) |

**1.4 SINGULAR NUMBER**

A. Where any device or part of equipment is referred in singular number (such as " rack"), reference applies to as many such devices as are required to complete installation.

**1.5 RELATED WORK**

A. Specification Order of Precedence: FAR Clause 52.236-21, VAAR Clause 852.236-71.

1. Field Cutting and Patching: Section 09 91 00, PAINTING.
2. Additional submittal requirements: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
3. Availability and source of references and standards specified in applicable publications: Section 01 42 19, REFERENCE STANDARDS.
4. Control of environmental pollution and damage for air, water, and land resources: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.
5. Requirements for non-hazardous building construction and demolition waste: Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT.
6. General requirements and procedures to comply with various federal mandates and U.S. Department of Veterans Affairs (VA) policies for sustainable design: Section 01 81 13,SUSTAINABLE DESIGN REQUIREMENTS.
7. Closures of openings in walls, floors, and roof decks against penetration of flame, heat, and smoke or gases in fire resistant rated construction: Section 07 84 00, FIRESTOPPING.
8. Sealant and caulking materials and their application: Section 07 92 00, JOINT SEALANTS.

9. General electrical requirements that are common to more than one section of Division 26: Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
10. Electrical conductors and cables in electrical systems rated 600 V and below: Section 26 05 21, LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW).
11. Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents: Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
12. Conduit and boxes: Section 26 05 33, RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS.
13. Wiring devices: Section 26 27 26, WIRING DEVICES.
14. Underground ducts, raceways, precast manholes and pull boxes: Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION.
15. Lightning protection: Section 26 41 00, FACILITY LIGHTNING PROTECTION.
16. General requirements common to more than one section in Division 28: Section 28 05 00, COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY.
17. Conductors and cables for electronic safety and security systems: Section 28 05 13, CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY.
18. Low impedance path to ground for electronic safety and security system ground fault currents: Section 28 05 26, GROUNDING AND BONDING FOR SECURITY SYSTEMS.
19. Conduits and partitioned telecommunications raceways for Electronic Safety and Security systems: Section 28 05 28.33, CONDUITS AND BACK BOXES FOR ELECTRONIC SAFETY AND SECURITY.
20. Physical Access Control System field-installed controllers connected by data transmission network: Section 28 13 00, PHYSICAL ACCESS DETECTION.
21. Detection and screening systems: Section 28 13 53, SECURITY ACCESS DETECTION.
22. Intrusion sensors and detection devices, and communication links to perform monitoring, alarm, and control functions: Section 28 16 11, INTRUSION DETECTION EQUIPMENT AND SYSTEMS.

23. Video surveillance system cameras, data transmission wiring, and control stations with associated equipment: Section 28 23 00, VIDEO SURVEILLANCE EQUIPMENT AND SYSTEMS.
24. Duress-panic alarms, emergency phones or call boxes, intercom systems, data transmission wiring and associated equipment: Section 28 26 00, ELECTRONIC PERSONAL PROTECTION EQUIPMENT AND SYSTEMS.
25. Alarm initiating devices, alarm notification appliances, control units, fire safety control devices, annunciators, power supplies, and wiring: Section 28 31 00, FIRE DETECTION AND ALARM.
26. Emergency Call telephones, intercom systems, with blue strobe light and equipment: Section 28 52 31, SECURITY EMERGENCY CALL/DURESS ALARM/COMMUNICATIONS SYSTEM AND EQUIPMENT.

**1.6 ADMINISTRATIVE REQUIREMENTS**

A. Assign a single communications project manager to serve as point of contact for Government, contractor, and design professional.

B. Be proactive in scheduling work.
   1. Use of premises is restricted at times directed by COR.
   2. Movement of materials: Unload materials and equipment delivered to site. Pay costs for rigging, hoisting, lowering and moving equipment on and around site, in building or on roof.
   3. Coordinate installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
   4. Sequence, coordinate, and integrate installations of materials and equipment for efficient flow of Work. Plan for large equipment requiring positioning prior to closing in building.
   5. Coordinate connection of materials, equipment, and systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies; provide required connection for each service.
   6. Initiate and maintain discussion regarding schedule for ceiling construction and install cables to meet that schedule.

C. Contact the Office of Telecommunications, Special Communications Team (005OP2H3) (202)461-5310 to have a Government-accepted Telecommunications COR assigned to project for telecommunications

review, equipment and system approval and coordination with other VA personnel.

D. Communications Project Manager Responsibilities:
   1. Assume responsibility for overall telecommunications system integration and coordination of work among trades, subcontractors, and authorized system installers.
   2. Coordinate with related work indicated on drawings or specified.
   3. Manage work related to telecommunications system installation in a manner approved by manufacturer.

**1.7 SUBMITTALS**

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Provide parts list including quantity of spare parts.

C. Provide manufacturer product information. Government reserves the right to require a list of installations where products have been in operation.

D. Provide Source Quality Control Submittal:
   1. Submit written certification from OEM indicating that proposed supervisor of installation and proposed provider of warranty maintenance are authorized representatives of OEM. Include individual's legal name, contact information and OEM credentials in certification.
   2. Submit written certification from OEM that wiring and connection diagrams meet Government Life Safety Guidelines, NFPA, NEC, NRTL, these specifications, and Joint Commission requirements and instructions, requirements, recommendations, and guidance set forth by OEM for the proper performance of system.
   3. Pre-acceptance Certification: Certification in accordance with procedure outlined in Section 01 00 00, GENERAL REQUIREMENTS and specific Division 27 qualification documentation.

E. Installer Qualifications: Submit three installations of similar size and complexity furnished and installed by installer; include:
   1. Installation location and name.
   2. Owner’s name and contact information including, address, telephone and email.
   3. Date of project start and date of final acceptance.

4. System project number.
5. Three paragraph description of each system related to this project; include function, operation, and installation.

F. Provide delegated design submittals (e.g. seismic support design).

G. Submittals are required for all equipment anchors and supports. Include weights, dimensions, center of gravity, standard connections, manufacturer's recommendations and behavior problems (e.g., vibration, thermal expansion,) associated with equipment or conduit. Anchors and supports to resist seismic load based on seismic design categories per section 4.0 of VA seismic design requirements H-18-8 dated August, 2013.

H. Test Equipment List:
1. Supply test equipment of accuracy better than parameters to be tested.
2. Submit test equipment list including make and model number:
   a. ANSI/TIA-1152 Level IIIe twisted pair cabling test instrument.
   b. Fiber optic insertion loss power meter with light source.
   c. Optical time domain reflectometer (OTDR).
   d. Volt-Ohm meter.
   e. Digital camera.
3. Supply only test equipment with a calibration tag from Government-accepted calibration service dated not more than 12 months prior to test.
4. Provide sample test and evaluation reports.

I. Submittal Drawings:
1. Telecommunications Space Plans/Elevations: Provide enlarged floor plans of telecommunication spaces indicating layout of equipment and devices, including receptacles and grounding provisions. Submit detailed plan views and elevations of telecommunication spaces showing racks, termination blocks, and cable paths. Include following rooms:
   a. Telecommunications rooms.
   b. Building Entrance Facility/Demarcation rooms.
   c. Server rooms/Data Center.
   d. Equipment rooms.
   e. Antenna Head End rooms.

2. Logical Drawings: Provide logical riser or schematic drawings for all systems.
   a. Provide riser diagrams systems and interconnection drawings for equipment assemblies; show termination points and identify wiring connections.
3. Access Panel Schedule on Submittal Drawings: Coordinate and prepare a location, size, and function schedule of access panels required to fully service equipment.

J. Provide sustainable design submittals.

K. Furnish electronic certified test reports to COR prior to final inspection and not more than 90 days after completion of tests.

**1.8 CLOSEOUT SUBMITTALS**

A. Provide following closeout submittals prior to project closeout date:
   1. Warranty certificate.
   2. Evidence of compliance with requirements such as low voltage certificate of inspection.
   3. Project record documents.
   4. Instruction manuals and software that are a part of system.

B. Maintenance and Operation Manuals: Submit in accordance with Section 01 00 00, GENERAL REQUIREMENTS.
   1. Prepare a manual for each system and equipment specified.
   2. Furnish on portable storage drive in PDF format or equivalent accepted by COR.
   3. Furnish complete manual as specified in specification section, fifteen days prior to performance of systems or equipment test.
   4. Furnish remaining manuals prior to final completion.
   5. Identify storage drive "MAINTENANCE AND OPERATION MANUAL" and system name.
   6. Include name, contact information and emergency service numbers of each subcontractor installing system or equipment and local representatives for system or equipment.
   7. Provide a Table of Contents and assemble files to conform to Table of Contents.
   8. Operation and Maintenance Data includes:
      a. Approved shop drawing for each item of equipment.

b. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of equipment.
c. A control sequence describing start-up, operation, and shutdown.
d. Description of function of each principal item of equipment.
e. Installation and maintenance instructions.
f. Safety precautions.
g. Diagrams and illustrations.
h. Test Results and testing methods.
i. Performance data.
j. Pictorial "exploded" parts list with part numbers. Emphasis to be placed on use of special tools and instruments. Indicate sources of supply, recommended spare parts, and name of servicing organization.
k. Warranty documentation indicating end date and equipment protected under warranty.
l. Appendix; list qualified permanent servicing organizations for support of equipment, including addresses and certified personnel qualifications.

C. Record Wiring Diagrams:
1. Red Line Drawings: Keep one E size 91.44 cm x 121.92 cm (36 inches x 48 inches) set of floor plans, on site during work hours, showing installation progress marked and backbone cable labels noted. Make these drawings available for examination during construction meetings or field inspections.
2. General Drawing Specifications: Detail and elevation drawings to be D size 61 cm x 91.44 cm (24 inches x 36 inches) with a minimum scale of 0.635 cm = 30.48 cm (1/4 inch = 12 inches). ER, TR and other enlarged detail floor plan drawings to be D size 61 cm x 91.44 cm (24” x 36”) with a minimum scale of 0.635 cm = 30.48 cm (1/4 inch = 12 inches). Building composite floor plan drawings to be D size 61 cm x 91.44 cm (24 inches x 36 inches) with a minimum scale of 3.175 mm = 30.48 cm (1/8 inch = 1’ 0 inch).
3. Building Composite Floor Plans: Provide building floor plans showing work area outlet locations and configuration, types of jacks, distance for each cable, and cable routing locations.
4. Floor plans to include:

a. Final room numbers and actual backbone cabling and pathway locations and labeling.
b. Inputs and outputs of equipment identified according to labels installed on cables and equipment
c. Device locations with labels.
d. Conduit.
e. Head-end equipment.
f. Wiring diagram.
g. Labeling and administration documentation.

5. Submit Record Wiring Diagrams within five business days after final cable testing.
6. Deliver Record Wiring Diagrams as CAD files in .dwg or .dgn or .rvt formats as determined by COR.
7. Deliver four complete sets of electronic record wiring diagrams to COR on portable storage drive.

D. Service Qualifications: Submit name and contact information of service organizations providing service to this installation within four hours of receipt of notification service is needed.

**1.9 MAINTENANCE MATERIAL SUBMITTALS**

A. After approval and prior to installation, furnish COR with the following:
1. A 300 mm (12 inch) length of each type and size of wire and cable along with tag from coils of reels from which samples were taken.
2. One coupling, bushing and termination fitting for each type of conduit.
3. Samples of each hanger, clamp and supports for conduit and pathways.
4. Duct sealing compound.

**1.10 QUALITY ASSURANCE**

A. Manufacturer’s Qualifications: Manufacturer must produce, as a principal product, the equipment and material specified for this project, and have manufactured item for at least three years.

B. Product and System Qualification:
1. OEM must have three installations of equipment submitted presently in operation of similar size and type as this project, that have continuously operated for a minimum of three years.

2. Government reserves the right to require a list of installations where products have been in operation before approval.
3. Authorized representative of OEM must be responsible for design, satisfactory operation of installed system, and certification.

C. Trade Contractor Qualifications: Trade contractor must have completed three or more installations of similar systems of comparable size and complexity with regards to coordinating, engineering, testing, certifying, supervising, training, and documentation. Identify these installations as a part of submittal.

D. System Supplier Qualifications: System supplier must be authorized by OEM to warranty installed equipment.

E. Telecommunications technicians assigned to system must be trained, and certified by OEM on installation and testing of system; provide written evidence of current OEM certifications for installers.

F. Manufactured Products:
1. Comply with FAR clause 52.236-5 for material and workmanship.
2. When more than one unit of same class of equipment is required, units must be product of a single manufacturer.
3. Equipment Assemblies and Components:
   a. Components of an assembled unit need not be products of same manufacturer.
   b. Manufacturers of equipment assemblies, which include components made by others, to assume complete responsibility for final assembled unit.
   c. Provide compatible components for assembly and intended service.
   d. Constituent parts which are similar must be product of a single manufacturer.
4. Identify factory wiring on equipment being furnished and on wiring diagrams.

G. Testing Agencies: Government reserves the option of witnessing factory tests. Notify COR minimum 15 working days prior to manufacturer performing the factory tests.
1. When equipment fails to meet factory test and re-inspection is required, contractor is liable for additional expenses, including expenses of Government.

**1.11 DELIVERY, STORAGE, AND HANDLING**

A. Delivery and Acceptance Requirements:

1. Government's approval of submittals must be obtained for equipment and material before delivery to job site.
2. Deliver and store materials to job site in OEM's original unopened containers, clearly labeled with OEM's name and equipment catalog numbers, model and serial identification numbers for COR to inventory cable, patch panels, and related equipment.

B. Storage and Handling Requirements:

1. Equipment and materials must be protected during shipment and storage against physical damage, dirt, moisture, cold and rain:
   a. Store and protect equipment in a manner that precludes damage or loss, including theft.
   b. Protect painted surfaces with factory installed removable heavy kraft paper, sheet vinyl or equivalent.
   c. Protect enclosures, equipment, controls, controllers, circuit protective devices, and other like items, against entry of foreign matter during installation; vacuum clean both inside and outside before testing and operating.

C. Coordinate storage.

**1.12 FIELD CONDITIONS**

A. Where variations from documents are requested in accordance with GENERAL CONDITIONS and Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, connecting work and related components must include additions or changes to branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels and installation methods.

B. A contract adjustment or additional time will not be granted because of field conditions pursuant to FAR 52.236-2 and FAR 52.236-3; a contract adjustment or additional time will not be granted for additional work required for complete and usable construction and systems pursuant to FAR 52.246-12.

**1.13 WARRANTY**

A. Comply with FAR clause 52.246-21, except as follows:

1. Warranty material and equipment to be free from defects, workmanship, and remain so for a period of one year for Emergency

Systems from date of final acceptance of system by Government; provide OEM's equipment warranty document to COR.

2. Government maintenance personnel must have ability to contact OEM for emergency maintenance and logistic assistance, remote diagnostic testing, and assistance in resolving technical problems at any time; contractor and OEM must provide this capability.

**PART 2 - PRODUCTS**

**2.1 PERFORMANCE AND DESIGN CRITERIA**

A. Provide communications spaces and pathways conforming to TIA 569, at a minimum.

B. In cases of renovations in historic or otherwise restrictive buildings, where it has been determined as impossible to follow above stated guidelines, exceptions must not modify maximum distances set forth in TIA 568 and 569; and exceptions must not in any way effect performance of entire TIP system.

C. Modification to administrative issues requires written approvals from COR with concurrence from SMCS 005OP2H3, OEM, contractor, and local authorities.

**2.2 EQUIPMENT IDENTIFICATION**

A. Provide laminated black phenolic resin with a white core nameplates with minimum 6 mm (1/4 inch) high engraved lettering.

B. Nameplates furnished by manufacturer as standard catalog items, unless other method of identification is indicated.

**2.3 UNDERGROUND WARNING TAPE**

A. Underground Warning: Standard 4-Mil polyethylene 76 mm (3 inch) wide tape detectable type; red with black letters imprinted with "CAUTION BURIED ELECTRIC LINE BELOW", orange with black letters imprinted with "CAUTION BURIED TELEPHONE LINE BELOW" or orange with black letters imprinted with "CAUTION BURIED FIBER OPTIC LINE BELOW", as applicable.

**2.4 WIRE LUBRICATING COMPOUND**

A. Provide non-hardening or forming adhesive coating cable lubricants suitable for cable jacket material and raceway.

**2.5 FIREPROOFING TAPE**

A. Provide flexible, conformable fabric tape of organic composition and coated one side with flame-retardant elastomer.

B. Tape must be self-extinguishing and cannot support combustion; arc-proof and fireproof.

C. Tape cannot deteriorate when subjected to water, gases, salt water, sewage, or fungus; and tape must be resistant to sunlight and ultraviolet light.

D. Application must withstand a 200-ampere arc for minimum 30 seconds.

E. Securing Tape: Glass cloth electrical tape minimum 0.18 mm (7 mils) thick and 19 mm (3/4 inch) wide.

**2.6 UNDERGROUND CABLES**

A. Provide buried closure suitable for enclosing a straight, butt, and branch splice in a container into which can be poured an encapsulating compound.

B. Provide closure of adequate strength to protect splice and maintain cable shield electrical continuity in buried environment.

C. Provide re-enterable encapsulating compound maintaining chemical stability of closure.

D. Provide filled splice cases in accordance with RUS Bull 345-72.

E. Provide gel filled cable meeting requirements of ICEA S-99-689 and RUS 1755.390 and RUS 1755.890.

F. In Vault or Manhole:

1. Provide underground closure suitable to house a straight, butt, and branch splice in a protective housing into which can be poured an encapsulating compound

2. Closure must be suitable thermoplastic, thermo-set, or stainless steel material supplying structural strength to pass mechanical and electrical requirements in a vault or maintenance hole (manhole) environment.

G. Re-Enterable Encapsulating Compound: Product maintaining chemical stability of closure.

H. Provide gel-filled splice cases in accordance with RUS Bull 345-72.

**2.7 TEMPORARY TIP PATHS (OVERHEAD TRACKS, ROAD/PATH BRIDGES, ETC.)**

A. Provide for copper, fiber optic, RF, coaxial and designated electronic system cables to maintain facility communications service during construction and install so as to not present a pedestrian and traffic (including construction) safety hazard.

B. TIP temporary cable installations are not required to meet industry standards; but each must be reviewed and accepted, in writing, by COR with concurrences from SMCS 005OP2H3, OI&T and facility safety officer, prior to installation.
   1. Be responsible for work associated with each temporary TIP path installation, required by system design and its removal when determined no longer necessary.
   2. Survey outside TIP locations usually encountered, including roads, driveways, marked paths, high traffic passage ways or personnel walkways, and provide COR with a plan for temporary paths.

**2.8 ACCESS PANELS**

A. Panels: 304 mm x 304 mm (12 inches by 12 inches), or size allowed by location to provide optimum access to equipment for maintenance and service.
B. Provide access panels and doors as required to allow service of materials and equipment that require inspection, replacement, repair or service.
C. Provide access panels where items installed require access and are concealed in floor, wall, furred space or above ceiling; ceilings consisting of lay-in or removable splined tiles do not require access panels.
D. Provide access panels with same fire rating classification as surface penetrated.

**PART 3 - EXECUTION**

**3.1 PREPARATION**

A. Penetrations and Sleeves:
   1. Lay out penetration and sleeve openings in advance, to permit provision in work.
   2. Set sleeves in forms before concrete is poured.
   3. Set sleeves prior to installation of structure for passage of pipes, conduit, ducts, etc.
   4. Provide sleeves and packing materials at penetrations of foundations, walls, slabs, partitions, and floors.
   5. Make sleeves that penetrate outside walls, basement slabs, footings, and beams waterproof.

6. Fill slots, sleeves and other openings in floors or walls if not used.
   a. Fill spaces in openings after installation of conduit or cable.
   b. Provide fill for floor penetrations to prevent passage of water, smoke, fire, and fumes.
   c. Provide fire resistant fill in rated floors and walls, to prevent passage of air, smoke and fumes.
7. Install sleeves through floors watertight and extend minimum 50.8 mm (2 inches) above floor surface.
8. Match and set sleeves flush with adjoining floor, ceiling, and wall finishes where raceways passing through openings are exposed in finished rooms.
9. Annular space between conduit and sleeve must be minimum 6 mm (1/4 inch).
10. Do not provide sleeves for slabs-on-grade, unless specified or indicated otherwise.
11. Comply with requirements for firestopping, for sleeves through rated fire walls and smoke partitions.
12. Do not support piping risers or conduit on sleeves.
13. Identify unused sleeves and slots for future installation.
14. Provide core drilling if walls are poured or otherwise constructed without sleeves and wall penetration is required; do not penetrate structural members.

B. Core Drilling:
   1. Avoid core drilling whenever possible.
   2. Coordinate openings with other trades and utilities, and prevent damage to structural reinforcement.
   3. Investigate existing conditions in vicinity of required opening prior to coring, including an x-ray of floor if determined necessary by competent person or COR.
   4. Protect areas from damage.

C. Verification of In-Place Conditions:
   1. Verify location, use and status of all material, equipment, and utilities that are specified, indicated, or determined necessary for removal.

a. Verify materials, equipment, and utilities to be removed are inactive, not required, or in use after completion of project.
b. Replace with equivalent any material, equipment and utilities that were removed by contractor that are required to be left in place.

2. Existing Utilities: Do not interrupt utilities serving facilities occupied by Government or others unless permitted under following conditions and then only after arranging to provide temporary utility services, according to requirements indicated:
   a. Notify COR in writing at least 14 days in advance of proposed utility interruptions.
   b. Do not proceed with utility interruptions without Government's written permission.

D. Provide suspended platforms, strap hangers, brackets, shelves, stands or legs for floor, wall and ceiling mounting of equipment as required.

E. Provide steel supports and hardware for installation of hangers, anchors, guides, and other support hardware.

F. Obtain and analyze catalog data, weights, and other pertinent data required for coordination of equipment support provisions and installation.

G. Verify site conditions and dimensions of equipment to ensure access for proper installation of equipment without disassembly that would void warranty.

**3.2 INSTALLATION - GENERAL**

A. Coordinate systems, equipment, and materials installation with other building components.

B. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings.

C. Conform to VAAR 852.236.91 arrangements indicated, recognizing that work may be shown in diagrammatic form or have been impracticable to detail all items because of variances in manufacturers' methods of achieving specified results.

D. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed in both exposed and un-exposed spaces.

E. Install equipment according to manufacturers' written instructions.

F. Install wiring and cabling between equipment and related devices.

G. Install cabling, wiring, and equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with minimum interference of adjacent other installations.

H. Provide access panel or doors where units are concealed behind finished surfaces.

I. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for wiring, cabling, and equipment installations.

J. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide maximum headroom and access for service and maintenance as possible.

K. Install systems, materials, and equipment giving priority to systems required to be installed at a specified slope.

L. Avoid interference with structure and with work or other trades, preserving adequate headroom and clearing doors and passageways to satisfaction of COR and code requirements.

M. Install equipment and cabling to distribute equipment loads on building structural members provided for equipment support under other sections; install and support roof-mounted equipment on structural steel or roof curbs as appropriate.

N. Provide supplementary or miscellaneous items, appurtenances, devices and materials for a complete installation.

**3.3 EQUIPMENT INSTALLATION**

A. Locate equipment as close as practical to locations shown on drawings.

B. Note locations of equipment requiring access on record drawings.

C. Access and Access Panels: Verify access panel locations and construction with COR.

D. Inaccessible Equipment:

1. Where Government determines that contractor has installed equipment not conveniently accessible for operation and maintenance, equipment must be removed and reinstalled as directed and without additional cost to Government.

2. Refer to Section 27 11 00, TELECOMMUNICATIONS ROOM FITTINGS for communication equipment cabinet assembly.

3. Refer to Section 27 11 00, TELECOMMUNICATIONS ROOM FITTINGS for equipment labeling.

**3.4 EQUIPMENT IDENTIFICATION**

A. Install an identification sign which clearly indicates information required for use and maintenance of equipment.

B. Secure identification signs with screws.

**3.5 CUTTING AND PATCHING**

A. Perform cutting and patching according to contract general requirements and as follows:

1. Remove samples of installed work as specified for testing.
2. Perform cutting, fitting, and patching of equipment and materials required to uncover existing infrastructure in order to provide access for correction of improperly installed existing or new work.
3. Remove and replace defective work.
4. Remove and replace non-conforming work.

B. Cut, remove, and legally dispose of selected equipment, components, and materials, including removal of material, equipment, devices, and other items indicated to be removed and items made obsolete by new work.

C. Provide and maintain temporary partitions or dust barriers adequate to prevent spread of dust and dirt to adjacent areas.

D. Protect adjacent installations during cutting and patching operations.

E. Protect structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

F. Patch finished surfaces and building components using new materials specified for original installation and experienced installers.

**3.6 FIELD QUALITY CONTROL**

A. Provide work according to VAAR 852.236.91 and FAR clause 52.236-5.

B. Provide minimum clearances and work required for compliance with NFPA 70, National Electrical Code (NEC), and manufacturers' instructions; comply with additional requirements indicated for access and clearances.

C. Verify all field conditions and dimensions that affect selection and provision of materials and equipment, and provide any disassembly, reassembly, relocation, demolition, cutting and patching required to provide work specified or indicated, including relocation and reinstallation of existing wiring and equipment.

1. Protect facility, equipment, and wiring from damage.

D. Submit written notice that:

1. Project has been inspected for compliance with documents.
2. Work has been completed in accordance with documents.

E. Non-Conforming Work: Conduct project acceptance inspections, final completion inspections, substantial completion inspections, and acceptance testing and demonstrations after verification of system operation and completeness by Contractor.

F. For project acceptance inspections, final completion inspections, substantial completion inspections, and testing/demonstrations that require more than one site visit by COR or design professional to verify project compliance for same material or equipment, Government reserves right to obtain compensation from contractor to defray cost of additional site visits that result from project construction or testing deficiencies and incompleteness, incorrect information, or non-compliance with project provisions.

1. COR will notify contractor, of hourly rates and travel expenses for additional site visits, and will issue an invoice to Contractor for additional site visits.
2. Contractor is not be eligible for extensions of project schedule or additional charges resulting from additional site visits that result from project construction or testing deficiencies/incompleteness, incorrect information, or non-compliance with Project provisions.

G. Tests:

1. Interim inspection is required at approximately 50 percent of installation.
2. Request inspection ten working days prior to interim inspection start date by notifying COR in writing; this inspection must verify equipment and system being provided adheres to installation, mechanical and technical requirements of construction documents.
3. Inspection to be conducted by OEM and factory-certified contractor representative, and witnessed by COR, facility and SMCS 0050P2H3 representatives.
4. Check each item of installed equipment to ensure appropriate NRTL listing labels and markings are fixed in place.

5. Verify cabling terminations in DEMARC, MCR, TER, SCC, ECC, TRs and head end rooms, workstation locations and TCO adhere to color code for T568B pin assignments and cabling connections are in compliance with TIA standards.
6. Visually confirm minimum Category 6 cable marking at TCOs, CCSs locations, patch cords and origination locations.
7. Review entire communications circulating ground system, each TGB and grounding connection, grounding electrode and outside lightning protection system.
8. Review cable tray, conduit and path/wire way installation practice.
9. OEM and contractor to perform:
   a. Fiber optical cable field inspection tests via attenuation measurements on factory reels; provide results along with OEM certification for factory reel tests.
   b. Coaxial cable field inspection tests via attenuation measurements on factory reels; provide results along with OEM certification for factory reel tests.
   c. Baseband cable field inspection tests via attenuation measurements on factory reels and provide results along with OEM certification for factory reel tests.
10. Relocate failed cable reels to a secured location for inventory, as directed by COR, and then remove from project site within two working days; provide COR with written confirmation of defective cable reels removal from project site.
11. Provide results of interim inspections to COR.
12. If major or multiple deficiencies are discovered, additional interim inspections could be required until deficiencies are corrected, before permitting further system installation.
    a. Additional inspections are scheduled at direction of COR.
    b. Re-inspection of deficiencies noted during interim inspections, must be part of system’s Final Acceptance Proof of Performance Test.
    c. The interim inspection cannot affect the system’s completion date unless directed by COR.
13. Facility COR will ensure test documents become a part of system’s official documentation package.

H. Pretesting: Re-align, re-balance, sweep, re-adjust and clean entire system and leave system working for a “break-in” period, upon completing installation of system and prior to Final Acceptance Proof of Performance Test. System RF transmitting equipment must not be connected to keying or control lines during “break-in” period.

1. Pretesting Procedure:
   a. Verify systems are fully operational and meet performance requirements, utilizing accepted test equipment and spectrum analyzer.
   b. Pretest and verify system functions and performance requirements conform to construction documents and, that no unwanted physical, aural and electronic effects, such as signal distortion, noise pulses, glitches, audio hum, poling noise are present.
2. Provide recorded system pretest measurements and certification that the system is ready for formal acceptance test to COR.

I. Acceptance Test:

1. Schedule an acceptance test date after system has been pretested, and pretest results and certification submitted to COR.
2. Give COR fifteen working days written notice prior to date test is expected to begin; include expected duration of time for test in notification.
3. Test in the presence of the following:
   a. COR.
   b. OEM representatives.
   c. VACO:
      1) CFM representative.
      2) AHJ-SMCS 005OP2H3, (202)461-5310.
   d. VISN-CIO, Network Officer and VISN representatives.
   e. Facility:
      1) FMS Service Chief, Bio-Medical Engineering and facility representatives.
      2) OI&T Service Chief and OI&T representatives.
      3) Safety Officer, Police Chief and facility safety representatives.
   f. Local Community Safety Personnel:
      1) Fire Marshal representative.

2) Disaster Coordinator representative.
3) EMS Representatives: Police, Sherriff, City, County or State representatives.

4. Test system utilizing accepted test equipment to certify proof of performance and Life and Public Safety compliance, FCC, NRTL, NFPA and OSHA compliance.
   a. Rate system as acceptable or unacceptable at conclusion of test; make only minor adjustments and connections required to show proof of performance.
      1) Demonstrate and verify that system complies with performance requirements under operating conditions.
      2) Failure of any part of system that precludes completion of system testing, and which cannot be repaired within four hours, terminates acceptance test of that portion of system.
      3) Repeated failures that result in a cumulative time of eight hours to affect repairs is cause for entire system to be declared unacceptable.
      4) If system is declared unacceptable, retesting must be rescheduled at convenience of Government and costs borne by the contractor.

J. Acceptance Test Procedure:
   1. Physical and Mechanical Inspection: The test team representatives must tour major areas to determine system and sub-systems are completely and properly installed and are ready for acceptance testing.
   2. A system inventory including available spare parts must be taken at this time.
   3. Each item of installed equipment must be re-checked to ensure appropriate NRTL (i.e. UL) certification listing labels are affixed.
   4. Confirm that deficiencies reported during Interim Inspections and Pretesting are corrected prior to start of Acceptance Test.
   5. Inventory system diagrams, record drawings, equipment manuals, pretest results.
   6. Failure of system to meet installation requirements of specifications is grounds for terminating testing and to schedule re-testing.

K. Operational Test:
   1. Government’s Condition of Acceptance of System Language:
      a. Without Acceptance: Until system fully meets conditions of construction documents, system’s ownership, use, operation and warranty commences at Government’s final acceptance date.
      b. With Conditional Acceptance: Stating conditions that need to be addressed by contractor or OEM and stating system’s use and operation to commence immediately while its warranty commences only at Government’s agreed final extended acceptance date.
      c. With Full Acceptance: Stating system’s ownership, use, operation and warranty to immediately commence at Government’s agreed to date of final acceptance.
L. Acceptance Test Conclusion: Reschedule testing on deficiencies and shortages with COR, after COR and SMCS AHJ jointly agree to results of the test, using the generated punch list or discrepancy list. Perform retesting to comply with these specifications at contractor's expense.
M. Proof of Performance Certification:
   1. If system is declared acceptable, AHJ (SMCS 005OP2H3) provides COR notice stating system processes to required operating standards and functions and is Government accepted for use by facility.
   2. Validate items with COR needing to be provided to complete project contract (i.e. charts & diagrams, manuals, spare parts, system warranty documents executed, etc.). Once items have been provided, COR contacts FMS service chief to turn over system from CFM oversight for beneficial use by facility.
   3. If system is declared unacceptable without conditions, rescheduled testing expenses are to be borne by contractor.

**3.7 CLEANING**

A. Remove debris, rubbish, waste material, tools, construction equipment, machinery and surplus materials from project site and clean work area, prior to final inspection and acceptance of work.
B. Put building and premises in neat and clean condition.
C. Remove debris on a daily basis.
D. Remove unused material, during progress of work.
E. Perform cleaning and washing required to provide acceptable appearance and operation of equipment to satisfaction of COR.

F. Clean exterior surface of all equipment, including concrete residue, dirt, and paint residue, after completion of project.

G. Perform final cleaning prior to project acceptance by COR.

H. Remove paint splatters and other spots, dirt, and debris; touch up scratches and mars of finish to match original finish.

I. Clean devices internally using methods and materials recommended by manufacturer.

J. Tighten wiring connectors, terminals, bus joints, and mountings, to include lugs, screws and bolts according to equipment manufacturer's published torque tightening values for equipment connectors. In absence of published connection or terminal torque values, comply with torque values specified in UL 486A-486B.

**3.8 TRAINING**

A. Provide training in accordance with subsection, INSTRUCTIONS, of Section 01 00 00, GENERAL REQUIREMENTS.

B. Provide training for equipment or system as required in each associated specification.

C. Develop and submit training schedule for approval by COR, at least 30 days prior to planned training.

**3.9 PROTECTION**

A. Protection of Fireproofing:

1. Install clips, hangers, clamps, supports and other attachments to surfaces to be fireproofed, if possible, prior to start of spray fireproofing work.
2. Install conduits and other items that would interfere with proper application of fireproofing after completion of spray fire proofing work.
3. Patch and repair fireproofing damaged due to cutting or course of work must be performed by installer of fireproofing and paid for by trade responsible for damage.

B. Maintain equipment and systems until final acceptance.

C. Ensure adequate protection of equipment and material during installation and shutdown and during delays pending final test of systems and equipment because of seasonal conditions.

- - - E N D - - -

# SECTION 27 05 26
# GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

## PART 1 - GENERAL

### 1.1 DESCRIPTION

A. This section specifies grounding and bonding requirements of communications installations based on the requirements of ANSI/TIA-607-D, Telecommunications Bonding and Grounding (Earthing) for Customer Premises. Work covered by this Section shall consist of furnishing supplies, labor, materials, equipment, labeling, and tools. Testing is required unless otherwise specified. An operable grounding and bonding infrastructure is required as described on the Drawings and/or required by these specifications. All materials shall be listed by a nationally recognized testing laboratory (NRTL).

### 1.2 SUMMARY

Section Includes:

A. Required Bonding Busbars.

B. Supplemental Bonding Networks.

C. Telecommunications Bonding Conductors.

D. Joining Requirements.

E. Overvoltage Surge Protectors.

### 1.3 REFERENCES

A. VA Infrastructure Standard for Telecommunications Spaces.

B. ANSI/TIA-607-D, Telecommunications Bonding and Grounding (Earthing) for Customer Premises.

C. NFPA 70, National Electrical Code (NEC).

D. International Annealed Copper Standard (IACS).

E. BICSI Information Technology Systems Installation Methods Manual (ITSIMM), Recommended Testing Procedures and Criteria.

F. UL 497 & UL 497A, UL Standards for Primary & Secondary Safety Protectors for Paired-Conductor Communications Circuits.

### 1.4 RELATED WORK

A. Facility grounding and bonding requirements: Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

B. Information Technology equipment enclosures: Section 27 11 16, COMMUNICATION CABINETS, RACKS, FRAMES, AND ENCLOSURES.

C. Cable trays: Section 27 05 36, CABLE TRAYS FOR COMMUNICATIONS SYSTEMS.

**1.5 SUBMITTALS**

A. Submit in accordance with Section 27 05 00, COMMON WORK RESULTS FOR COMMUNICATIONS SYSTEMS.

B. Provide riser diagram indicating location of communications grounding system connections indicating routing of grounding conductors.

C. Closeout Submittals: Provide test reports of ground resistance to each primary or secondary bonding busbar (PBB/SBB) located in each telecommunications space impacted by the work.

**PART 2 - PRODUCTS**

**2.1 BONDING BUSBARS.**

Bonding busbars are located in each telecommunications space and in each network rack/cabinet. Bonding busbars provide common locations in the telecommunications space for the connection of the telecommunications bonding conductors.

A. Common Requirements.

1. Provided with holes for use with correctly-matched UL Listed two-hole lugs and hardware.
2. Constructed of copper or copper alloy with a minimum of 95% conductivity when annealed.
3. Annealed as specified by the International Annealed Copper Standard (IACS).
4. Installation resulting in a maximum 4.0Ω to ground resistance measured from any point in the system.
5. Installation is insulated from the mounting surface through the use of appropriate insulators.
6. UL Listed.

B. Primary Bonding Busbar (PBB). The PBB is a dedicated extension of the building grounding electrode system for the telecommunications infrastructure. The PBB also serves as the central attachment point for Secondary Bonding Busbars (SBB) via Telecommunications Bonding Backbone (TBB).

1. Pre-drilled copper with holes to accommodate lug mounting holes.
2. Sized for current applications and future growth.
3. Insulated from its supports.
4. Electro-tin plated is acceptable.

5. Maintain a 2” min clearance between busbar and finished wall.
6. Size must be 0.25” thick by 4” wide by 16” length.

C. Secondary Bonding Busbar (SBB). The SBB is a common point of connection for telecommunications system and equipment bonding to a ground located in each Telecommunications Room.
1. Pre-drilled holes to accommodate dual-lug mounting holes.
2. 0.25” thick x 2” wide with varying length to be sized for current applications and future growth.
3. Maintain a 2” min clearance between the finished wall and busbar.
4. Copper or tin annealed copper.

D. Rack Bonding Busbar (RBB). The RBB is a busbar located in a cabinet, rack, or frame.
1. Mounting. Horizontal mounting to an EIA-310-D 19” equipment rack is specified.
2. Capacity: 10 Double-hole lugs.
3. Size & material 0.75” wide x 19” length x 0.25” thick – Copper or tin annealed copper.

**2.2 SUPPLEMENTAL BONDING NETWORKS.**

Also known as Signal Reference Grids (SRGs), Mesh Bonding Networks (Mesh-BN), or Isolated Bonding Networks (IBNs), the requirements for supplemental bonding networks are not specified in this document. Supplemental bonding networks may not be used to replace a standards-compliant bonding infrastructure.

**2.3 TELECOMMUNICATIONS BONDING BACKBONE (TBB).**

The TBB bonds the facility Primary Bonding Busbar (PBB) to telecommunications space Secondary Bonding Busbars (SBBs).

A. Material. Stranded copper wire with a green jacket (or per NEC depending on size), run as a continuous conductor.

B. Size. The TBB shall be sized to meet the requirements of ANSI/TIA-607-D and will be as straight as practicable avoiding bends.

C. Bonding the TBB to the PBB and each SBB will require a UL Listed irreversible compression (crimp) dual-lug connector.

**2.4 BONDING CONDUCTORS.**

A. Telecommunications Equipment Bonding Conductor (TEBC). The TEBC connects the cabinets and racks in the telecommunications space to the space’s bonding busbar (PBB or SBB).

1. Material. Stranded copper wire with a green jacket (or per NEC depending on size), run as a continuous conductor.
2. Size. The TBB shall be sized to meet the requirements of ANSI/TIA-607-D. The minimum size for the TEBC shall be AWG 6.
3. Bonding. Bonded to the telecommunications space bonding busbar (PBB or SBB) via a UL Listed two-hole compression lug. Rack Bonding Conductors (RBCs) are connected to the TEBC using UL Listed irreversible compression (crimp) connectors.

B. Rack Bonding Conductor (RBC). The RBC is a bonding conductor from the cabinet or Rack Bonding Busbar (RBB) to the Telecommunications Equipment Bonding Conductor (TEBC).

1. Material. Stranded copper wire with a green jacket run as a continuous conductor.
2. Size. The minimum size for the RBC shall be AWG 6.
3. Bonding. Bonded to the Telecommunications Equipment Bonding Conductor (TEBC) using UL Listed irreversible compression (crimp) connectors.
   a. Where connected to a server cabinet, the RBC extends to the bottom of the server cabinet allowing Equipment Bonding Conductors to be attached at any point in the cabinet.
   b. Where connected to a network rack/cabinet, the Rack Bonding Conductor (RBC) is bonded to the Rack Bonding Busbar (RBB) via a UL Listed two-hole compression lug.

C. Equipment/Unit Bonding Conductor (EBC/UBC). The Equipment/Unit Bonding Conductor connects individual equipment in a cabinet or rack to the Rack Bonding Conductor (RBC) or Rack Bonding Busbar (RBB). Equipment Bonding conductors are also used as cable tray bonding conductors to bond cable tray sections to the Telecommunications Equipment Bonding Conductor (TEBC).

1. Material. Stranded copper wire with a green jacket run as a continuous conductor.
2. Size. The minimum size for the RBC shall be AWG 6.
3. Bonding.
   a. Where used in a server cabinet, bonded to the Rack Bonding Connector (RBC) using UL Listed irreversible compression (crimp)

connectors and to IT equipment via a UL Listed two-hole compression lug. (Some IT equipment may require one-hole lugs.)

b. Where used in a network cabinet/rack, bonded to the Rack Bonding Busbar (RBB) via a UL Listed two-hole compression lug and to IT equipment via a UL Listed two-hole compression lug. (Some IT equipment may require one-hole lugs.)

c. Where used as a cable tray bonding conductor connecting cable tray sections, bonded to each adjoining section of the cable tray using UL Listed two-hole compression lugs.

d. Where used as a cable tray bonding conductor connecting cable tray sections to the Telecommunications Equipment Bonding Conductor (TEBC), bonded to the TEBC using UL Listed irreversible compression (crimp) connectors and to the cable tray via a UL Listed two-hole compression lug.

4. Contractor shall furnish a minimum of ten (10) EBCs for each RBB. Five (5) EBCs shall be outfitted as described here and shall be six (6) feet in length. Five (5) EBCs shall be outfitted as described here and shall be nine (9) feet in length. Contractor shall use field measurements to determine EBC cable length when directed by VA project managers.

**2.5 OVERVOLTAGE SURGE PROTECTORS.**

A. Protectors are voltage-limiting devices intended to protect equipment, wiring, and personnel against the effects of excessive potentials and currents in communications lines caused by lightning, contacts with power conductors, power induction, and rises in ground potential.

1. Compliance. Protectors shall be compliant with UL 497 and/or UL 497A, as applicable.

2. Performance. Protectors shall be rated to support copper UTP performance Category 5e at 100MHz.

3. Protection. Voltage suppression shall be via low capacitance solid state protectors only, rated at 18V for copper backbone applications or 65V for VOIP or PoE applications.

4. Construction. Provide protection for each pair.

5. Termination shall be insulation-displacement contact.

6. Mounting. Protectors shall be wall-mounted.

**PART 3 - EXECUTION**

**3.1 IMPLEMENTATION**

A. Components of the telecommunications bonding system will be installed and connected using materials and techniques required by ANSI/TIA-607-D. The use of antioxidant joint compound is required for all connections excluding protector 110 block connections.

B. Testing.

1. Perform tests per BICSI Information Technology Systems Installation Methods Manual (ITSIMM), Recommended Testing Procedures and Criteria.
2. Perform two-point bond test using trained installers qualified to use test equipment.
3. Conduct continuity tests to verify that metallic pathways in telecommunications spaces are bonded to PBB or SBB.
4. Conduct electrical continuity test to verify that PBB is effectively bonded to the facility grounding electrode conductor.
5. Perform resistance tests to ensure rack and cabinet bonding connection resistance measures less than 4Ω to PBB or SBB.

- - - E N D - - -

# SECTION 27 05 33
# CONDUITS AND BACKBOXES FOR COMMUNICATIONS SYSTEMS

## PART 1 - GENERAL

### 1.1 DESCRIPTION

A. This section specifies conduit, fittings, and boxes to form raceway systems for communications cabling.

### 1.2 RELATED WORK

A. Bedding of conduits: Section 31 20 00, EARTH MOVING.

B. Sealing around penetrations to maintain integrity of fire rated construction: Section 07 84 00, FIRESTOPPING.

C. Fabrications for deflection of water away from building envelope at penetrations: Section 07 60 00, FLASHING AND SHEET METAL.

D. Sealing around conduit penetrations through building envelope to prevent moisture migration into building: Section 07 92 00, JOINT SEALANTS.

E. Identification and painting of conduit and other devices: Section 09 91 00, PAINTING.

F. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.

### 1.3 SUBMITTALS

A. In accordance with Section 27 05 11, COMMON WORK RESULTS FOR COMMUNICATIONS SYSTEMS, submit the following:

1. Size and location of cabinets, splice boxes, and pull boxes.
2. Layout of required conduit penetrations through structural elements.
3. Catalog cuts marked with specific item proposed and area of application identified.

B. Certification: Provide letter prior to final inspection, certifying material is in accordance with construction documents and properly installed.

## PART 2 - PRODUCTS

### 2.1 MATERIAL

A. Minimum Conduit Size: 19 mm (3/4 inch).

B. Conduit:

1. Rigid Galvanized Steel: Conform to UL 6, ANSI C80.1.

2. Rigid Aluminum: Conform to UL 6A, ANSI C80.5.
3. Rigid Intermediate Steel Conduit (IMC): Conform to UL 1242, ANSI C80.6.
4. Electrical Metallic Tubing (EMT):
   a. Maximum Size: 105 mm (4 inches).
   b. Install only for cable rated 600 volts or less.
   c. Conform to UL 797, ANSI C80.3.
5. Flexible Galvanized Steel Conduit: Conform to UL 1.
6. Liquid-tight Flexible Metal Conduit: Conform to UL 360.
7. Direct Burial Plastic Conduit: Conform to UL 651 and UL 651A, heavy wall PVC, or high density polyethylene (HDPE).
8. Surface Metal Raceway: Conform to UL 5.

C. Conduit Fittings:
1. Rigid Galvanized Steel and Rigid Intermediate Steel Conduit Fittings:
   a. Provide fittings meeting requirements of UL 514B and ANSI/ NEMA FB 1.
   b. Sealing: Provide threaded cast iron type. Use continuous drain type sealing fittings to prevent passage of water and vapor. In concealed work, install sealing fittings in flush steel boxes with blank cover plates having same finishes as other electrical plates in room.
   c. Standard Threaded Couplings, Locknuts, Bushings, and Elbows: Only steel or malleable iron materials are acceptable. Integral retractable type IMC couplings are also acceptable.
   d. Locknuts: Bonding type with sharp edges for digging into metal wall of an enclosure.
   e. Bushings: Metallic insulating type, consisting of an insulating insert molded or locked into metallic body of fitting. Bushings made entirely of metal or nonmetallic material are not permitted.
   f. Erickson (union-type) and Set Screw Type Couplings:
      1) Couplings listed for use in concrete are permitted for use to complete a conduit run where conduit is installed in concrete.
      2) Use set screws of case hardened steel with hex head and cup point to seat in conduit wall for positive ground.
   g. Provide OEM approved fittings.

2. Rigid Aluminum Conduit Fittings:
   a. Standard Threaded Couplings, Locknuts, Bushings, and Elbows: Malleable iron, steel or aluminum alloy materials; Zinc or cadmium plate iron or steel fittings. Aluminum fittings containing more than 0.4 percent copper are not permitted.
   b. Locknuts and Bushings: As specified for rigid steel and IMC conduit.
   c. Set Screw Fittings: Not permitted for use with aluminum conduit.
3. Electrical Metallic Tubing Fittings:
   a. Conform to UL 514B and ANSI/ NEMA FB1; only steel or malleable iron materials are acceptable.
   b. Couplings and Connectors: Concrete tight and rain tight, with connectors having insulated throats.
      1) Use gland and ring compression type couplings and connectors for conduit sizes 50 mm (2 inches) and smaller.
      2) Use set screw type couplings with four set screws each for conduit sizes over 50 mm (2 inches).
      3) Use set screws of case-hardened steel with hex head and cup point to seat in wall of conduit for positive grounding.
   c. Indent type connectors or couplings are not permitted.
   d. Die-cast or pressure-cast zinc-alloy fittings or fittings made of "pot metal" are not permitted.
   e. Provide OEM approved fittings.
4. Flexible Steel Conduit Fittings:
   a. Conform to UL 514B; only steel or malleable iron materials are acceptable.
   b. Provide clamp type, with insulated throat.
   c. Provide OEM approved fittings.
5. Liquid-tight Flexible Metal Conduit Fittings:
   a. Conform to UL 514B and ANSI/ NEMA FB1; only steel or malleable iron materials are acceptable.
   b. Fittings must incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening.
   c. Provide connectors with insulated throats to prevent damage to cable jacket.
   d. Provide OEM approved fittings.

6. Direct Burial Plastic Conduit Fittings: Provide fittings meeting requirements of UL 514C and NEMA TC3, and as recommended by conduit manufacturer.
7. Expansion and Deflection Couplings:
   a. Conform to UL 467 and UL 514B.
   b. Accommodate 19 mm (3/4 inch) deflection, expansion, or contraction in any direction, and allow 30-degree angular deflections.
   c. Include internal flexible metal braid sized to ensure conduit ground continuity and fault currents in accordance with UL 467, and NEC code tables for ground conductors.
   d. Jacket: Flexible, corrosion-resistant, watertight, moisture and heat resistant molded rubber material with stainless steel jacket clamps.
8. Rigid Aluminum Fittings:
   a. Provide malleable iron, steel or aluminum alloy materials; zinc or cadmium plate iron or steel fittings. Aluminum fittings containing more than 0.4 percent copper are prohibited.
   b. Locknuts and Bushings: As specified for rigid steel and IMC conduit.
   c. Set Screw Fittings: Not permitted for use with aluminum conduit.
   d. Indent type connectors or couplings are prohibited.
   e. Die-cast or pressure-cast zinc-alloy fittings or fittings made of “pot metal” are not permitted.
   f. Provide OEM approved fittings.

D. Conduit Supports:
1. Parts and Hardware: Provide zinc-coat or equivalent corrosion protection.
2. Individual Conduit Hangers: Designed for the purpose, having a pre-assembled closure bolt and nut, and provisions for receiving a hanger rod.
3. Multiple Conduit (Trapeze) Hangers: Minimum 38 mm by 38 mm (1-1/2 by 1-1/2 inch), 2.78 mm (12 gage) steel, cold formed, lipped channels; with minimum 9 mm (3/8 inch) diameter steel hanger rods.
4. Solid Masonry and Concrete Anchors: Self-drilling expansion shields, or machine bolt expansion.

E. Outlet, Splice, and Pull Boxes:
   1. Conform to UL-50 and UL-514A.
   2. Cast metal where required by NEC or shown, and equipped with rustproof boxes.
   3. Sheet Metal Boxes: Galvanized steel, except where otherwise shown.
   4. Install flush mounted wall or ceiling boxes with raised covers so that front face of raised cover is flush with wall.
   5. Install surface mounted wall or ceiling boxes with surface style flat or raised covers.

F. Warning Tape: Standard, 4-Mil polyethylene 76 mm (3 inch) wide tape detectable type, red with black letters, and imprinted with "CAUTION BURIED COMMUNICATIONS CABLE BELOW".

G. Flexible Nonmetallic Communications Raceway (Innerduct) and Fittings:
   1. General: Provide UL 910 listed plenum, riser, and general purpose corrugated pliable communications raceway.
   2. Provide Communications Raceway with a factory installed 567 kg (1250 lb.) tensile pre-lubricated pull tape.
   3. Use only metallic straps, hangers and fittings to support raceway from building structure. Cable ties are not permitted for securing raceway to building structure.
   4. Provide fittings to be installed in spaces used for environmental air made of materials that do not exceed flammability, smoke generation, ignitibility, and toxicity requirements of environmental air space.
   5. Size: Metric Designator 53 (trade size 2) or smaller.
   6. Outside Plant: Plenum-rated where each innerduct is 75 mm (3 inches) and larger.
   7. Inside Plant: Listed and marked for installation in plenum airspaces and minimum 25 mm (1 inch) inside diameter.
   8. Plenum: Non-metallic communications raceway.
      a. Constructed of low smoke emission, flame retardant PVC with corrugated construction.
      b. UL 94 V-O rating for flame spreading limitation.
   9. Provide innerduct reel lengths as necessary to ensure ducts are continuous.

10. Provide pulling accessories used for innerduct including but not limited to, inner duct lubricants, spreaders, applicators, grips, swivels, harnesses, and line missiles (blown air) compatible with materials being pulled.

H. Outlet Boxes:

1. Flush wall mounted 12.7 cm (5 inches) square x 7.3 cm (2-7/8 inches); deep pressed galvanized steel.
2. 2-Gang Tile Box:
   a. Flush backbox type for installation in block walls.
   b. Minimum 92 mm (3-5/8 inches) deep.

I. Weatherproof Outlet Boxes: Surface mount two gang, 67 mm (2-5/8 inches) deep weatherproof cast aluminum with powder coated finish internal threads on hubs 19 mm (3/4 inch) minimum.

**PART 3 - EXECUTION**

**3.1 EQUIPMENT INSTALLATION AND REQUIREMENTS**

A. Raceways typically required for cabling systems unless otherwise indicated:

| System | Specification Section | Installed Method |
|---|---|---|
| Grounding | 27 05 26 | Conduit Not Required |
| Control, Communication and Signal Wiring | 27 15 01 | Complete Conduit Allowed in Non-Partitioned Cable Tray or Cable Ladders |
| Master Antenna Television Equipment and Systems | 27 41 31 | Conduit to Cable Tray, Partitioned Cable Tray |
| Public Address and Mass Notification Systems | 27 51 16 | Complete conduit |
| Intercommunications and Program systems | 27 51 23 | Conduit to Cable Tray, Partitioned Cable Tray |
| Nurse Call | 27 52 23 | Complete Conduit |
| Miscellaneous Medical Systems | 27 52 41 | Complete Conduit |
| Distributed Radio Antenna Equipment and System | 27 53 19 | Conduit to Cable Tray, Partitioned Cable Tray |
| Grounding and Bonding for Electronic Safety and Security | 28 05 26 | Conduit Not Required Unless Required by Code |

**Commented [BKM1]:** Entire section 3.1.A including table should be removed and moved to the TDM. This needs to be accomplished by the TDM owner (to be determined). It is not critical to have this in the TDM prior to publication of this spec, so long as it is moved to a 'for action' parking lot where it won't be lost forever.

**Commented [MiG2]:** Specification section numbering is not compliant with current CSI MasterFormat in multiple sections; the overall CFM specs should be reviewed and reorganized for this.

| System | Specification Section | Installed Method |
|---|---|---|
| Physical Access Control System | 28 13 00 | Conduit to Cable Tray Partitioned Cable Tray |
| Physical Access Control System and Database Management | 28 13 16 | Conduit to Cable Tray Partitioned Cable Tray |
| Security Access Detection | 28 13 53 | Complete Conduit |
| Intrusion Detection System | 28 16 00 | Conduit to Cable Tray, Partitioned Cable Tray |
| Video Surveillance | 28 23 00 | Complete Conduit |
| Electronic Personal Protection System | 28 26 00 | Conduit to Cable Tray, Partitioned Cable Tray |
| Fire Detection and Alarm | 28 31 00 | Complete Conduit |

B. Penetrations:

1. Cutting or Holes:

a. Locate holes in advance of installation. Where proposed in structural sections, obtain approval of structural engineer and COR prior to drilling through structural sections.

b. Make holes through concrete and masonry in new and existing structures with a diamond core drill or concrete saw. Pneumatic hammer, impact electric, hand or manual hammer type drills are not permitted; COR may grant limited permission by request, in condition of limited working space.

c. Fire Stop: Where conduits, wireways, and other communications raceways pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING.

1) Fill and seal clearances between raceways and openings with fire stop material.

2) Install only retrofittable, non-hardening, and reusable firestop material that can be removed and reinstalled to seal around cables inside conduits.

d. Waterproofing at Floor, Exterior Wall, and Roof Conduit Penetrations: Seal clearances around conduit and make watertight

as specified in Section 07 92 00, JOINT SEALANTS or directed by waterproofing manufacturer.

C. Conduit Installation:

1. Minimum conduit size of 19 mm (3/4 inch), but not less than size required for 40 percent fill.
2. Install insulated bushings on all conduit ends.
3. Install pull boxes after every 180 degrees of bends (two 90-degree bends) or every 100ft. Size boxes per TIA 569.
4. Extend vertical conduits/sleeves through floors minimum 75 mm (3 inches) above floor and minimum 75 mm (3 inches) below ceiling of floor below.
5. Terminate conduit runs to and from a backboard in a TR or interstitial space at top or bottom of backboard. Install conduits to enter telecommunication rooms next to wall and flush with backboard.
6. Where drilling is necessary for vertical conduits, locate holes so as not to affect structural sections.
7. Seal empty conduits located in telecommunications rooms or on backboards to prevent entrance of moisture and gases and to meet fire resistance requirements.
8. Provide pull wire in all empty conduits; sleeves through floor are exceptions.
9. Complete each entire conduit run installation before pulling in cables.
10. Flattened, dented, or deformed conduit is not permitted.
11. Ensure conduit installation does not encroach into ceiling height head room, walkways, or doorways.
12. Cut conduit square with a hacksaw, ream, remove burrs, and draw tight.
13. Install conduit mechanically continuous.
14. Independently support conduit at 2.44 m (8 feet) on center; do not use other supports (i.e., suspended ceilings, suspended ceiling supporting members, luminaires, conduits, mechanical piping, or mechanical ducts).
15. Support conduit within 300 mm (1 foot) of changes of direction, and within 300 mm (1 foot) of each enclosure to which connected.

16. Close ends of empty conduit with plugs or caps to prevent entry of debris, until cables are pulled in.
17. Conduit installations under fume and vent hoods are prohibited.
18. Attach conduits to cabinets, splice cases, pull boxes and outlet boxes with bonding type locknuts. For rigid and IMC conduit installations, provide a locknut on inside of enclosure, made up wrench tight. Do not make conduit connections to box covers.
19. Do not use aluminum conduits in wet locations.
20. Unless otherwise indicated on drawings or specified herein, conceal conduits within finished walls, floors and ceilings.
21. Conduit Bends:
    a. Make bends with standard conduit bending machines; observe minimum bend radius for cable type and outside diameter.
    b. Conduit hickey is permitted only for slight offsets, and for straightening stubbed conduits.
    c. Bending of conduits with a pipe tee or vise is not permitted.
    d. Minimum radius of communication conduit bends:

| Sizes of Conduit Trade Size | Radius of Conduit Bends mm, Inches |
|---|---|
| 3/4 | 150 (6) |
| 1 | 230 (9) |
| 1-1/4 | 350 (14) |
| 1-1/2 | 430 (17) |
| 2 | 525 (21) |
| 2-1/2 | 635 (25) |
| 3 | 775 (31) |
| 3-1/2 | 900 (36) |
| 4 | 1125 (45) |

22. Layout and Homeruns - Deviations: Make only where necessary to avoid interferences and only after drawings showing proposed deviations have been submitted and approved by COR.

D. Concealed Work Installation:
1. In Concrete:
    a. Conduit: Rigid steel or IMC.
    b. Align and run conduit in direct lines.

c. Install conduit through concrete beams only when the following occurs:
   1) Where shown on structural drawings.
   2) As accepted by COR prior to construction, and after submittal of drawing showing location, size, and position of each penetration.
d. Installation of conduit in concrete that is less than 75 mm (3 inches) thick is prohibited.
   1) Conduit outside diameter larger than 1/3 of slab thickness is prohibited.
   2) Space between Conduits in Slabs: Approximately six conduit diameters apart, except one conduit diameter at conduit crossings.
   3) Install conduits approximately in center of slab to ensure a minimum of 19 mm (3/4 inch) of concrete around conduits.
e. Make couplings and connections watertight. Use thread compounds that are NRTL listed conductive type to ensure low resistance ground continuity through conduits. Tightening set screws with pliers is not permitted.

E. Furred or Suspended Ceilings and in Walls:
   1. Rigid steel, IMC or rigid aluminum. Different type conduits mixed indiscriminately in same system is not permitted.
   2. Align and run conduit parallel or perpendicular to building lines.
   3. Tightening set screws with pliers is not permitted.

F. Exposed Work Installation:
   1. Unless otherwise indicated on drawings, exposed conduit is only permitted in telecommunications rooms.
      a. Provide rigid steel, IMC or rigid aluminum.
      b. Different type of conduits mixed indiscriminately in system is not permitted.
   2. Align and run conduit parallel or perpendicular to building lines.
   3. Install horizontal runs close to ceiling or beams and secure with conduit straps.
   4. Support horizontal or vertical runs at not over 2400 mm (96 inches) intervals.
   5. Painting:

a. Paint exposed conduit as specified in Section 09 91 00, PAINTING.
b. Refer to Section 09 91 00, PAINTING for preparation, paint type, and exact color.
c. Provide labels where conduits pass through walls and floors and at maximum 6000 mm (20 foot) intervals in between.

G. Expansion Joints:
1. Conduits 75 mm (3 inches) and larger, that are secured to building structure on opposite sides of a building expansion joint, require expansion and deflection couplings. Install couplings in accordance with manufacturer's recommendations.
2. Provide conduits smaller than 75 mm (3 inches) with pull boxes on both sides of expansion joint. Connect conduits to expansion and deflection couplings as specified.
3. Install expansion and deflection couplings where shown.

H. Seismic Areas:
1. In seismic areas, follow H-18-8 Seismic Design Requirements.
2. Rigidly secure conduit to building structure on opposite sides of a building expansion joint with pull boxes on both sides of joint.
3. Connect conduits to pull boxes with 375 mm (15 inches) of slack flexible conduit.
4. Install green copper wire minimum #6 AWG in flexible conduit for bonding jumper.

I. Conduit Supports, Installation:
1. Select AC193 code listed mechanical anchors or fastening devices with safe working load not to exceed 1/4 of proof test load.
2. Use pipe straps or individual conduit hangers for supporting individual conduits. Maximum distance between supports is 2.5 m (8 foot) on center.
3. Support multiple conduit runs with trapeze hangers. Use trapeze hangers designed to support a load equal or greater than sum of the weights of the conduits, wires, hanger itself, and 90 kg (200 pounds). Attach each conduit with U-bolts or other accepted fasteners.
4. Support conduit independent of pull boxes, luminaires, suspended ceiling components, angle supports, duct work, and similar items.
5. Fastenings and Supports in Solid Masonry and Concrete:

a. New Construction: Use steel or malleable iron concrete inserts set in place prior to placing concrete.

b. Existing Construction:

1) Code AC193 listed wedge type steel expansion anchors minimum 6 mm (1/4 inch) bolt size and minimum 28 mm (1-1/8 inch) embedment.

2) Power set fasteners minimum 6 mm (1/4 inch) diameter with depth of penetration minimum 75 mm (3 inches).

3) Use vibration and shock resistant anchors and fasteners for attaching to concrete ceilings.

6. Fastening to Hollow Masonry: Toggle bolts are permitted.

7. Fastening to Metal Structures: Use machine screw fasteners or other devices designed and accepted for application.

8. Bolts supported only by plaster or gypsum wallboard are not acceptable.

9. Attachment by wood plugs, rawl plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.

10. Do not support conduit from chain, wire, or perforated strap.

11. Spring steel type supports or fasteners are not permitted except horizontal and vertical supports/fasteners within walls.

12. Vertical Supports:

a. Install riser clamps and supports for vertical conduit runs in accordance with NEC.

b. Provide supports for cable and wire with fittings that include internal wedges and retaining collars.

J. Box Installation:

1. Boxes for Concealed Conduits:

a. Flush mounted.

b. Provide raised covers for boxes to suit wall or ceiling, construction and finish. In spaces not controlled by VA (i.e., common hallways) covers must be lockable.

2. In addition to boxes shown, install additional boxes where needed to prevent damage to cables during pulling.

3. Remove only knockouts as required and plug unused openings. Use threaded plugs for cast metal boxes and snap-in metal covers for sheet metal boxes.
4. Stencil or install phenolic nameplates on covers of boxes identified on riser diagrams; for example "SIG-FA JB No. 1".
5. Outlet boxes mounted back-to-back in same wall are not permitted. A minimum 600 mm (24 inches) center-to-center lateral spacing must be maintained between boxes.

K. Flexible Nonmetallic Communications Raceway (Innerduct), Installation:
1. Install Innerduct in cable tray. Innerduct may not be free-hung.
2. Install only in accessible spaces not subject to physical damage or corrosive influences.
3. Make bends manually to assure internal diameter of tubing is not effectively reduced.
4. Extend each segment of innerduct minimum 300 mm (12 inches) beyond end of service conduit tie or cable tray. Restrain innerduct ends with wall mount clamps and seal when cable is installed.

**3.2 TESTING**

A. Examine fittings and locknuts for secureness.
B. Test RMC, IMC and EMT systems for electrical continuity and resistance to ground.

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# SECTION 27 05 36
# CABLE TRAYS FOR COMMUNICATIONS SYSTEMS

## PART 1 - GENERAL

### 1.1 DESCRIPTION:

This section specifies requirements for telecommunications cabling cable tray and raceway equipment.

### 1.2 SUMMARY

Section Includes:

A. Cable Tray.

B. Fiber Optic Cable Raceway.

### 1.3 REFERENCES

A. VA Infrastructure Standard for Telecommunications Spaces.

### 1.4 RELATED WORK:

A. Grounding and bonding: Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.

### 1.5 SUBMITTALS:

A. Submit in accordance with Section 27 05 00, COMMON WORK RESULTS FOR COMMUNICATIONS SYSTEMS.

## PART 2 - PRODUCTS

### 2.1 CABLE TRAY.

A. Design. Wire basket with tray insert. Maximum 2” x 4” wire mesh construction. Constructed of round, smooth wire with continuous top side to minimize cable sheath damage.

B. Finish. Coated to prevent rust.

C. Size. Cable tray shall be sized to hold the maximum expected cable load at not more than 40% fill and not more than 6” maximum cable depth.

D. Accessories. Provide and install the following components and accessories as necessary to achieve the design:

1. Overhead mounting equipment (thread-rod, unistrut, nuts, washers, etc.) suitable for the supporting structural elements.

2. Tray section splicing hardware.

3. Tray insert.

4. Cable waterfalls.

5. Ground strap kits.

6. Bend radius limiters.

**2.2 FIBER OPTIC CABLE RACEWAY.**

A. Design. Raceway system shall be a modular system of channels, fittings, and brackets, able to be assembled with couplers. Fittings for cable spillout shall maintain a minimum 2” bend radius.

B. Materials. Raceway shall be constructed of rigid PVC and ABS plastics.

C. Size. Raceway shall be nominally sized 4”x4”.

D. Accessories. Provide and install the following components and accessories as necessary to achieve the design:

1. Overhead mounting equipment (thread-rod, unistrut, nuts, washers, etc.) suitable for the supporting structural elements.

2. Hinged channel covers.

3. Raceway section couplers.

4. Channel corners and intersections.

5. Spillway fittings.

**PART 3 - EXECUTION**

**3.1 IMPLEMENTION:**

A. Cable tray shall be used in horizontal applications.

B. Cable tray sections shall be bonded together with bonding conductors and the system bonded to the bonding busbar in the space.

C. Support horizontal cable tray not less than every 5’ (shorter spans if recommended by the equipment manufacturer).

- - - E N D - - -

# SECTION 27 05 53
# IDENTIFICATION FOR COMMUNICATIONS SYSTEMS

## PART 1 - GENERAL

### 1.1 DESCRIPTION:

This section specifies labeling and identification requirements for information technology (IT) equipment cabinets, racks, and cabling.

### 1.2 SUMMARY

Section Includes:

A. Equipment and component labels.

B. Labeling implementation requirements.

### 1.3 REFERENCES

A. VA Infrastructure Standard for Telecommunications Spaces.

### 1.4 RELATED WORK:

A. Server cabinets and network racks: Section 27 11 16, COMMUNICATIONS CABINETS, RACKS, FRAMES, AND ENCLOSURES.

B. Cable management equipment: Section 27 11 23, COMMUNICATIONS CABLE MANAGEMENT AND LADDER RACK.

C. Copper UTP cabling: Section 27 13 13, COMMUNICATIONS COPPER BACKBONE CABLING.

D. Fiber optic cabling: Section 27 13 23, COMMUNICATIONS OPTICAL FIBER BACKBONE CABLING.

### 1.5 SUBMITTALS:

A. Submit in accordance with Section 27 05 00, COMMON WORK RESULTS FOR COMMUNICATIONS SYSTEMS.

## PART 2 - PRODUCTS

### 2.1 EQUIPMENT AND COMPONENT LABELS.

A. Materials. Materials used for labeling equipment, components, and telecommunications cabling shall be appropriate for the installation environment, durable and permanent, and heat-resistant if necessary for labeling in high-temperature environments.

**PART 3 - EXECUTION**

**3.1 IMPLEMENTION:**

A. Governing Standard. Labeling and identification of equipment, components, and telecommunications cabling shall be based on ANSI/TIA-606-C, Administration Standard for Telecommunications Infrastructure, and NFPA 70, National Electrical Code, as modified by guidance in the VA Infrastructure Standard for Telecommunications Spaces.

B. All passive infrastructure equipment, components, and telecommunications cabling installed shall be labeled at the time of installation.

C. Telecommunications cable labeling shall include delivery of complete and accurate connection documentation (where each cable terminates at each end) matching the installed labels.

D. Label locations shall be as specified in the VA Infrastructure Standard for Telecommunications Spaces.

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# SECTION 27 10 00
# STRUCTURED CABLING

## PART 1 - GENERAL

### 1.1 DESCRIPTION:

This section specifies requirements for telecommunications structured cabling systems.

### 1.2 SUMMARY

Section Includes:

A. Computer Room Backbone Structured Cabling.

B. Computer Room Horizontal Structured Cabling.

C. Facility Backbone Structured Cabling.

D. Facility Horizontal Structured Cabling.

### 1.3 REFERENCES

A. VA Infrastructure Standard for Telecommunications Spaces.

### 1.4 RELATED WORK:

A. Cabling labeling and identification: Section 27 05 53, IDENTIFICATION FOR COMMUNICATIONS SYSTEMS.

B. Cable termination locations and equipment: Section 27 11 19, COMMUNICATIONS TERMINATION BLOCKS AND PATCH PANELS.

### 1.5 SUBMITTALS:

A. Submit in accordance with Section 27 05 00, COMMON WORK RESULTS FOR COMMUNICATIONS SYSTEMS.

## PART 2 - PRODUCTS

### 2.1 COMPUTER ROOM BACKBONE STRUCTURED CABLING.

Backbone structured cabling in the computer room environment (first level backbone) connects the Main Distribution Areas (MDAs) to the Horizontal Distribution Areas (HDAs).

A. Install first level backbone structured cabling in overhead cable tray and fiber raceway systems following diverse path routing.

B. All cabling used shall be pre-terminated and procured to the specific length required by the design (horizontal and vertical paths) with no more than 1 meter of excess length on each end.

C. Terminate first level backbone structured cabling in the top RU positions of each network rack or cabinet, working downward, with patch panel equipment mounted on the front rails.

D. Mirror distribution on the A-side and B-side MDA and HDA elements.

1. In MDA network racks or cabinets:
   a. Install angled UTP patch panel(s) for each backbone UTP patch panel in the same-side HDA in the computer room beginning in RU45.
   b. Install an angled panel cover on the lowest UTP patch panel.
   c. Install a blanking panel in the RU below the UTP patch panels.
   d. Install fiber optic distribution cabinets to support the backbone fiber distribution from each HDA.
   e. Install a blanking panel in the RU below the fiber optic distribution cabinet(s).
2. In HDA network racks:
   a. Install fiber optic distribution cabinet(s) and populate with fiber optic distribution cassettes starting in RU45.
   b. Install a blanking panel in the RU below the last fiber cabinet.
   c. Install UTP patch panel(s) below the blanking panel.
   d. Install a blanking panel in the RU below the last UTP patch panel.

E. Install UTP cables between the same-side MDAs and HDAs.

F. Install 12- or 24-strand multimode fiber optic cables between each fiber cassette in the HDA to either the same-side MDA or the opposite side MDA as appropriate.

**2.2 COMPUTER ROOM HORIZONTAL STRUCTURED CABLING.**

Horizontal structured cabling in the computer room environment connects the Equipment Distributors (EDs) in the server cabinets to each supported Horizontal Distribution Area (HDA).

A. Install horizontal structured cabling in overhead cable tray and fiber raceway systems following diverse path routing.

B. All cabling used shall be pre-terminated and procured to the specific length required by the design (horizontal and vertical paths) with no more than 1 meter of excess length on each end.

C. In the server cabinets, terminate horizontal structured cabling in EDs located in the top 5U of each cabinet, with patch panel equipment mounted on the rear rails.
   1. Install fiber optic distribution cabinet(s) starting in RU45 and populate with fiber optic distribution cassettes to support the requirement.
   2. Install a blanking panel in the RU below the last fiber cabinet.
   3. Install copper UTP patch panel(s) below the blanking panel.

D. In the HDAs, terminate horizontal structured cabling in the RU positions immediately below the first level backbone structured cabling equipment of each network rack , working downward, with patch panel equipment mounted on the front rails.
   1. Install fiber optic distribution cabinet(s) and populate with fiber optic distribution cassettes to support each server cabinet.
   2. Install a blanking panel in the RU below the fiber optic distribution cabinet(s).

E. Install 12- or 24-strand multimode fiber optic cables between the server cabinet ED and both HDAs.

F. Install UTP cables between the server cabinet ED and both HDAs.

**2.3 FACILITY BACKBONE STRUCTURED CABLING.**

Backbone structured cabling (inter-building and intra-building first level backbone) connects the Entrance Rooms to the Main Distribution Areas (MDAs) in the computer room, and connects the Main Distribution Areas to each Telecommunications Room (TR). This specification describes facility backbone structured cabling when the Entrance Rooms and computer room are in the same building, connected entirely by environmentally conditioned pathways (no outside plant pathways are transited).

A. Interior to each telecommunications space, install facility backbone structured cabling in overhead cable tray and fiber raceway systems.

B. All facility backbone structured cabling shall be redundant and follow diverse path routing.

C. Facility backbone cabling shall be field-terminated (fusion spliced).

D. In the Entrance Room, MDA, and TR network racks or cabinets designated for facility backbone distribution, install fiber optic distribution cabinets as required for the quantity of fibers installed.

E. Between each Entrance Room and the computer room:

1. Provide 2 diversely routed paths of backbone cabling from each Entrance Room. One path will terminate on the A-side MDA and one path will terminate on the B-side MDA.
2. Install a minimum of 24 strands of multimode fiber optic cabling and 12 strands of single-mode fiber optic cabling per path.
3. Populate the fiber optic distribution cabinets on each end with a sufficient quantity of multimode OM4 and single-mode OS1 fiber optic splice cassettes per path.

F. Between each MDA and each TR:

1. No zone/intermediate distribution areas (ZDAs/IDAs) intermediate cross-connects (ICCs) shall be used. All facility backbone cabling between the MDAs and TRs shall be run directly and continuously.
2. Provide 2 diversely routed paths of backbone cabling, one from the A-side MDA and one from the B-side MDA.
3. Where the TR is located in the same building as the computer room MDAs (does not transit outside plant pathways) and the path distance is less than 400 meters, install a minimum of 24 strands of multimode fiber optic cabling and 12 strands of single-mode fiber optic cabling per path.
   a. Populate the fiber optic distribution cabinets on each end with a sufficient quantity of multimode OM4 and single-mode OS1 fiber optic splice cassettes per path.
4. Where the TR is located in a different building as the computer room (transits outside plant pathways) or the path distance is greater than 400m, install a minimum of 24 strands of single-mode fiber optic cabling per path.
   a. Populate the fiber optic distribution cabinets on each end with a sufficient quantity of single-mode OS2 fiber optic splice cassettes per path.

**2.4 FACILITY HORIZONTAL STRUCTURED CABLING.**

Facility horizontal structured cabling (horizontal distribution) connects the Telecommunications Room (TR) to each end-user Work Area Outlet (WAO).

A. Interior to each TR, install horizontal distribution structured cabling in overhead cable tray systems.
B. All horizontal distribution structured cabling shall have a minimum of 2 cables per WAO.
C. Horizontal distribution structured cabling may be field-terminated.
D. In each TR install sufficient UTP patch panels to support the quantity of WAOs in the TR's serving zone.
    1. Plan network racks such that patch panels and horizontal cable managers are located in the top 1/3 (RU31-45), switching equipment in the middle 1/3 (RU16-30), and power distribution and other services in the bottom 1/3 (RU1-15).
E. Install a minimum of 2 UTP cables between the TR UTP patch panels and each work area faceplate.
F. Each typical end-user receptacle shall be constructed of a single-gang workbox with one connector chassis, a minimum of two non-proprietary Category 6A 8P8C media interface connectors (RJ-45), and a four-position keystone faceplate.
    1. Modular plug terminated links (MPTL) are permitted to service wireless access points (WAPs), cameras, and other Power over Ethernet (PoE) devices where mating will be very infrequent.

**PART 3 - EXECUTION**

**3.1 IMPLEMENTION:**

A. 100% construction drawing sets shall include drawings detailing the computer room and facility/campus structured cabling systems, including:
    1. Cable media performance categories for each type of run.
    2. Cabling and equipment quantities.
    3. Elevation drawings showing equipment placement in individual enclosures.
    4. Full interconnection diagram for all structured cabling.
    5. Port map and cable label matrices.
B. All cabling and equipment shall be labeled per the requirements of the VA Infrastructure Standard for Telecommunications Spaces.

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# SECTION 27 11 16
# COMMUNICATIONS CABINETS, RACKS, FRAMES, AND ENCLOSURES

## PART 1 - GENERAL

### 1.1 DESCRIPTION:

This section specifies Information Technology (IT) equipment enclosures for use in VA telecommunications spaces.

### 1.2 SUMMARY

Section Includes:

A. Server Cabinets.

B. Network Channel Racks.

C. Network Cabinets.

D. Telecommunications Enclosures.

E. Pathway Racks.

### 1.3 REFERENCES

A. VA Infrastructure Standard for Telecommunications Spaces.

### 1.4 RELATED WORK:

A. Cabling termination equipment, rack-mounted: Section 27 11 19, COMMUNICATIONS TERMINATION BLOCKS AND PATCH PANELS.

B. Cable management equipment: Section 27 11 23, COMMUNICATIONS CABLE MANAGEMENT AND LADDER RACK.

C. Power distribution equipment: Section 27 11 26, COMMUNICATIONS RACK MOUNTED POWER PROTECTION AND POWER STRIPS.

D. Grounding and bonding equipment: Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.

E. Labeling and identification requirements: Section 27 05 53, IDENTIFICATION FOR COMMUNICATIONS SYSTEMS.

F. Seismic bracing: Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

### 1.5 SUBMITTALS:

A. Submit in accordance with Section 27 05 00, COMMON WORK RESULTS FOR COMMUNICATIONS SYSTEMS.

## PART 2 - PRODUCTS

### 2.1 SERVER CABINETS.

A. Height. Cabinets shall provide 45 standard rack units (RU) of space (45U) for mounting equipment.

B. Dimensions. Nominal dimensions for server cabinets are 84” (2134mm) tall, 23.6” (600mm) wide, and 48” (1220mm) deep, including side panels and doors. Minimum depth is 46” (1168mm). Maximum width is 24” (610mm).

C. Doors and Panels.

1. Front Door. Provide a single locking, latched, hinged metal front door for the server cabinet with minimum 75% open perforated design for airflow.

2. Rear Door. Provide a single or double locking, latched, hinged metal rear door for the server cabinet.

a. If a vertical exhaust duct (VED, “chimney”) is specified for the server cabinet, the rear door shall be solid.

b. If no VED is specified, the rear door shall be perforated with a minimum of 75% open design for airflow.

3. Side Panels. Provide removable, locking solid metal side panels. Side panels shall have cable pass-through cut-outs protected with brushed grommets on each side, aligned on each side to allow Rack PDU cables to pass between enclosures to Zone PDUs.

D. Locks. All locks on a server cabinet shall be keyed the same. Provide two keys per cabinet.

E. Color. The cabinet and all components shall be white in color.

F. Equipment Mounting Rack. The cabinet shall provide an EIA-310-E compliant 19” racking system with front and rear rails using standard 3/8” x 3/8” square hole mounting.

1. Rear Rails. Position rear rails with a minimum of 6” of clearance between the rails and the rear doors to accommodate rear-mounted angled patch panels and up to four (4) vertical rack PDUs.

G. Components. The cabinet shall be supplied with the following standard equipment:

a. Air dams for left and right of the front rails.

b. Finger cable managers.

c. Bottom panel with brushed grommets.

d. Top panel with brushed grommets.

e. Toolless mounting brackets for vertical Rack PDUs.

f. 45U of 1RU blanking panels.

**2.2 NETWORK CHANNEL RACKS.**

A. Height. Racks shall provide 45 standard rack units (RU) of space (45U) for mounting equipment.

B. Dimensions. Nominal dimensions for network racks are 86” (2184mm) tall, 24” (610mm) wide, and 40” (1220mm) deep (30”/762mm between front and rear mounting rails).

C. Side Panels. The rack shall have integral metal side panels (a "channel" rack) constructed with a cable management pattern of staggered shapes (circles, hexagons, etc.) to allow for connection points for cable management accessories.

E. Color. The rack and all components shall be white in color.

F. Equipment Mounting Rack. The rack shall provide an EIA-310-E compliant 19" racking system with front and rear rails using standard 3/8" x 3/8" square hole mounting EIA-tapped 10-32 holes.

G. Components. The rack shall be supplied with the following standard equipment:

a. Toolless mounting brackets for vertical Rack PDUs.

b. 30U of 1RU blanking panels.

c. Vertical cable managers with doors on both left and right of the rack (size commensurate with the requirement).

d. Cable management accessories as necessary to maintain cable bend radii, uniformity, and neatness (e.g. d-rings, spools, bend radius limiters, finger cable managers, waterfalls, etc.).

**2.3 NETWORK CABINETS.**

A. Height. Cabinets shall provide 45 standard rack units (RU) of space (45U) for mounting equipment.

B. Dimensions. Minimum depth is 46" (1168mm). Maximum width is 24" (610mm).

C. Doors and Panels.

1. Front Door. Provide a single locking, latched, hinged metal front door for the server cabinet with minimum 75% open perforated design for airflow.

2. Rear Door. Provide a single, double locking, latched, hinged metal rear door for the server cabinet.

The rear door shall be perforated with a minimum of 75% open design for airflow.

3. Side Panels. Provide removable, locking solid metal side panels. Side panels shall have cable pass-through cut-outs protected with brushed grommets on each side, aligned on each side to allow Rack PDU and communications cables to pass between enclosures to Zone PDUs.

D. Locks. All locks on a server cabinet shall be keyed the same. Provide two keys per cabinet.

E. Color. The cabinet and all components shall be white in color.

F. Equipment Mounting Rack. The cabinet shall provide an EIA-310-E compliant 19" racking system with front and rear rails using standard 3/8" x 3/8" square hole mounting.

G. Components. The cabinet shall be supplied with the following standard equipment:

a. Air dams for left and right of the front rails.

b. Bottom panel with brushed grommets.

c. Top panel with brushed grommets.

d. Toolless mounting brackets for vertical Rack PDUs.

e. 45U of 1RU blanking panels.

f. Cable management accessories as necessary to maintain cable bend radii, uniformity, and neatness (e.g. d-rings, spools, bend radius limiters, finger cable managers, waterfalls, etc.).

**2.4 TELECOMMUNICATIONS ENCLOSURES (TE).**

Telecommunications Enclosures (TEs) are swing-out wall-mounted enclosures.

A. Height. TEs shall provide 12 or 26 or other standard rack units (RU) of space for mounting equipment.

B. Dimensions. Nominal dimensions for server cabinets are 24” (610mm) 48” (1220mm) tall, 24” (610mm) wide, and 30” (760mm) deep.

C. Doors and Panels.

1. Front Door. TEs shall have a single locking, latched, hinged metal front door with a tempered glass front.

2. Rear Panel. TEs shall have a latched, hinged metal rear door that mounts to the wall, allowing the body of the TE to be swung open for rear equipment access. If latched exterior to the body of the TE, the latch shall be locking.

a. Cabling Cutouts. The top and bottom surfaces of the rear panel shall have cabling cutouts to accommodate telecommunications cabling entering the TE. Edge-protection grommets for the cabling cutouts shall be provided.

b. Power Cutout. The rear panel shall have a cutout on the rear mounting surface allowing power to be installed internal to the TE.

3. Locks. All locks on a TE shall be keyed the same. Provide two keys per TE.

D. Load Rating. The TE shall support 300lb (136kg) of total weight.

E. Color. The cabinet and all components shall be white in color.

F. Equipment Mounting Rack. The cabinet shall provide an EIA-310-E compliant 19” racking system with front and rear rails using standard threaded #12-24 hole mounting.

G. Components. The cabinet shall be supplied with the following standard equipment:

a. 1U shelf (two per TE).

b. Vertical cable management kits (one per each full 12U of TE height).

c. Fan kit to evacuate heat generated by active equipment (two per TE).

d. Filter kit for fans (two per TE).

**2.5 PATHWAY RACKS.**

A. Height. Pathway racks shall provide a minimum of 5 standard rack units (RU) of space (5U) for mounting Equipment Distributor equipment.

B. Dimensions. Nominal dimensions for pathway racks are 12.6” tall, 23.6” wide, and 9” deep.

C. Mounting. Pathway racks shall mount to standard basket-style cable tray.

E. Color. Pathway racks shall be white in color.

F. Equipment Mounting Rack. The cabinet shall provide an EIA-310-E compliant 19” racking system with rails using standard 3/8” x 3/8” square hole mounting EIA-tapped 10-32 holes .

**PART 3 - EXECUTION**

**3.1 INSTALLATION:**

A. Where to be installed in structures assigned to Seismic Design Category C, D, E, or F, seismic bracing equivalent to that for other storage racks per VA Master Specification 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS section 3.7 (“Install… to withstand earthquake forces and anchored to the floor or laterally braced from the top to the structural elements”) is required.

B. Casters on floor-mounted enclosures shall be retracted and the enclosures leveled and stabilized.

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# SECTION 27 11 19
# COMMUNICATIONS TERMINATION BLOCKS AND PATCH PANELS

## PART 1 - GENERAL

### 1.1 DESCRIPTION:

This section specifies cable termination and management equipment to be mounted in information technology (IT) equipment cabinets and racks.

### 1.2 SUMMARY

Section Includes:

A. Copper UTP Patch Panels.

B. Fiber Optic Distribution Cabinets.

C. Fiber Optic Distribution Cassettes.

D. Fiber Optic Splice Cassettes.

E. Horizontal Cable Managers.

F. Blanking Panels.

### 1.3 REFERENCES

A. VA Infrastructure Standard for Telecommunications Spaces.

### 1.4 RELATED WORK:

A. Server cabinets and network racks: Section 27 11 16, COMMUNICATIONS CABINETS, RACKS, FRAMES, AND ENCLOSURES.

B. Cable management equipment: Section 27 11 23, COMMUNICATIONS CABLE MANAGEMENT AND LADDER RACK.

C. Labeling and identification requirements: Section 27 05 53, IDENTIFICATION FOR COMMUNICATIONS SYSTEMS.

D. Copper UTP cabling: Section 27 13 13, COMMUNICATIONS COPPER BACKBONE CABLING.

E. Copper UTP cabling termination: Section 27 13 13.13, COMMUNICATIONS COPPER CABLE SPLICING AND TERMINATIONS.

F. Fiber optic cabling: Section 27 13 23, COMMUNICATIONS OPTICAL FIBER BACKBONE CABLING.

G. Fiber optic cabling termination: Section 27 13 23.13, COMMUNICATIONS OPTICAL FIBER SPLICING AND TERMINATIONS.

### 1.5 SUBMITTALS:

A. Submit in accordance with Section 27 05 00, COMMON WORK RESULTS FOR COMMUNICATIONS SYSTEMS.

**PART 2 - PRODUCTS**

**2.1 COPPER (UTP) PATCH PANELS.**

A. Form Factor. 1U, 19” rack-mountable. Default form factor for patch panels shall be angled to extend not less than 4” (104mm) forward from the mounting rail.

B. Capacity. 48 copper 8P8C ports in groupings of 6.

C. Interface. Copper (UTP) patch panels shall accept pre-terminated single 8P8C keystone jacks and 6-jack cassettes.

D. Accessories. Provide each patch panel installation with the following accessories.

1. Angled panel cover. Specify angled panel covers at the top and bottom of each stack of angled patch panels. Covers shall mount to the same RU rail positions as the top and bottom patch panels.

2. Rear cable manager tray. Specify one rear cable manager tray per patch panel. Trays shall mount to the same RU rail positions as the patch panel.

**2.2 FIBER OPTIC DISTRIBUTION CABINETS.**

A. Form Factor. 1U, 19” rack-mountable, angled to extend not less than 4” (104mm) forward from the mounting rail.

B. Capacity. 144 fibers in a variety of distribution and/or splice cassettes.

C. Door. Cabinets shall be supplied with a locking front cover.

D. Accessories. Provide each distribution cabinet with the following accessories.

1. Rear cable manager. Specify one rear cable manager with fiber storage rings per distribution cabinet. Trays shall mount to the same RU rail positions as the distribution cabinet.

2. 0RU patch cord managers. Specify one pair of patch cord managers per distribution cabinet. Managers shall mount to the same RU rail positions as the distribution cabinet and rear cable manager.

**2.3 FIBER OPTIC SPLICE CASSETTES.**

Fiber optic splice cassettes are used in backbone structured cabling connecting the Entrance Rooms to the Main Distribution Areas (MDAs) in the computer room, and the MDAs to Telecommunications Rooms (TRs) where field-terminated (fusion spliced) cable is used.

A. Form Factor. Designed to install in rack-mounted fiber optic distribution cabinet.

B. Connections. Adapters on the front of the cassette shall accept // 6 duplex Lucent connector (LC) fiber pairs // // 3 sets of 8-strand multi-fiber push-on (MPO) connectors // // other (per specific design) //.

C. Design. Splice cassette modules shall be self-contained to integrate fiber adapter bulkhead and splice holders. No additional splice trays shall be necessary. Each module shall provide // 12 // // 24 // fiber splice connections.

D. Fiber Type. Provide multimode OM4 and single-mode OS2 splice cassettes as required by the quantity of each type of fiber installed.

**2.5 HORIZONTAL CABLE MANAGERS.**

A. Form Factor. 2U, 19” rack-mountable.

B. Door. Horizontal cable managers shall have a double-hinged front cover to protect installed cables.

C. Fingers. 6-port spacing (five fingers).

**2.6 BLANKING PANELS.**

A. Form Factor. 2RU, 19” rack-mountable, flat or angled to extend 4” (104mm) forward from the mounting rail.

B. Transition. Blanking panel shall have a transition cover from angled front to flat front.

C. Quantity. Provide blanking panels to fill 75% of all RUs in all server cabinets and network cabinets.

**PART 3 - EXECUTION**

**3.1 INSTALLATION:**

Not used.

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# SECTION 27 11 26
# COMMUNICATIONS RACK MOUNTED POWER PROTECTION AND POWER STRIPS

## PART 1 - GENERAL

### 1.1 DESCRIPTION

This section specifies power distribution equipment and interconnections supporting equipment deployed in telecommunications spaces (entrance rooms, computer rooms, and telecommunications rooms).

### 1.2 SUMMARY

Section Includes:

A. Zone Power Distribution Units (zPDUs).

B. Rack-Mounted Uninterruptible Power Supply (UPS) Units.

C. Rack Power Distribution Units (rPDUs).

### 1.3 REFERENCES

A. VA Infrastructure Standard for Telecommunications Spaces.

### 1.4 RELATED WORK

A. General electrical requirements that are common to more than one section in Division 27: Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.

B. IT equipment enclosures: Section 27 11 16, COMMUNICATIONS CABINETS, RACKS, FRAMES, AND ENCLOSURES

### 1.5 SUBMITTALS

A. Submit in accordance with Section 27 05 00, COMMON WORK RESULTS FOR COMMUNICATIONS SYSTEMS.

B. For each type of product:

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for rack-mounted power protection and power strips.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

## PART 2 - PRODUCTS

### 2.1 ZONE POWER DISTRIBUTION UNITS (ZONE PDU)

A. Provide components from a single manufacturer.

B. 60 Amp Zone PDU:

1. Description: Zone PDU with A/B redundant 3-phase 60A input

circuits and three (3) pairs of A/B redundant L21-20R outlets allowing each supported Standard Density (5kW) enclosure to operate at full density rating.

2. Input Connection: Dual 60A three-phase 208V hard-wired, with junction box and five-wire (L+L+L+N+G) DIN copper terminal blocks accommodating 4AWG conductors. Power cord 10’ (3m) length.

3. Output Connection: Three (3) pairs of A/B (redundant) L21-20R outlets.

4. Power Capacity: 43.2kW (21.6kW redundant at full load); 5.7kW fully-rated at each L21-20R outlet.

5. Enclosure: Fully self-contained.

6. Mounting: 1” rack-mount.

C. 30 Amp Zone PDU:

1. Description: Zone PDU with A/B redundant 3-phase 30A input circuits and two (2) pairs of A/B redundant L21-20R outlets allowing each supported Standard Density (5kW) enclosure to operate at partial density rating.

2. Input Connection: Dual 30A three-phase 208V L21-30P. Power cord 10’ (3m) length.

3. Output Connection: Two (2) pairs of A/B (redundant) L21-20P outlets.

4. Power Capacity: 21.6kW (10.8kW redundant at full load); combined 8.6kW rated output through each A/B pair of L21-20R outlets.

5. Enclosure: Fully self-contained.

6. Mounting: 1” rack-mount.

**2.2 RACK-MOUNTED UNINTERRUPTIBLE POWER SUPPLY (UPS) UNITS**

A. Provide components from a single manufacturer.

B. Description: 5kW three-phase 208V 20A rack-mounted UPS with L21-20 input and output connections.

C. Input Connection: Single input NEMA L21-20P plug (twistlock three-phase five wire L+L+L+N+G). Power cord minimum 3’ (1m) length.

D. Output Connection: Single output NEMA L21-20R receptacle.

E. Power Capacity: 5kW

F. Enclosure: Fully self-contained.

G. Mounting: 19” rack mount.

H. Battery Capacity: Ten minutes at 70% load (3.5kW).

I. Cooling: Fan-cooled, front air entry, rear exhaust.

**2.3 RACK POWER DISTRIBUTION UNITS (RACK PDUS)**

A. Provide components from a single manufacturer.

B. Description: Metered/monitored three-phase 208V 20A vertical Rack Power Distribution Unit (Rack PDU), 5.7kW, with IEC60320 outlets.

C. Input Connection: Single input NEMA L21-20P plug (twistlock three-phase five wire L+L+L+N+G). Power cord 10’ (3m) length.

D. Output Connections.

1. For Computer Room applications: Minimum 30 each C13 and 6 each C19. Outlets grouped in phase-grouping banks (A-B, B-C, C-A) or alternating to assist with phase balancing. Outlets labelled with associated phase-grouping bank.

2. For Telecommunications Room (TR) and entrance room applications: Minimum 30 each C13, 6 each C19, 2 each L5-20. Outlets grouped in phase-grouping banks (A-B, B-C, C-A) or alternating to assist with phase balancing. Outlets labelled with associated phase-grouping bank.

E. Power Capacity: 5.7kW rated.

F. Enclosure: Fully self-contained.

G. Mounting: Toolless mounting, orientation vertical at rear of enclosure, taking up zero RU spaces. Up to two Rack PDUs must be able to be installed on each side for High Density (10kW) enclosures.

H. Mounting Hardware: As required to connect to the specific enclosure make/model.

I. Number of RPDUs: 2 for Standard Density (up to 5kW) enclosures, 4 for High Density (10kW) enclosures.

J. Metering: Local display provides input line currents (Amperage). Additional metering items (voltage, power, energy, power factor) across the unit or at individual outlets, is acceptable.

K. Monitoring: RJ45 Ethernet port allows connection to an external monitoring system. Supports SNMP v3 with SSL Encryption.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

A. DEFINITION: Sides (left/right) of the enclosure are as when

viewed from the rear (hot aisle) of the enclosure for the purposes of this section.

B. Zone PDUs.

1. Install Zone PDUs only in enclosures that require them.
2. Zone PDUs shall not be installed in enclosures supported by busbar power distribution.
3. Install Zone PDUs beginning in RU position 1 or the first open RU position above any rack-mounted UPS unit, at the bottom of the 19” rack, on the rear rails of the enclosure.
4. Connect the Zone PDU power cords to the upstream branch circuit supporting the enclosures.

C. Rack-Mounted UPS Units.

1. Install rack-mounted UPS units only in enclosures that require them. Rack-mounted UPS units shall not be installed downstream of another UPS system (cascaded).
2. Where non-redundant UPS power is required to support the enclosure, install the rack-mounted UPS unit in the A side power distribution.
3. Install rack-mounted UPS units beginning in RU position 1, at the bottom of the 19” rack, with the exhaust ports facing the rear of the enclosure. No other equipment should be installed below the rack-mounted UPS units.
4. Connect the rack-mounted UPS unit power cord to the appropriate (A side) power receptacle on the upstream Zone PDU.

D. Rack PDUs.

1. Install Rack PDUs in matched A/B pairs only.
2. Install A side Rack PDUs on the left side of the enclosure and B side Rack PDUs on the right side of the enclosure, interior to the rear enclosure door.
3. Connect the Rack PDU power cord to the upstream rack-mounted UPS unit (where present) or the appropriate power receptacle on the upstream Zone PDU.

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# SECTION 27 13 23
# COMMUNICATIONS OPTICAL FIBER BACKBONE CABLING

## PART 1 - GENERAL

### 1.1 DESCRIPTION:

This section specifies requirements for telecommunications optical fiber backbone cabling.

### 1.2 SUMMARY

Section Includes:

A. Multimode Optical Fiber Backbone Cables.

B. Single Mode Optical Fiber Backbone Cables.

C. Hybrid Optical Fiber Backbone Cables.

### 1.3 REFERENCES

A. VA Infrastructure Standard for Telecommunications Spaces.

### 1.4 RELATED WORK:

A. Computer room structured cabling: Section 27 10 00, STRUCTURED CABLING.

B. Termination equipment: Section 27 11 19, COMMUNICATIONS TERMINATION BLOCKS AND PATCH PANELS.

B. Cable labeling requirements: Section 27 05 53, IDENTIFICATION FOR COMMUNICATIONS SYSTEMS.

### 1.5 SUBMITTALS:

A. Submit in accordance with Section 27 05 00, COMMON WORK RESULTS FOR COMMUNICATIONS SYSTEMS.

## PART 2 - PRODUCTS

### 2.1 MULTIMODE OPTICAL FIBER BACKBONE CABLES.

Multimode fiber optic backbone cables are specified for inside plant use, for data center backbone use as well as for intrabuilding campus backbone.

A. Performance Category. Laser-optimized OM4 or OM5 cables are specified.

B. Testing. All fiber optic backbone media shall pass all Tier 1 requirements (attenuation with an Optical Loss Test Set or OLTS, verification of cable length and polarity) and all Tier 2 requirements (characterization by an Optical Time Domain Reflectometer or OTDR resulting in indication of the uniformity of cable attenuation and connector insertion loss).

C. Termination. For computer room first level backbone usage, factory pre-terminated cables with MPO connectors are required. Fiber will be field terminated (fusion spliced) when used to connect the computer room to Telecommunications Rooms (TRs) and other telecommunications spaces.

1. Polarity. For pre-terminated MPO-MPO cables, the polarity of the cables shall be matched to the type of fiber optic distribution cassettes specified.

D. Jacket Color.

1. OM4. Aqua.

2. OM5. Lime.

E. Jacket Rating. Communications Multipurpose Cable, Plenum (CMP) shall be specified if any portion of the cable passes through an NEC-defined plenum. Communications Multipurpose Cable, Riser (CMR) shall be specified for all other applications. CMP may be used as a substitute for CMR.

F. Bundling and Construction. Bundles consisting of multiples of sub-bundles (subunits) of 12 strands of fiber are specified. Cables shall be dielectric and tight-buffered. Construction shall match the rear entry requirements of the fiber optic distribution or splice cassette such that the sub-bundle (subunit) remains jacketed into the cassette.

G. Length. Backbone cabling for computer room first level backbone use (pre-terminated) shall be procured to the specific length required by the design (horizontal and vertical paths) with no more than 1 meter of excess length on each end.

**2.2 SINGLE MODE OPTICAL FIBER BACKBONE CABLES.**

Single mode fiber optic backbone cables are specified for inside and outside plant use, for campus backbone (interbuilding and intrabuilding) use.

A. Performance Category. OS1 is specified for inside plant applications. Inside/outside rated OS2 is specified for applications where the pathway transits an outside plant path.

B. Testing. All fiber optic backbone media shall pass all Tier 1 requirements (attenuation with an Optical Loss Test Set or OLTS, verification of cable length and polarity) and all Tier 2 requirements

(characterization by an Optical Time Domain Reflectometer or OTDR resulting in indication of the uniformity of cable attenuation and connector insertion loss).

C. Termination. Fiber will be field terminated (fusion spliced) when used to connect the computer room to Telecommunications Rooms (TRs) and other telecommunications spaces.

D. Jacket Color. Yellow.

E. Jacket Rating. Communications Multipurpose Cable, Plenum (CMP) shall be specified if any portion of the cable passes through an NEC-defined plenum. Communications Multipurpose Cable, Riser (CMR) shall be specified for all other applications. CMP may be used as a substitute for CMR.

F. Bundling and Construction. Bundles consisting of multiples of sub-bundles (subunits) of 12 strands of fiber are specified. Cables shall be dielectric and tight-buffered for OS1, and loose-tube gel-filled for OS2.

**2.3 HYBRID OPTICAL FIBER BACKBONE CABLES.**

Hybrid cables containing multiple 12-strand bundles (subunits) of multimode and/or single mode fiber are acceptable.

**PART 3 - EXECUTION**

**3.1 IMPLEMENTATION.**

A. A. All cabling and equipment shall be labeled per the requirements of the VA Infrastructure Standard for Telecommunications Spaces.

B. Interior to telecommunications spaces, install fiber optic backbone cabling in overhead cable tray and fiber raceway systems.

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# SECTION 27 15 13
# COMMUNICATIONS COPPER HORIZONTAL CABLING

## PART 1 - GENERAL

### 1.1 DESCRIPTION:

This section specifies requirements for telecommunications copper (UTP) horizontal distribution cabling outside of the computer room. For copper (UTP) horizontal cabling in structured cabling systems in the computer room, see Section 27 13 13 Communications Copper Backbone Cabling.

### 1.2 SUMMARY

Section Includes:

A. Copper (UTP) Horizontal Cables.

### 1.3 REFERENCES

A. VA Infrastructure Standard for Telecommunications Spaces.

### 1.4 RELATED WORK:

A. Computer room structured cabling: Section 27 10 00, STRUCTURED CABLING.

B. Termination equipment: Section 27 11 19, COMMUNICATIONS TERMINATION BLOCKS AND PATCH PANELS.

B. Cable labeling requirements: Section 27 05 53, IDENTIFICATION FOR COMMUNICATIONS SYSTEMS.

### 1.5 SUBMITTALS:

A. Submit in accordance with Section 27 05 00, COMMON WORK RESULTS FOR COMMUNICATIONS SYSTEMS.

## PART 2 - PRODUCTS

### 2.1 COPPER (UTP) HORIZONTAL CABLES.

Copper (UTP) horizontal cables connect the Telecommunications Room (TR) to each end-user Work Area Outlet (WAO) (horizontal distribution).

A. Performance Category. Copper (UTP) horizontal cables shall meet the Category 6A performance requirements. Category 6A connectors are required.

B. Performance Specifications. Meets or exceeds TIA-EIA-568-C.2-10 and TSB-155.

C. Limited Power (LP) Certification. UL Listed as x-LP (0.5A).

D. Termination. Field terminated TIA 568B.

E. Testing. Following installation, each cable shall be field certified to meet performance category requirements per TIA 568-C.2.

F. Conductor Size. 22-24AWG.

G. Jacket Rating. Communications Multipurpose Cable, Plenum (CMP) shall be specified if any portion of the cable passes through an NEC-defined plenum. Communications Multipurpose Cable, Riser (CMR) shall be specified for all other applications. CMP may be used as a substitute for CMR.

H. Construction. Copper Clad Aluminum (CCA) cable is not permitted.

J. Length. The maximum distance for UTP horizontal cables is limited to 295 feet.

**PART 3 - EXECUTION**

**3.1 IMPLEMENTATION.**

A. A. All cabling and equipment shall be labeled per the requirements of the VA Infrastructure Standard for Telecommunications Spaces.

B. Interior to the TR, install horizontal copper (UTP) structured cabling in overhead cable tray.

- - - E N D - - -

# SECTION 27 15 13.13
# COMMUNICATIONS OPTICAL FIBER SPLICING AND TERMINATIONS

## PART 1 - GENERAL

### 1.1 DESCRIPTION:

This section specifies requirements for terminations of fiber optic cabling.

### 1.2 SUMMARY

Section Includes:

A. Termination Requirements.

### 1.3 REFERENCES

A. VA Infrastructure Standard for Telecommunications Spaces.

### 1.4 RELATED WORK:

A. Termination equipment: Section 27 11 19, COMMUNICATIONS TERMINATION BLOCKS AND PATCH PANELS.

B. Fiber optic cabling requirements: Section 27 13 23, COMMUNICATIONS OPTICAL FIBER BACKBONE CABLING.

### 1.5 SUBMITTALS:

A. Submit in accordance with Section 27 05 00, COMMON WORK RESULTS FOR COMMUNICATIONS SYSTEMS.

## PART 2 - PRODUCTS

Not used.

## PART 3 - EXECUTION

### 3.1 TERMINATION REQUIREMENTS.

A. Terminate fiber optic cabling with duplex Lucent connector (LC) connectors.

B. Pre-terminated connections are preferred for computer room structured cabling applications. Field termination (fusion splicing) for non-computer room applications where cable lengths cannot be determined in advance is acceptable.

- - - E N D - - -

# SECTION 27 16 19
# COMMUNICATIONS PATCH CORDS, STATION CORDS, AND CROSS CONNECT WIRE

## PART 1 - GENERAL

### 1.1 DESCRIPTION:

This section specifies requirements for telecommunications patch cords.

### 1.2 SUMMARY

Section Includes:

A. Copper (UTP) Patch Cables.

B. Fiber Optic Patch Cables.

### 1.3 REFERENCES

A. VA Infrastructure Standard for Telecommunications Spaces.

### 1.4 RELATED WORK:

A. Termination equipment: Section 27 11 19, COMMUNICATIONS TERMINATION BLOCKS AND PATCH PANELS.

B. Cable labeling requirements: Section 27 05 53, IDENTIFICATION FOR COMMUNICATIONS SYSTEMS.

### 1.5 SUBMITTALS:

A. Submit in accordance with Section 27 05 00, COMMON WORK RESULTS FOR COMMUNICATIONS SYSTEMS.

## PART 2 - PRODUCTS

### 2.1 COPPER (UTP) PATCH CABLES.

A. Performance Category. Patch cables shall meet the Category 6A performance requirements. Category 6A connectors are required.

B. Termination Method. Factory pre-terminated TIA 568B.

C. Conductor Size. 22-28AWG. Where 28AWG patch cords are specified, the overall horizontal channel distance is reduced.

D. Length. Patch cords of the shortest appropriate length shall be used.

### 2.2 FIBER OPTIC PATCH CABLES.

A. Construction. Fiber patch cords shall be constructed of pairs (2-strands) of multimode laser-enhanced 50/125µm or single mode laser-optimized 9/125µm // fiber.

B. Performance Category. Multimode patch cords shall meet the OM4 performance requirements.

C. Connectors. Duplex Lucent connector (LC) connectors are required. Where polarity requirements are not known, reversible polarity duplex LC connectors are specified on one end.

D. Termination Method. Factory pre-terminated.

E. Length. Patch cords of the shortest appropriate length shall be used.

**PART 3 - EXECUTION**

**3.1 IMPLEMENTATION.**

A. Patch cords shall not be used to connect equipment in different server cabinets.

B. Patch cords shall be neatly installed using cable management equipment and following cable management principles.

C. Upon installation patch cords shall be labeled in accordance with the requirements of the VA Infrastructure Standard for Telecommunications Spaces.

- - - E N D - - -

# SECTION 28 31 00
# FIRE DETECTION AND ALARM

## PART 1 - GENERAL

### 1.1 DESCRIPTION

A. This section of the specifications includes the furnishing, installation, and connection of the fire alarm equipment to form a complete coordinated system ready for operation. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, control units, fire safety control devices, annunciators, power supplies, and wiring as shown on the drawings and specified. The fire alarm system shall not be combined with other systems such as building automation, energy management, security, etc.

B. Fire alarm systems shall comply with requirements of the most recent VA FIRE PROTECTION DESIGN MANUAL and NFPA 72 unless variations to NFPA 72 are specifically identified within these contract documents by the following notation: "variation". The design, system layout, document submittal preparation, and supervision of installation and testing shall be provided by a technician that is certified NICET level III or a registered fire protection engineer. The NICET certified technician shall be on site for the supervision and testing of the system. Factory engineers from the equipment manufacturer, thoroughly familiar and knowledgeable with all equipment utilized, shall provide additional technical support at the site as required by the COR or his authorized representative. Installers shall have a minimum of 2 years experience installing fire alarm systems.

C. Fire alarm signals shall have a general evacuation fire alarm signal in accordance with ASA S3.41 to notify all occupants in the respective building to evacuate.

D. Alarm signals (by device), supervisory signals (by device) and system trouble signals (by device not reporting) shall be distinctly transmitted to the main fire alarm system control unit located in the Front Lobby.

E. The fire alarm control unit shall automatically transmit alarm signals to a listed central station using a digital alarm communicator transmitter in accordance with NFPA 72.

**1.2 SCOPE**

A. A fully addressable fire alarm system shall be designed and installed in accordance with the specifications and drawings. Device location and wiring runs shown on the drawings are for reference only unless specifically dimensioned. Actual locations shall be in accordance with NFPA 72 and this specification.

B. Basic Performance:

1. Alarm and trouble signals from the fire alarm control panel shall be digitally encoded by UL listed electronic devices onto a multiplexed communication system.
2. Response time between alarm initiation (contact closure) and recording at the main fire alarm control unit (appearance on alphanumeric read out) shall not exceed 5 seconds.
3. The signaling line circuits (SLC) between building fire alarm control units shall be wired Class X in accordance with NFPA 72. Isolation shall be provided so that no more than one building can be lost due to a short circuit fault.
4. Initiating device circuits (IDC) shall be wired Class B in accordance with NFPA 72.
5. Signaling line circuits (SLC) within buildings shall be wired Class B in accordance with NFPA 72. Individual signaling line circuits shall be limited to covering 22,500 square feet (2,090 square meters) of floor space or 3 floors whichever is less.
6. Notification appliance circuits (NAC) shall be wired Class B in accordance with NFPA 72.

**1.3 RELATED WORK**

A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. Requirements for procedures for submittals.

B. Section 21 13 13 - WET-PIPE SPRINKLER SYSTEMS. Requirements for sprinkler systems.

C. Section 28 05 00 – COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY. Requirements for general requirements that are common to more than one section in Division 28.

D. Section 28 05 13 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for conductors and cables.

E. Section 28 05 26 - GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY. Requirements for grounding of equipment.

F. Section 28 05 28.33 - CONDUITS AND BACKBOXES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for infrastructure.

**1.4 SUBMITTALS**

A. General: Submit 5 copies in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, and Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

B. Drawings:

1. Prepare drawings using Revit 19 and include all contractor's information. Layering shall be by VA criteria as provided by the COR. Bid drawing files on Revit will be provided to the Contractor at the pre-construction meeting. The contractor shall be responsible for verifying all critical dimensions shown on the drawings provided by VA.
2. Floor plans: Provide locations of all devices (with device number at each addressable device corresponding to control unit programming), appliances, panels, equipment, junction/terminal cabinets/boxes, risers, electrical power connections, individual circuits and raceway routing, system zoning; number, size, and type of raceways and conductors in each raceway; conduit fill calculations with cross section area percent fill for each type and size of conductor and raceway. Only those devices connected and incorporated into the final system shall be on these floor plans. Do not show any removed devices on the floor plans. Show all interfaces for all fire safety functions.
3. Riser diagrams: Provide, for the entire system, the number, size and type of riser raceways and conductors in each riser raceway and number of each type device per floor and zone. Show door holder interface, elevator control interface, HVAC shutdown interface, fire extinguishing system interface, and all other fire safety interfaces. Show wiring Styles on the riser diagram for all circuits. Provide diagrams both on a per building and campus wide basis.
4. Detailed wiring diagrams: Provide for control panels, modules, power supplies, electrical power connections, auxiliary relays and

annunciators showing termination identifications, size and type conductors, circuit boards, LED lamps, indicators, adjustable controls, switches, ribbon connectors, wiring harnesses, terminal strips and connectors, spare zones/circuits. Diagrams shall be drawn to a scale sufficient to show spatial relationships between components, enclosures and equipment configuration.

5. Two weeks prior to final inspection, the Contractor shall deliver to the COTR 3 sets of as-built drawings and one set of the as-built drawing computer files. As-built drawings (floor plans) shall show all new and/or existing conduit used for the fire alarm system.

C. Manuals:

1. Submit simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals including technical data sheets for all items used in the system, power requirements, device wiring diagrams, dimensions, and information for ordering replacement parts.
   a. Wiring diagrams shall have their terminals identified to facilitate installation, operation, expansion and maintenance.
   b. Wiring diagrams shall indicate internal wiring for each item of equipment and the interconnections between the items of equipment.
   c. Include complete listing of all software used and installation and operation instructions including the input/output matrix chart.
   d. Provide a clear and concise description of operation that gives, in detail, the information required to properly operate, inspect, test and maintain the equipment and system. Provide all manufacturer's installation limitations including but not limited to circuit length limitations.
   e. Complete listing of all digitized voice messages.
   f. Provide standby battery calculations under normal operating and alarm modes. Battery calculations shall include the magnets for holding the doors open for one minute.
   g. Include information indicating who will provide emergency service and perform post contract maintenance.

h. Provide a replacement parts list with current prices. Include a list of recommended spare parts, tools, and instruments for testing and maintenance purposes.

i. A computerized preventive maintenance schedule for all equipment. The schedule shall be provided on disk in a computer format acceptable to the VAMC and shall describe the protocol for preventive maintenance of all equipment. The schedule shall include the required times for systematic examination, adjustment and cleaning of all equipment. A printout of the schedule shall also be provided in the manual. Provide the disk in a pocket within the manual.

j. Furnish manuals in 3 ring loose-leaf binder or manufacturer's standard binder.

k. A printout for all devices proposed on each signaling line circuit with spare capacity indicated.

2. Two weeks prior to final inspection, deliver 4 copies of the final updated maintenance and operating manual to the COTR.

a. The manual shall be updated to include any information necessitated by the maintenance and operating manual approval.

b. Complete "As installed" wiring and schematic diagrams shall be included that shows all items of equipment and their interconnecting wiring. Show all final terminal identifications.

c. Complete listing of all programming information, including all control events per device including an updated input/output matrix.

d. Certificate of Installation as required by NFPA 72 for each building. The certificate shall identify any variations from the National Fire Alarm Code.

e. Certificate from equipment manufacturer assuring compliance with all manufacturers installation requirements and satisfactory system operation.

D. Certifications:

1. Together with the shop drawing submittal, submit the technician's NICET level III fire alarm certification as well as certification from the control unit manufacturer that the proposed performer of contract maintenance is an authorized representative of the major

equipment manufacturer. Include in the certification the names and addresses of the proposed supervisor of installation and the proposed performer of contract maintenance. Also include the name and title of the manufacturer's representative who makes the certification.

2. Together with the shop drawing submittal, submit a certification from either the control unit manufacturer or the manufacturer of each component (e.g., smoke detector) that the components being furnished are compatible with the control unit.
3. Together with the shop drawing submittal, submit a certification from the major equipment manufacturer that the wiring and connection diagrams meet this specification, UL and NFPA 72 requirements.

**1.5 WARRANTY**

All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of one year from the date of acceptance of the entire installation by the Contracting Officer.

**1.6 APPLICABLE PUBLICATIONS**

A. The publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. The publications are referenced in text by the basic designation only and the latest editions of these publications shall be applicable.

B. National Fire Protection Association (NFPA):

NFPA 13 .....Standard for the Installation of Sprinkler Systems, 2019 edition

NFPA 14 ..... Standard for the Installation of Standpipes and Hose Systems, 2019 edition

NFPA 20 ..... Standard for the Installation of Stationary Pumps for Fire Protection, 2019 edition

NFPA 70.....National Electrical Code (NEC), 2020 edition

NFPA 72.....National Fire Alarm Code, 2019 edition

NFPA 90A.....Standard for the Installation of Air Conditioning and Ventilating Systems, 2018 edition

NFPA 101.....Life Safety Code, 2018 edition

C. Underwriters Laboratories, Inc. (UL): Fire Protection Equipment Directory

D. Factory Mutual Research Corp (FM): Approval Guide, 2007-2011

E. American National Standards Institute (ANSI):

S3.41.....Audible Emergency Evacuation Signal, 1990 edition, reaffirmed 2008

F. International Code Council, International Building Code (IBC), 2018 edition

**PART 2 - PRODUCTS**

**2.1 EQUIPMENT AND MATERIALS, GENERAL**

A. All equipment and components shall be new and the manufacturer's current model. All equipment shall be tested and listed by Underwriters Laboratories, Inc. or Factory Mutual Research Corporation for use as part of a fire alarm system. The authorized representative of the manufacturer of the major equipment shall certify that the installation complies with all manufacturers' requirements and that satisfactory total system operation has been achieved.

**2.2 CONDUIT, BOXES, AND WIRE**

A. Conduit shall be in accordance with Section 28 05 28.33 CONDUIT AND BACKBOXES FOR ELECTRONIC SAFETY AND SECURITY and as follows:

1. All new conduits shall be installed in accordance with NFPA 70.
2. Conduit fill shall not exceed 40 percent of interior cross sectional area.
3. All new conduits shall be 3/4 inch (19 mm) minimum.

B. Wire:

1. Wiring shall be in accordance with NEC article 760, Section 28 05 13, CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY, and as recommended by the manufacturer of the fire alarm system. All wires shall be color coded. Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than

18 AWG for initiating device circuits and 14 AWG for notification device circuits.

3. Any fire alarm system wiring that extends outside of a building shall have additional power surge protection to protect equipment from physical damage and false signals due to lightning, voltage and current induced transients. Protection devices shall be shown on the submittal drawings and shall be UL listed or in accordance with written manufacturer's requirements.
4. All wire or cable used in underground conduits including those in concrete shall be listed for wet locations.

C. Terminal Boxes, Junction Boxes, and Cabinets:

1. Shall be galvanized steel in accordance with UL requirements.
2. All boxes shall be sized and installed in accordance with NFPA 70.
3. covers shall be repainted red in accordance with Section 09 91 00, PAINTING and shall be identified with white markings as "FA" for junction boxes and as "FIRE ALARM SYSTEM" for cabinets and terminal boxes. Lettering shall be a minimum of 3/4 inch (19 mm) high.
4. Terminal boxes and cabinets shall have a volume 50 percent greater than required by the NFPA 70. Minimum sized wire shall be considered as 14 AWG for calculation purposes.
5. Terminal boxes and cabinets shall have identified pressure type terminal strips and shall be located at the base of each riser. Terminal strips shall be labeled as specified or as approved by the COTR.

**2.3 FIRE ALARM CONTROL UNIT**

A. General:

1. The building shall be provided with a fire alarm control unit and shall operate as a supervised zoned fire alarm system.
2. Each power source shall be supervised from the other source for loss of power.
3. All circuits shall be monitored for integrity.
4. Visually and audibly annunciate any trouble condition including, but not limited to main power failure, grounds and system wiring derangement.
5. Transmit digital alarm information to the main fire alarm control unit.

B. Enclosure:
   1. The control unit shall be housed in a cabinet suitable for both recessed and surface mounting. Cabinet and front shall be corrosion protected, given a rust-resistant prime coat, and manufacturer's standard finish.
   2. Cabinet shall contain all necessary relays, terminals, lamps, and legend plates to provide control for the system.

D. Power Supply:
   1. The control unit shall derive its normal power from a 120-volt, 60 Hz dedicated supply connected to the emergency power system. Standby power shall be provided by a 24-volt DC battery as hereinafter specified. The normal power shall be transformed, rectified, coordinated, and interfaced with the standby battery and charger.
   2. The door holder power shall be arranged so that momentary or sustained loss of main operating power shall not cause the release of any door.
   3. Power supply for smoke detectors shall be taken from the fire alarm control unit.
   4. Provide protectors to protect the fire alarm equipment from damage due to lightning or voltage and current transients.
   5. Provide new separate and direct ground lines to the outside to protect the equipment from unwanted grounds.

E. Circuit Supervision: Each alarm initiating device circuit, signaling line circuit, and notification appliance circuit, shall be supervised against the occurrence of a break or ground fault condition in the field wiring. These conditions shall cause a trouble signal to sound in the control unit until manually silenced by an off switch.

F. Supervisory Devices: All sprinkler system valves, standpipe control valves, post indicator valves (PIV), and main gate valves shall be supervised for off-normal position. Closing a valve shall sound a supervisory signal at the control unit until silenced by an off switch. The specific location of all closed valves shall be identified at the control unit. Valve operation shall not cause an alarm signal. Low air pressure switches and duct detectors shall be monitored as supervisory signals. The power supply to the elevator shunt trip breaker shall be monitored by the fire alarm system as a supervisory signal.

G. Trouble signals:
   1. Arrange the trouble signals for automatic reset (non-latching).
   2. System trouble switch off and on lamps shall be visible through the control unit door.

H. Function Switches: Provide the following switches in addition to any other switches required for the system:
   1. Remote Alarm Transmission By-pass Switch: Shall prevent transmission of all signals to the main fire alarm control unit when in the "off" position. A system trouble signal shall be energized when switch is in the off position.
   2. Alarm Off Switch: Shall disconnect power to alarm notification circuits on the local building alarm system. A system trouble signal shall be activated when switch is in the off position.
   3. Trouble Silence Switch: Shall silence the trouble signal whenever the trouble silence switch is operated. This switch shall not reset the trouble signal.
   4. Reset Switch: Shall reset the system after an alarm, provided the initiating device has been reset. The system shall lock in alarm until reset.
   5. Lamp Test Switch: A test switch or other approved convenient means shall be provided to test the indicator lamps.
   6. Drill Switch: Shall activate all notification devices without tripping the remote alarm transmitter. This switch is required only for general evacuation systems specified herein.
   7. Door Holder By-Pass Switch: Shall prevent doors from releasing during fire alarm tests. A system trouble alarm shall be energized when switch is in the abnormal position.
   8. Elevator recall By-Pass Switch: Shall prevent the elevators from recalling upon operation of any of the devices installed to perform that function. A system trouble alarm shall be energized when the switch is in the abnormal position.
   9. HVAC/Smoke Damper By-Pass: Provide a means to disable HVAC fans from shutting down and/or smoke dampers from closing upon operation of an initiating device designed to interconnect with these devices.

I. Remote Transmissions:

1. Provide capability and equipment for transmission of alarm, supervisory and trouble signals to the main fire alarm control unit.
2. Transmitters shall be compatible with the systems and equipment they are connected to such as timing, operation and other required features.

J. Remote Control Capability: Each building fire alarm control unit shall be installed and programmed so that each must be reset locally after an alarm, before the main fire alarm control unit can be reset. After the local building fire alarm control unit has been reset, then the all system acknowledge, reset, silence or disabling functions can be operated by the main fire alarm control unit

K. System Expansion: Design the control units and enclosures so that the system can be expanded in the future (to include the addition of 20 percent more alarm initiating, alarm notification and door holder circuits) without disruption or replacement of the existing control unit and secondary power supply.

**2.4 STANDBY POWER SUPPLY**

B. Batteries:

1. Battery shall be of the sealed, maintenance free type, 24-volt nominal.
2. Battery shall have sufficient capacity to power the fire alarm system for not less than 24 hours plus 5 minutes of alarm to an end voltage of 1.14 volts per cell, upon a normal AC power failure.
3. Battery racks shall be steel with an alkali-resistant finish. Batteries shall be secured in seismic areas 2B, 3, or 4 as defined by the Uniform Building Code.

C. Battery Charger:

1. Shall be completely automatic, with constant potential charger maintaining the battery fully charged under all service conditions. Charger shall operate from a 120-volt, 60-hertz emergency power source.
2. Shall be rated for fully charging a completely discharged battery within 48-hours while simultaneously supplying any loads connected to the battery.
3. Shall have protection to prevent discharge through the charger.

4. Shall have protection for overloads and short circuits on both AC and DC sides.
5. A trouble condition shall actuate the fire alarm trouble signal.
6. Charger shall have automatic AC line voltage regulation, automatic current-limiting features, and adjustable voltage controls.

**2.6 ALARM NOTIFICATION APPLIANCES**

A. Strobes:
1. Xenon flash tube type minimum 15 candela in toilet rooms and 75 candela in all other areas with a flash rate of 1 HZ. Strobes shall be synchronized where required by the National Fire Alarm Code (NFPA 72).
2. Backplate shall be red with 1/2 inch (13 mm) permanent red letters. Lettering to read "Fire", be oriented on the wall or ceiling properly, and be visible from all viewing directions.
3. Each strobe circuit shall have a minimum of 20 percent spare capacity.
4. Strobes may be combined with the audible notification appliances specified herein.

B. Fire Alarm Horns:
1. Shall be electric, utilizing solid state electronic technology operating on a nominal 24 VDC.
2. Shall be a minimum nominal rating of 80 dBA at 10 feet (3,000 mm).
3. Mount on removable adapter plates on conduit boxes.
4. Horns located outdoors shall be of weatherproof type with metal housing and protective grille.
5. Each horn circuit shall have a minimum of 20 percent spare capacity.

**2.7 ALARM INITIATING DEVICES**

A. Manual Fire Alarm Stations:
1. Shall be non-break glass, address reporting type.
2. Station front shall be constructed of a durable material such as cast or extruded metal or high impact plastic. Stations shall be semi-flush type.
3. Stations shall be of single action pull down type with suitable operating instructions provided on front in raised or depressed letters, and clearly labeled "FIRE."

4. Operating handles shall be constructed of a durable material. On operation, the lever shall lock in alarm position and remain so until reset. A key shall be required to gain front access for resetting, or conducting tests and drills.
5. Unless otherwise specified, all exposed parts shall be red in color and have a smooth, hard, durable finish.

B. Smoke Detectors:
1. Smoke detectors shall be photoelectric type and UL listed for use with the fire alarm control unit being furnished.
2. Smoke detectors shall be addressable type complying with applicable UL Standards for system type detectors. Smoke detectors shall be installed in accordance with the manufacturer's recommendations and NFPA 72.
3. Detectors shall have an indication lamp to denote an alarm condition. Provide remote indicator lamps and identification plates where detectors are concealed from view. Locate the remote indicator lamps and identification plates flush mounted on walls so they can be observed from a normal standing position.
4. All spot type and duct type detectors installed shall be of the photoelectric type.
5. Photoelectric detectors shall be factory calibrated and readily field adjustable. The sensitivity of any photoelectric detector shall be factory set at 3.0 plus or minus 0.25 percent obscuration per foot.
6. Detectors shall provide a visual trouble indication if they drift out of sensitivity range or fail internal diagnostics. Detectors shall also provide visual indication of sensitivity level upon testing. Detectors, along with the fire alarm control units shall be UL listed for testing the sensitivity of the detectors.

D. Water Flow and Pressure Switches:
1. Wet pipe water flow switches and dry pipe alarm pressure switches for sprinkler systems shall be connected to the fire alarm system by way of an address reporting interface device.
2. All new water flow switches shall be of a single manufacturer and series and non-accumulative retard type. See Section 21 13 13, WET-

PIPE SPRINKLER SYSTEMS for new switches added. Connect all switches shown on the approved shop drawings.

3. All new switches shall have an alarm transmission delay time that is conveniently adjustable from 0 to 60 seconds. Initial settings shall be 30-45 seconds. Timing shall be recorded and documented during testing.

**2.8 SUPERVISORY DEVICES**

A. Duct Smoke Detectors:

1. Duct smoke detectors shall be provided and connected by way of an address reporting interface device. Detectors shall be provided with an approved duct housing mounted exterior to the duct, and shall have perforated sampling tubes extending across the full width of the duct (wall to wall). Detector placement shall be such that there is uniform airflow in the cross section of the duct.
2. Interlocking with fans shall be provided in accordance with NFPA 90A and as specified hereinafter under Part 3.2, "TYPICAL OPERATION".
3. Provide remote indicator lamps, key test stations and identification nameplates (e.g. "DUCT SMOKE DETECTOR AHU-X") for all duct detectors. Locate key test stations in plain view on walls or ceilings so that they can be observed and operated from a normal standing position.

B. Sprinkler and Standpipe System Supervisory Switches:

1. Each sprinkler system water supply control valve, riser valve or zone control valve, and each standpipe system riser control valve shall be equipped with a supervisory switch. Standpipe hose valves, and test and drain valves shall not be equipped with supervisory switches.
2. PIV (post indicator valve) or main gate valve shall be equipped with a supervisory switch.
3. Valve supervisory switches shall be connected to the fire alarm system by way of address reporting interface device. See Section 21 13 13, WET-PIPE SPRINKLER SYSTEMS for new switches to be added. Connect tamper switches for all control valves shown on the approved shop drawings.
4. The mechanism shall be contained in a weatherproof die-cast aluminum housing that shall provide a 3/4 inch (19 mm) tapped conduit

entrance and incorporate the necessary facilities for attachment to the valves.

5. The entire installed assembly shall be tamper-proof and arranged to cause a switch operation if the housing cover is removed or if the unit is removed from its mounting.
6. Where dry-pipe sprinkler systems are installed, high and low air pressure switches shall be provided and monitored by way of an address reporting interface devices.

**2.9 ADDRESS REPORTING INTERFACE DEVICE**

A. Shall have unique addresses that reports directly to the building fire alarm panel.
B. Shall be configurable to monitor normally open or normally closed devices for both alarm and trouble conditions.
C. Shall have terminal designations clearly differentiating between the circuit to which they are reporting from and the device that they are monitoring.
D. Shall be UL listed for fire alarm use and compatibility with the panel to which they are connected.
E. Shall be mounted in weatherproof housings if mounted exterior to a building.

**2.10 SMOKE BARRIER DOOR CONTROL**

A. Electromagnetic Door Holders:
   1. New Door Holders shall be standard wall mounted electromagnetic type. In locations where doors do not come in contact with the wall when in the fully open position, an extension post shall be added to the door bracket.
   2. Operation shall be by 24-volt DC supplied from a battery located at the fire alarm control unit. Door holders shall be coordinated as to voltage, ampere drain, and voltage drop with the battery, battery charger, wiring and fire alarm system for operation as specified.
B. A maximum of twelve door holders shall be provided for each circuit. Door holders shall be wired to allow releasing doors by smoke zone.
C. Door holder control circuits shall be electrically supervised.
D. Smoke detectors shall not be incorporated as an integral part of door holders.

**2.11 UTILITY LOCKS AND KEYS:**

A. All key operated test switches, control units, annunciator panels and lockable cabinets shall be provided with a single standardized utility lock and key.

B. Key-operated manual fire alarm stations shall have a single standardized lock and key separate from the control equipment.

C. All keys shall be delivered to the COTR.

**2.12 SPARE AND REPLACEMENT PARTS**

A. Provide spare and replacement parts as follows:

1. Manual pull stations - 1
2. Heat detectors - 2 of each type
3. Fire alarm strobes - 5
4. Fire alarm bells - 5
5. Fire alarm speakers - 5
6. Smoke detectors - 2
7. Duct smoke detectors with all appurtenances - 1
8. Sprinkler system water flow switch - 1 of each size
9. Sprinkler system water pressure switch - 1 of each type
10. Sprinkler valve tamper switch - 1 of each type
11. Control equipment utility locksets - 5
12. Control equipment keys - 5
13. 2.5 oz containers aerosol smoke - 5
14. Printer paper - 3 boxes
15. Printer replacement ribbons - 3
16. Monitor modules - 2
17. Control modules - 2
18. Fire alarm SLC cable (same as installed) – 500 feet (152 m)

C. Spare and replacement parts shall be in original packaging and submitted to the COTR.

D. Furnish and install a storage cabinet of sufficient size and suitable for storing spare equipment. Doors shall include a pad locking device. Padlock to be provided by the VA. Location of cabinet to be determined by the COTR.

E. Provide to the VA, all hardware, software, programming tools, license and documentation necessary to permanently modify the fire alarm system on site. The minimum level of modification includes addition and

deletion of devices, circuits, zones and changes to system description, system operation, and digitized evacuation and instructional messages.

**2.13 INSTRUCTION CHART:**

Provide typewritten instruction card mounted behind a Lexan plastic or glass cover in a stainless steel or aluminum frame with a backplate. Install the frame in a conspicuous location observable from each control unit where operations are performed. The card shall show those steps to be taken by an operator when a signal is received under all conditions, normal, alarm, supervisory, and trouble. Provide an additional copy with the binder for the input output matrix for the sequence of operation. The instructions shall be approved by the COTR before being posted.

**PART 3 - EXECUTION**

**3.1 INSTALLATION:**

A. Installation shall be in accordance with NFPA 70, 72, 90A, and 101 as shown on the drawings, and as recommended by the major equipment manufacturer. Fire alarm wiring shall be installed in conduit. All conduit and wire shall be installed in accordance with, Section 28 05 13 CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY, Section 28 05 26 GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY, Section 28 05 28.33 CONDUIT AND BACKBOXES FOR ELECTRONIC SAFETY AND SECURITY, and all penetrations of smoke and fire barriers shall be protected as required by Section 07 84 00, FIRESTOPPING.

B. All conduits, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas.

C. All new and reused exposed conduits shall be painted in accordance with Section 09 91 00, PAINTING to match surrounding finished areas and red in unfinished areas.

F. All fire detection and alarm system devices, control units and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas. Exact locations are to be approved by the COTR.

G. Speakers shall be ceiling mounted and fully recessed in areas with suspended ceilings. Speakers shall be wall mounted and recessed in

finished areas without suspended ceilings. Speakers may be surface mounted in unfinished areas.

H. Strobes shall be flush wall mounted with the bottom of the unit located 80 inches (2,000 mm) above the floor or 6 inches (150 mm) below ceiling, whichever is lower. Locate and mount to maintain a minimum 36 inches (900 mm) clearance from side obstructions.

I. Manual pull stations shall be installed not less than 42 inches (1,050 mm) or more than 48 inches (1,200 mm) from finished floor to bottom of device and within 60 inches (1,500 mm) of a stairway or an exit door.

J. Where possible, locate water flow and pressure switches a minimum of 12 inches (300 mm) from a fitting that changes the direction of the flow and a minimum of 36 inches (900 mm) from a valve.

K. Mount valve tamper switches so as not to interfere with the normal operation of the valve and adjust to operate within 2 revolutions toward the closed position of the valve control, or when the stem has moved no more than 1/5 of the distance from its normal position.

L. Connect flow and tamper switches installed under Section 21 13 13, WET-PIPE SPRINKLER SYSTEMS.

M. Connect combination closer-holders installed under Section 08 71 00, DOOR HARDWARE.

**3.2 TYPICAL OPERATION**

A. Activation of any manual pull station, water flow or pressure switch, or smoke detector shall cause the following operations to occur:

1. Continuously sound a temporal pattern general alarm and flash all strobes in the building in alarm until reset at the local fire alarm control unit in the Buildings.
2. Release the magnetic door holders after the alert signal.
3. Transmit a separate alarm signal, via the main fire alarm control unit to the fire department.
4. Unlock the electrically locked exit doors within the zone of alarm.

E. Operation of a smoke detector at a corridor door used for automatic closing shall also release the magnetic door holders.

F. Operation of duct smoke detectors shall cause a system supervisory condition and shut down the ventilation system and close the associated smoke dampers as appropriate.

G. Operation of any sprinkler or standpipe system valve supervisory switch, high/low air pressure switch, or fire pump alarm switch shall cause a system supervisory condition.

H. Alarm verification shall not be used for smoke detectors installed for the purpose of early warning.

**3.3 TESTS**

A. Provide the service of a NICET level III, competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment to technically supervise and participate during all of the adjustments and tests for the system. Make all adjustments and tests in the presence of the COTR.

B. When the systems have been completed and prior to the scheduling of the final inspection, furnish testing equipment and perform the following tests in the presence of the COTR. When any defects are detected, make repairs or install replacement components, and repeat the tests until such time that the complete fire alarm systems meets all contract requirements. After the system has passed the initial test and been approved by the COTR, the contractor may request a final inspection.

1. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
2. Test the insulation on all installed cable and wiring by standard methods as recommended by the equipment manufacturer.
3. Run water through all flow switches. Check time delay on water flow switches. Submit a report listing all water flow switch operations and their retard time in seconds.
4. Open each alarm initiating and notification circuit to see if trouble signal actuates.
5. Ground each alarm initiation and notification circuit and verify response of trouble signals.

**3.4 FINAL INSPECTION AND ACCEPTANCE**

A. Prior to final acceptance a minimum 30 day "burn-in" period shall be provided. The purpose shall be to allow equipment to stabilize and potential installation and software problems and equipment malfunctions to be identified and corrected. During this diagnostic period, all system operations and malfunctions shall be recorded. Final acceptance

will be made upon successful completion of the "burn-in" period and where the last 14 days is without a system or equipment malfunction.

B. At the final inspection a factory trained representative of the manufacturer of the major equipment shall repeat the tests in Article 3.3 TESTS and those required by NFPA 72. In addition the representative shall demonstrate that the systems function properly in every respect. The demonstration shall be made in the presence of a VA representative.

**3.5 INSTRUCTION**

A. The manufacturer's authorized representative shall provide instruction and training to the VA as follows:

1. Six 1-hour sessions to engineering staff, security police and central attendant personnel for simple operation of the system. Two sessions at the start of installation, 2 sessions at the completion of installation and 2 sessions 3 months after the completion of installation.
2. Four 2-hour sessions to engineering staff for detailed operation of the system. Two sessions at the completion of installation and 2 sessions 3 months after the completion of installation.
3. Three 8-hour sessions to electrical technicians for maintaining, programming, modifying, and repairing the system at the completion of installation and one 8-hour refresher session 3 months after the completion of installation.

B. The Contractor and/or the Systems Manufacturer's representative shall provide a typewritten "Sequence of Operation" including a trouble shooting guide of the entire system for submittal to the VA. The sequence of operation will be shown for each input in the system in a matrix format and provided in a loose-leaf binder. When reading the sequence of operation, the reader will be able to quickly and easily determine what output will occur upon activation of any input in the system. The INPUT/OUTPUT matrix format shall be as shown in Appendix A to NFPA 72.

C. Furnish the services of a competent instructor for instructing personnel in the programming requirements necessary for system expansion. Such programming shall include addition or deletion of devices, zones, indicating circuits and printer/display text.

**- - END - -**