

DEPARTMENT OF VETERANS AFFAIRS

Correct Water System for Legionella Phase 2

517-17-101

Master Construction Specifications
08/24/17

Department of Veteran Affairs: Office of Acquisitions, Logistics &
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of Facilities Planning: Facilities Standards Service

**DEPARTMENT OF VETERANS AFFAIRS
MASTER SPECIFICATIONS**

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VOLUME 1

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The drawings listed below accompanying this specification and form a part
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<u>ELECTICAL</u>	
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SECTION 01 00 00
GENERAL REQUIREMENTS

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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 replacing domestic water piping as required by drawings and specifications.
- B. Visits to the site by Bidders may be made only by appointment with the Medical Center Contracting Officer.
- C. 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.
- D. 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.
- E. Training:
 - 1. Beginning July 31, 2005, all employees of general contractor or subcontractors shall have the 10-hour OSHA certified Construction Safety course and the superintendent shall have a 30-hour OSHA certified Construction Safety course/or other relevant competency training, as determined by VA CP with input from the ICRA team.
 - 2. Submit training records of all such employees for approval before the start of work.

1.2 STATEMENT OF BID ITEM(S)

BASE BID: Contractor shall perform all work as indicated in the contract documents (drawings and specifications). The work includes the installation of mixing valves, Chicago Faucets or equal with the following Characteristics -

Minimum pressure - 30 pounds square inch, maximum pressure - 125 pounds square inch, hot water temp. - 120 degrees Fahrenheit to 180 degrees Fahrenheit, temperature out - 80 degrees Fahrenheit - 120 degrees Fahrenheit, stops and Chicago Faucets or equal with the following characteristics: ½" inlet, 2 ¼" tee, ½" National pipe thread female threaded inlet, Slip wall flange, operating pressure 20 (pounds square inch) and operating temperature 40 (180) degrees Fahrenheit on existing sinks on the basement, first, second, third, fourth, fifth and sixth floors, the installation of two injector

ports in Rm BB103, the installation of two Armstrong DRV 80 Digital Recirculation Valve's (The Brain) or equal in RM BB103 in building #1 as indicated on the contract documents. The Armstrong DRV 80 Digital Recirculation Valve will have the following characteristics. Connections - 3" National pipe thread internal (female), electronic module: PC/ABS Safety - Thermal shutdown upon inlet supply failure and or power failure, Pressure: Maximum. - inlet supply static - 150 pounds square inch, Dynamic pressure - 125 pounds square inch, maximum hot water supply 185 degrees, Minimum. hot water supply - 5 degrees above set point, maximum inlet cold water - 75 degrees, minimum set point 81 degrees Fahrenheit, minimum. inlet cold water - 34 degrees Fahrenheit, Flow rate - 165 gallons per minute at 20 pounds square inch drop minimum recirculation flow rate at 10 gallons per minute.

Power supply - 110 Volts/Amperes - 60 Hertz. Thermal ratification abilities, Auxiliary relay type - single pole changeover relay contacts, power supply - 20 volts alternating current / 24 volts direct current, supply fuse - 2 amperes, user to be able to adjust the valve using a Microsoft windows based laptop/PC computer with vendor supplied valve programming software. The installation of an online Water Quality Monitoring System and the installation of a hot and cold-water line from building 1 to building 35. The second party commissioning by the contractor of the water lines, wireless network online continuous quality monitoring system and the secondary Armstrong meter. Construction duration for Base Bid is 270 calendar days from Notice to Proceed. All work will be performed at the Veterans Affairs Medical Center, Beckley, WV 25801

BID ITEM 2 (Bid Alternate 1): Contractor shall perform all work as described in BID ITEM 1 (BASE BID) except deduct all work associate with BID ITEM 2, 2 - Armstrong DRV 80 Digital Recirculation Valve's (The Brain) in Room BB103, Building 1. Construction duration for Bid Item #2 is 225 calendar days from Notice to Proceed. All work will be performed at the Veteran Affairs Medical Center, Beckley, WV 25801

BID ITEM 3 (Bid Alternate 2): Contractor shall perform all work as described in BID ITEM 1 (BASE BID & BID ITEM 2) except deduct all work associate with BID ITEM 3, The installation of 2 - Armstrong DRV 80 Digital Recirculation Valve's (The Brain) in Room BB103,

building 1 and BID ITEM 3, (Bid Alternate 2): Contractor shall perform all The installation of sinks, mixing valves, faucets and stops in the basement, fourth and sixth floors in building 1 and the installation of mixing valves and stops in building 35. Construction duration for Bid Item #3 is 161 calendar days from Notice to Proceed. All work will be performed at the Veteran Affairs Medical Center, Beckley, WV 25801

Offeror or quoter is urged and expected to inspect the site where the work will be performed prior to submitting a proposal.

Contractor will be required to maintain a safe environment for all staff, visitors and patients.

Contractor will be required to store material in a contractor supplied storage building.

Contractor will be required to supply a dumpster for material disposal, and Office trailer which will be located on VA property.

Adherence to VA Specifications and Special Hospital Requirements during all phases of construction is required by the Contractor.

A copy of the VA Master Specifications will be provided by the VA and distributed to each prospective general contractor to use in his bidding process.

The Contractor will have 270 calendar days to complete work from the date Notice to Proceed is given.

Contractor will be required to complete form VA Directive 6550 and submit to the CO/COR for approval prior to ordering or installing any system, network or Wireless system on the VA Information Network. This is to ensure system to be installed is compatible with the VA Network.

The general contractor shall conform to all the provisions of the contract documents, and shall provide the necessary sub-contractors, materials and labor required to complete the project.

It is the responsibility of the contractor to coordinate with the CO and COR for badging all onsite personnel. Contractor personnel must pass a VA required background check and have a VA issued badge prior to beginning any work.

Contracting personnel must have a TB test prior to starting work working.

Personnel working around any sensitive material must complete VA privacy training.

The general contractor shall conform to all the provisions & specifications of the contract documents and shall provide the necessary sub-contractors, materials and labor required to complete the project.

1.3 SPECIFICATIONS AND DRAWINGS FOR CONTRACTOR

- A. AFTER AWARD OF CONTRACT, A PDF electronic File of Drawings and specifications will be furnished.

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 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. Key Control:

1. The General Contractor shall provide duplicate keys and lock combinations to the COR for 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.

D. 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 COR and Facility Safety Officer 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 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 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 COR and facility Safety Officer.
- G. Egress Routes for Construction Workers: Maintain free and unobstructed egress. Inspect daily. Report findings and corrective actions weekly to COR and facility Safety Officer. 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.
- H. Flammable and Combustible Liquids: Store, dispense and use liquids in accordance with 29 CFR 1926, NFPA 241 and NFPA 30.
- I. Hot Work: Perform and safeguard hot work operations in accordance with NFPA 241 and NFPA 51B. Coordinate with COR. Obtain permits from facility Safety Officer at least 48 hours in advance. Designate contractor's responsible project-site fire prevention program manager to permit hot work.
- J. Fire Hazard Prevention and Safety Inspections: Inspect entire construction areas weekly. Coordinate with, and report findings and corrective actions weekly to COR and facility Safety Officer.

- K. 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.
- L. Dispose of waste and debris in accordance with NFPA 241. Remove from buildings daily.
- M. Perform other construction, alteration and demolition operations in accordance with 29 CFR 1926.

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 determined by the COR.
- E. Workmen are subject to rules of Medical Center applicable to their conduct.
- F. Execute work to interfere as little as possible with normal functioning of Medical Center, including operations of utility services, fire protection systems and any existing equipment, and with work being done

by others. Use of equipment and tools that transmit vibrations and noises through the building structure, are not permitted in buildings that are occupied, during construction, jointly by patients or medical personnel, and Contractor's personnel, except as permitted by COR where required by limited working space.

1. Do not store materials and equipment in other than assigned areas.
2. Schedule delivery of materials and equipment to immediate construction working areas within buildings in use by Department of Veterans Affairs in quantities sufficient for not more than two work days. Provide unobstructed access to Medical Center areas required to remain in operation.

G. 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 COR.

H. When an area is turned over to Contractor, Contractor shall accept entire responsibility therefore.

1. Contractor shall maintain in operating condition existing fire protection and alarm equipment. Regarding 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.

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

1. No utility service such as water, gas, steam, sewers or electricity, or fire protection systems and communications systems may be interrupted without prior approval of COR. Electrical work shall be accomplished with all affected circuits or equipment de-energized. When an electrical outage cannot be accomplished, work on any

- energized circuits or equipment shall not commence without the Medical Center Director's prior knowledge and written approval
2. Contractor shall submit a request to interrupt any such services to COR, in writing, 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 COR.
 5. In case of a contract construction emergency, service will be interrupted on approval of COR. Such approval will be confirmed in writing as soon as practical.
 6. 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.
- J. 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.
- K. 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 COR.
- L. Coordinate the work for this contract with other construction operations as directed by COR. This includes the scheduling of traffic and the use of roadways, as specified in Article, use of roadways.

1.7 ALTERATIONS

- A. Survey: Before any work is started, the Contractor shall make a thorough survey with the COR and the Contracting Officer, of areas of buildings in which alterations occur and areas which are anticipated routes of access, and furnish a report, signed by both, all three, to the to areas within buildings where alterations occur and which have been agreed upon by Contractor and COR.
- B. Any items required by drawings to be either reused or relocated or both, found during this survey to be nonexistent, or in opinion of COR, 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 damage caused by Contractor's workmen in executing work of this contract.
- D. Protection: Provide the following protective measures:
 - 1. Wherever existing 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 Project 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 COR 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 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 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 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 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 that have been part of the construction.

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 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 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.

1.10 PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES, AND IMPROVEMENTS – NOT USED

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 COR. Existing work to be altered or extended and that is found to be defective in any way, shall be reported to the COR before it is disturbed. Materials and workmanship used in restoring work, shall

conform in type and quality to that of original existing construction, except as otherwise shown or specified.

- B. Upon completion of contract, deliver work complete and undamaged. Existing work (walls, ceilings, partitions, floors, mechanical and electrical work, lawns, paving, roads, walks, etc.) disturbed or removed as a result of performing required new work, shall be patched, repaired, reinstalled, or replaced with new work, and refinished and left in as good condition as existed before commencing work.
- C. At Contractor's own expense, Contractor shall immediately restore to service and repair any damage caused by Contractor's workmen to existing piping and conduits, wires, cables, etc., of utility services or of fire protection systems and communications systems (including telephone) which are indicated on drawings and which are not scheduled for discontinuance or abandonment.
- D. Expense of repairs to such utilities and systems not shown on drawings or locations of which are unknown will be covered by adjustment to contract time and price in accordance with clause entitled "CHANGES" (FAR 52.243-4 and VAAR 852.236-88) and "DIFFERING SITE CONDITIONS" (FAR 52.236-2) of Section 00 72 00, GENERAL CONDITIONS.

1.12 PHYSICAL DATA - NOT USED

1.13 PROFESSIONAL SURVEYING SERVICES - NOT USED

1.14 LAYOUT OF WORK - NOT USED

1.15 AS-BUILT DRAWINGS

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

1.16 USE OF ROADWAYS

- A. For hauling, use only established public roads and roads on Medical Center property and, when authorized by the COR, such temporary roads which are necessary in the performance of contract work. Temporary roads

shall be constructed 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.

1.17 TEMPORARY USE OF MECHANICAL AND ELECTRICAL EQUIPMENT

- A. Use of new installed mechanical and electrical equipment to provide heat, ventilation, plumbing, light and power will be permitted subject to compliance with the following provisions:
 - 1. Permission to use each unit or system must be given by COR. If the equipment is not installed and maintained in accordance with the following provisions, the COR will withdraw permission for use of the equipment.
 - 2. Electrical installations used by the equipment shall be completed in accordance with the drawings and specifications to prevent damage to the equipment and the electrical systems, i.e. transformers, relays, circuit breakers, fuses, conductors, motor controllers and their overload elements shall be properly sized, coordinated and adjusted. Voltage supplied to each item of equipment shall be verified to be correct and it shall be determined that motors are not overloaded. The electrical equipment shall be thoroughly cleaned before using it and again immediately before final inspection including vacuum cleaning and wiping clean interior and exterior surfaces.
 - 3. Units shall be properly lubricated, balanced, and aligned. Vibrations must be eliminated.
 - 4. Automatic temperature control systems for preheat coils shall function properly and all safety controls shall function to prevent coil freeze-up damage.
 - 5. The air filtering system utilized shall be that which is designed for the system when complete, and all filter elements shall be replaced at completion of construction and prior to testing and balancing of system.
 - 6. All components of heat production and distribution system, metering equipment, condensate returns, and other auxiliary facilities used in

- temporary service shall be cleaned prior to use; maintained to prevent corrosion internally and externally during use; and cleaned, maintained and inspected prior to acceptance by the Government.
- B. Prior to final inspection, the equipment or parts used which show wear and tear beyond normal, shall be replaced with identical replacements, at no additional cost to the Government.
 - C. This paragraph shall not reduce the requirements of the mechanical and electrical specifications sections.

1.18 TEMPORARY TOILETS - NOT USED

1.19 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. Electricity (for Construction and Testing): Furnish all temporary electric services.
 - 1. Obtain electricity by connecting to the Medical Center electrical distribution system. The Contractor shall meter and pay for electricity required for electric cranes and hoisting devices, electrical welding devices and any electrical heating devices providing temporary heat. Electricity for all other uses is available at no cost to the Contractor.
- E. Water (for Construction and Testing): Furnish temporary water service.
 - 1. Obtain water by connecting to the Medical Center water distribution system. Provide reduced pressure backflow preventer at each connection. Water is available at no cost to the Contractor.

2. Maintain connections, pipe, fittings and fixtures and conserve water-use so none is wasted. Failure to stop leakage or other wastes will be cause for revocation (at COR's discretion) of use of water from Medical Center's system.
- F. Steam: Furnish steam system for testing required in various sections of specifications.
1. Obtain steam for testing by connecting to the Medical Center steam distribution system. Steam is available at no cost to the Contractor.
 2. Maintain connections, pipe, fittings and fixtures and conserve steam-use so none is wasted. Failure to stop leakage or other waste will be cause for revocation (at COR's discretion), of use of steam from the Medical Center's system.

1.20 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.

1.21 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 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 COR and shall be considered concluded only when the 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 COR, does not demonstrate

sufficient qualifications in accordance with requirements for instructors above.

1.22 CONSTRUCTION SIGN - NOT USED

SECTION 01 33 23

SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

PART 1 - GENERAL

1.1 DESCRIPTION

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

1.2 DEFINITIONS

- A. Preconstruction Submittals: Submittals which are required prior to issuing contract notice to proceed or starting construction. For example, Certificates of insurance; Surety bonds; Site-specific safety plan; Construction progress schedule; Schedule of values; Submittal register; List of proposed subcontractors.
- B. Shop Drawings: Drawings, diagrams, and schedules specifically prepared to illustrate some portion of the work. Drawings prepared by or for the Contractor to show how multiple systems and interdisciplinary work will be integrated and coordinated.
- C. Product Data: Catalog cuts, illustrations, schedules, diagrams, performance charts, instructions, and brochures, which describe and illustrate size, physical appearance, and other characteristics

- of materials, systems, or equipment for some portion of the work. Samples of warranty language when the contract requires extended product warranties.
- D. Samples: Physical examples of materials, equipment, or workmanship that illustrate functional and aesthetic characteristics of a material or product and establish standards by which the work can be judged. Color samples from the manufacturer's standard line (or custom color samples if specified) to be used in selecting or approving colors for the project. Field samples and mock-ups constructed to establish standards by which the ensuing work can be judged.
 - E. Design Data: Calculations, mix designs, analyses, or other data pertaining to a part of work.
 - F. Test Reports: Report which includes findings of a test required to be performed by the Contractor on an actual portion of the work. Report which includes finding of a test made at the job site or on sample taken from the job site, on portion of work during or after installation.
 - G. Certificates: Document required of Contractor, or of a manufacturer, supplier, installer, or subcontractor through Contractor. The purpose is to document procedures, acceptability of methods, or personnel qualifications for a portion of the work.
 - H. Manufacturer's Instructions: Pre-printed material describing installation of a product, system, or material, including special notices and MSDS concerning impedances, hazards, and safety precautions.
 - I. Manufacturer's Field Reports: Documentation of the testing and verification actions taken by manufacturer's representative at the job site on a portion of the work, during or after installation, to confirm compliance with manufacturer's standards or instructions. The documentation must indicate whether the material, product, or system has passed or failed the test.
 - J. Operation and Maintenance Data: Manufacturer data that is required to operate, maintain, troubleshoot, and repair equipment, including manufacturer's help, parts list, and product line documentation. This data shall be incorporated in an operations and maintenance manual.
 - K. Closeout Submittals: Documentation necessary to properly close out a construction contract. For example, Record Drawings and as-built drawings. Also, submittal requirements necessary to properly close out a phase of construction on a multi-phase contract.

1.3 SUBMITTAL REGISTER

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

1.4 SUBMITTAL SCHEDULING

- A. Submittals are to be scheduled, submitted, reviewed, and approved prior to the acquisition of the material or equipment.
- B. Coordinate scheduling, sequencing, preparing, and processing of submittals with performance of work so that work will not be delayed by submittal processing. Allow time for potential resubmittal.
- C. No delay costs or time extensions will be allowed for time lost in late submittals or resubmittals.
- D. All submittals are required to be approved prior to the start of the specified work activity.

1.5 SUBMITTAL PREPARATION

- A. Each submittal is to be complete and in sufficient detail to allow ready determination of compliance with contract requirements.
- B. Collect required data for each specific material, product, unit of work, or system into a single submittal. Prominently mark choices, options, and portions applicable to the submittal. Partial submittals will not be accepted for expedition of construction effort. Submittal will be returned without review if incomplete.

- C. If available product data is incomplete, provide Contractor-prepared documentation to supplement product data and satisfy submittal requirements.
- D. All irrelevant or unnecessary data shall be removed from the submittal to facilitate accuracy and timely processing. Submittals that contain the excessive amount of irrelevant or unnecessary data will be returned with review.
- E. Provide a transmittal form for each submittal with the following information:
 - 1. Project title, location and number.
 - 2. Construction contract number.
 - 3. Date of the drawings and revisions.
 - 4. Name, address, and telephone number of subcontractor, supplier, manufacturer, and any other subcontractor associated with the submittal.
 - 5. List paragraph number of the specification section and sheet number of the contract drawings by which the submittal is required.
 - 6. When a resubmission, add alphabetic suffix on submittal description.
For example, submittal 18 would become 18A, to indicate resubmission.
 - 7. Product identification and location in project.
- F. The Contractor is responsible for reviewing and certifying that all submittals are in compliance with contract requirements before submitting for VA review. Proposed deviations from the contract requirements are to be clearly identified. All deviations submitted must include a side by side comparison of item being proposed against item specified. Failure to point out deviations will result in the VA requiring removal and replacement of such work at the Contractor's expense.
- G. Stamp, sign, and date each submittal transmittal form indicating action taken.
- H. Stamp used by the Contractor on the submittal transmittal form to certify that the submittal meets contract requirements is to be similar to the following:

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

1.6 SUBMITTAL FORMAT AND TRANSMISSION

- A. Provide submittals in electronic format, with the exception of material samples. Use PDF as the electronic format, unless otherwise specified or directed by the Contracting Officer.
- B. Compile the electronic submittal file as a single, complete document. Name the electronic submittal file specifically according to its contents.
- C. Electronic files must be of sufficient quality that all information is legible. Generate PDF files from original documents so that the text included in the PDF file is both searchable and can be copied. If

documents are scanned, Optical Character Resolution (OCR) routines are required.

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

1.7 SAMPLES

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

1.8 OPERATION AND MAINTENANCE DATA

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

1.9 TEST REPORTS

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

1.10 VA REVIEW OF SUBMITTALS AND RFIS

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

1.11 APPROVED SUBMITTALS

- A. The VA approval of submittals is not to be construed as a complete check, and indicates only that the general method of construction, materials, detailing, and other information are satisfactory.
- B. VA approval of a submittal does not relieve the Contractor of the responsibility for any error which may exist. The Contractor is responsible for fully complying with all contract requirements and the

satisfactory construction of all work, including the need to check, confirm, and coordinate the work of all subcontractors for the project.

Non-compliant material incorporated in the work will be removed and replaced at the Contractor's expense.

- C. After submittals have been approved, no resubmittal for the purpose of substituting materials or equipment will be considered unless accompanied by an explanation of why a substitution is necessary.
- D. Retain a copy of all approved submittals at project site, including approved samples.

1.12 WITHHOLDING OF PAYMENT

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

**SECTION 01 35 26
SAFETY REQUIREMENTS**

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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):

- 10-2013.....Standard for Portable Fire Extinguishers
- 30-2012.....Flammable and Combustible Liquids Code
- 51B-2014.....Standard for Fire Prevention During Welding,
Cutting and Other Hot Work
- 70-2014.....National Electrical Code
- 70B-2013.....Recommended Practice for Electrical Equipment
Maintenance
- 70E-2015Standard for Electrical Safety in the Workplace
- 99-2012.....Health Care Facilities Code
- 241-2013.....Standard for Safeguarding Construction,
Alteration, and Demolition Operations
- F. The Joint Commission (TJC)
 - TJC ManualComprehensive Accreditation and Certification
Manual
- G. U.S. Nuclear Regulatory Commission
 - 10 CFR 20Standards for Protection Against Radiation
- H. U.S. Occupational Safety and Health Administration (OSHA):
 - 29 CFR 1904Reporting and Recording Injuries & Illnesses
 - 29 CFR 1910Safety and Health Regulations for General
Industry
 - 29 CFR 1926Safety and Health Regulations for Construction
Industry
 - CPL 2-0.124.....Multi-Employer Citation Policy
- I. VHA Directive 2005-007

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 power-lines, 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:

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

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;

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

1. Days away from work (any time lost after day of injury/illness onset);
2. Restricted work;
3. Transfer to another job;
4. Medical treatment beyond first aid;
5. Loss of consciousness;
6. 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,
7. any incident that leads to major equipment damage (greater than \$5000).

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

Major incident/impact - Any mishap that leads to fatalities, hospitalizations, amputations, and losses of an eye as a result 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.

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

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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 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 COR
- 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 COR 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 and COR 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 and COR. 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 in order to safeguard onsite personnel, visitors, the public and the environment.

1.5 ACTIVITY HAZARD ANALYSES (AHAS) :

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)

- A. 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.
- B. Work shall not begin until the AHA for the work activity has been accepted by the Contracting Officer and COR 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 and COR 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 and COR.

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.

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).
- 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 and COR 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 COR 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 and COR.
- 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 and COR 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 and COR 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 and COR 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 accidents. 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 and COR 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 and COR within 5 calendar days of the accident. The Contracting Officer and COR 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 and COR 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 and COR monthly. The contractor and associated sub-contractors' OSHA 300 logs will be made available to the Contracting Officer and COR 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 or COR 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 or COR 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 or COR 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.
- 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 Facility Safety Manager 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 Infection Control and COR. The Infection Control Permits will be posted outside the appropriate construction area. More than one permit may be issued for a construction project if the work is located in separate areas requiring separate classes. The primary project scope area for this project is: **Class [2]**, 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 COR
 - 2) Execute work by methods to minimize raising dust from construction operations.
 - 3) Ceiling tiles: Immediately replace a ceiling tiles displaced for visual inspection.
 - b. Upon Completion:
 - 1) Clean work area upon completion of task
 - 2) Notify the COR
2. Class II requirements:
 - a. During Construction Work:
 - 1) Notify the COR

- 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 COR
3. Class III requirements:
- a. During Construction Work:
- 1) Obtain permit from the COR
 - 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 COR 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 COR
4. Class IV requirements:
- a. During Construction Work:
 - 1) Obtain permit from the COR
 - 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 COR 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 COR

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

1. Class III and IV - closed door with masking tape applied over the frame and door is acceptable for projects that can be contained in a single room.
2. Construction, demolition or reconstruction not capable of containment within a single room must have the following barriers erected and made presentable on hospital occupied side:
 - a. Class III & IV (where dust control is the only hazard, and an agreement is reached with the COR and Medical Center) - Airtight 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 polystyrene, 6-mil thickness meeting local fire codes
2. Barrier Doors: Self Closing Two-hour fire-rated solid core wood in steel frame, painted
3. Dust proof 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 Contracting Officer and COR 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 maintain clean work areas directly outside construction area at all times.

4. Vacuum and wet mop all transition areas from construction to the occupied medical center at the end of each workday. Vacuum shall utilize HEPA filtration. Maintain surrounding area frequently. Remove debris as it is created. Transport these outside the construction area in containers with tightly fitting lids.
 - i. The contractor shall not haul debris through patient-care areas without prior approval of the 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.
 - j. 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.
 - k. 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

- D. 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 and COR 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.

- E. 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, $\frac{3}{4}$ hour fire/smoke rated doors with self-closing devices.
 - 2. Install 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 COR.
- G. Egress Routes for Construction Workers: Maintain free and unobstructed egress. Inspect daily. Report findings and corrective actions weekly to the COR.
- 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.
- 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 COR. 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 COR.

- M. Smoke Detectors: Prevent accidental operation. Remove temporary covers at end of work operations each day. Coordinate with COR.
- N. Hot Work: Perform and safeguard hot work operations in accordance with NFPA 241 and NFPA 51B. Coordinate with COR.
- O. Fire Hazard Prevention and Safety Inspections: Inspect entire construction areas weekly. Coordinate with, and report findings and corrective actions weekly to COR.
- 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 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 Chief of Facilities Management 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 Facility Safety Manager.
- C.** Before beginning any electrical work, an Activity Hazard Analysis (AHA) will be conducted to include Shock Hazard and Arc Flash Hazard analyses (NFPA Tables can be used only as a last alternative and it is strongly suggested a full Arc Flash Hazard 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 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.
- D.** 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 feet (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 feet (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 feet (6 m) in height, positive fall protection shall be used.

1.18 EXCAVATION AND TRENCHES - NOT USED

1.19 CRANES - NOT USED

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 COR.

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 Facility Safety Manager COR. Obtain permits from COR at least prior to starting 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
- E. Portable ladders, used as temporary access, shall extend at least 3 feet (0.9 m) above the upper landing surface.
 - 1. When a 3 feet (0.9-m) extension is not possible, a grasping device (such as a grab rail) shall be provided to assist workers in mounting and dismounting the ladder.
 - 2. In no case shall the length of the ladder be such that ladder deflection under a load would, by itself, cause the ladder to slip from its support.
- G. Ladders shall be inspected for visible defects on a daily basis and after any occurrence that could affect their safe use. Broken or damaged ladders shall be immediately tagged "DO NOT USE," or with similar wording, and withdrawn from service until restored to a condition meeting their original design.

1.24 FLOOR & WALL OPENINGS

- A. All floor and wall openings shall comply with 29 CFR 1926 Subpart M.
- B. Floor and roof holes/openings are any that measure over 2 in (51 mm) in any direction of a walking/working surface which persons may trip or fall into or where objects may fall to the level below. 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

SECTION 01 42 19
REFERENCE STANDARDS

PART 1 - GENERAL

1.1 DESCRIPTION

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

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

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

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

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

DEPARTMENT OF VETERANS AFFAIRS

Office of Construction & Facilities Management

Facilities Quality Service (00CFM1A)

811 Vermont Avenue, NW - Room 462

Washington, DC 20420

Telephone Number: (202) 565-5214

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.aabchg.com
AAMA	American Architectural Manufacturer's Association http://www.aamanet.org
AAN	American Nursery and Landscape Association http://www.anla.org
AASHTO	American Association of State Highway and Transportation Officials http://www.aashto.org
AATCC	American Association of Textile Chemists and Colorists http://www.aatcc.org
ACGIH	American Conference of Governmental Industrial Hygienists http://www.acgih.org
ACI	American Concrete Institute http://www.aci-int.net
ACPA	American Concrete Pipe Association http://www.concrete-pipe.org
ACPPA	American Concrete Pressure Pipe Association http://www.acppa.org
ADC	Air Diffusion Council http://flexibleduct.org
AGA	American Gas Association http://www.aga.org
AGC	Associated General Contractors of America http://www.agc.org
AGMA	American Gear Manufacturers Association, Inc. http://www.agma.org
AHAM	Association of Home Appliance Manufacturers http://www.aham.org
AISC	American Institute of Steel Construction http://www.aisc.org
AISI	American Iron and Steel Institute http://www.steel.org

AITC	American Institute of Timber Construction http://www.aitc-glulam.org
AMCA	Air Movement and Control Association, Inc. http://www.amca.org
ANLA	American Nursery & Landscape Association http://www.anla.org
ANSI	American National Standards Institute, Inc. http://www.ansi.org
APA	The Engineered Wood Association http://www.apawood.org
ARI	Air-Conditioning and Refrigeration Institute http://www.ari.org
ASAE	American Society of Agricultural Engineers http://www.asae.org
ASCE	American Society of Civil Engineers http://www.asce.org
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers http://www.ashrae.org
ASME	American Society of Mechanical Engineers http://www.asme.org
ASSE	American Society of Sanitary Engineering http://www.asse-plumbing.org
ASTM	American Society for Testing and Materials http://www.astm.org
AWI	Architectural Woodwork Institute http://www.awinet.org
AWS	American Welding Society http://www.aws.org
AWWA	American Water Works Association http://www.awwa.org
BHMA	Builders Hardware Manufacturers Association http://www.buildershardware.com
BIA	Brick Institute of America http://www.bia.org
CAGI	Compressed Air and Gas Institute http://www.cagi.org
CGA	Compressed Gas Association, Inc. http://www.cganet.com
CI	The Chlorine Institute, Inc. http://www.chlorineinstitute.org

CISCA	Ceilings and Interior Systems Construction Association http://www.cisca.org
CISPI	Cast Iron Soil Pipe Institute http://www.cispi.org
CLFMI	Chain Link Fence Manufacturers Institute http://www.chainlinkinfo.org
CPMB	Concrete Plant Manufacturers Bureau http://www.cpmc.org
CRA	California Redwood Association http://www.calredwood.org
CRSI	Concrete Reinforcing Steel Institute http://www.crsi.org
CTI	Cooling Technology Institute http://www.cti.org
DHI	Door and Hardware Institute http://www.dhi.org
EGSA	Electrical Generating Systems Association http://www.egsa.org
EEI	Edison Electric Institute http://www.eei.org
EPA	Environmental Protection Agency http://www.epa.gov
ETL	ETL Testing Laboratories, Inc. http://www.etl.com
FAA	Federal Aviation Administration http://www.faa.gov
FCC	Federal Communications Commission http://www.fcc.gov
FPS	The Forest Products Society http://www.forestprod.org
GANA	Glass Association of North America http://www.cssinfo.com/info/gana.html/
FM	Factory Mutual Insurance http://www.fmglobal.com
GA	Gypsum Association http://www.gypsum.org
GSA	General Services Administration http://www.gsa.gov
HI	Hydraulic Institute http://www.pumps.org

HPVA	Hardwood Plywood & Veneer Association http://www.hpva.org
ICBO	International Conference of Building Officials http://www.icbo.org
ICEA	Insulated Cable Engineers Association Inc. http://www.icea.net
\ICAC	Institute of Clean Air Companies http://www.icac.com
IEEE	Institute of Electrical and Electronics Engineers http://www.ieee.org/
IMSA	International Municipal Signal Association http://www.imsasafety.org
IPCEA	Insulated Power Cable Engineers Association
NBMA	Metal Buildings Manufacturers Association http://www.mbma.com
MSS	Manufacturers Standardization Society of the Valve and Fittings Industry Inc. http://www.mss-hq.com
NAAMM	National Association of Architectural Metal Manufacturers http://www.naamm.org
NAPHCC	Plumbing-Heating-Cooling Contractors Association http://www.phccweb.org.org
NBS	National Bureau of Standards See - NIST
NBBPVI	National Board of Boiler and Pressure Vessel Inspectors http://www.nationboard.org
NEC	National Electric Code See - NFPA National Fire Protection Association
NEMA	National Electrical Manufacturers Association http://www.nema.org
NFPA	National Fire Protection Association http://www.nfpa.org
NHLA	National Hardwood Lumber Association http://www.natlhardwood.org
NIH	National Institute of Health http://www.nih.gov
NIST	National Institute of Standards and Technology http://www.nist.gov
NLMA	Northeastern Lumber Manufacturers Association, Inc. http://www.nelma.org

NPA National Particleboard Association
18928 Premiere Court
Gaithersburg, MD 20879
(301) 670-0604

NSF National Sanitation Foundation
<http://www.nsf.org>

NWWDA Window and Door Manufacturers Association
<http://www.nwwda.org>

OSHA Occupational Safety and Health Administration
Department of Labor
<http://www.osha.gov>

PCA Portland Cement Association
<http://www.portcement.org>

PCI Precast Prestressed Concrete Institute
<http://www.pci.org>

PPI The Plastic Pipe Institute
<http://www.plasticpipe.org>

PEI Porcelain Enamel Institute, Inc.
<http://www.porcelainenamel.com>

PTI Post-Tensioning Institute
<http://www.post-tensioning.org>

RFCI The Resilient Floor Covering Institute
<http://www.rfci.com>

RIS Redwood Inspection Service
See - CRA

RMA Rubber Manufacturers Association, Inc.
<http://www.rma.org>

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

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

IGMA Insulating Glass Manufacturers Alliance
<http://www.igmaonline.org>

SJI Steel Joist Institute
<http://www.steeljoist.org>

SMACNA Sheet Metal and Air-Conditioning Contractors
National Association, Inc.
<http://www.smacna.org>

SSPC The Society for Protective Coatings
<http://www.sspc.org>

STI	Steel Tank Institute http://www.steeltank.com
SWI	Steel Window Institute http://www.steelwindows.com
TCA	Tile Council of America, Inc. http://www.tileusa.com
TEMA	Tubular Exchange Manufacturers Association http://www.tema.org
TPI	Truss Plate Institute, Inc. 583 D'Onofrio Drive; Suite 200 Madison, WI 53719 (608) 833-5900
UBC	The Uniform Building Code See ICBO
UL	Underwriters' Laboratories Incorporated http://www.ul.com
ULC	Underwriters' Laboratories of Canada http://www.ulc.ca
WCLIB	West Coast Lumber Inspection Bureau 6980 SW Varns Road, P.O. Box 23145 Portland, OR 97223 (503) 639-0651
WRCLA	Western Red Cedar Lumber Association P.O. Box 120786 New Brighton, MN 55112 (612) 633-4334
WWPA	Western Wood Products Association http://www.wwpa.org

SECTION 01 74 19
CONSTRUCTION WASTE MANAGEMENT

PART 1 - GENERAL

1.1 DESCRIPTION

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

1.2 RELATED WORK

Provide and coordinate all necessary work and products meeting the requirements associated with all applicable specification sections and plans to produce a system complete, functional and ready for the purpose

intended. No statements here in shall relieve the Contractor of responsibilities described elsewhere in the contract documents.

- A. Section 02 41 00, Demolition.
- B. Disconnecting utility services: Section 01 00 00, General Requirements.

1.3 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.

1.4 GOVERNMENT POLICY

GOVERNMENT POLICY

- A. All waste disposal shall be in compliance with local and state code.

1.5 PLAN

- A. Contractor shall practice efficient waste management when managing 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. 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 the greatest extent feasible.
- D. Contractor shall be responsible for implementation of any special programs involving rebates or similar incentives related to recycling.
- 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.
- F. Contractor shall layout and label 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.

1.6 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.

1.7 SUBMITTALS

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

- A. Prepare and submit to the 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.
Description of materials to be site-separated and self hauled to designated facilities.
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.

1.8 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. West Virginia Recycle and Waste Disposal Guide.

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 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.

3.2 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.

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 contract 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 COR 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 COR 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 COR 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 COR.
- 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 COR. 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 COR and copied to the designated Commissioning Representatives for the Contractor and subcontractors on the Commissioning Team for information only in order to expedite the communication process. These issues must be understood as the professional opinion of the Commissioning Agent and as suggestions for resolution.
3. In the event that any Commissioning Issues and suggested resolutions are deemed by the COR to require either an official interpretation of the construction documents or require a modification of the contract documents, the Contracting Officer or COR will issue an official directive to this effect.
4. All parties to the Commissioning Process shall be individually responsible for alerting the COR 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 COR, 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 NETWORK ANALYSIS SCHEDULES
- D. Section 01 32.16.15 PROJECT SCHEDULES (SMALL PROJECTS - DESIGN/BID/BUILD)

- E. Section 01 32.16.16 NETWORK ANALYSIS SCHEDULES (SMALL PROJECTS - DESIGN/BID/BUILD)
- F. Section 01 32.16.17 PROJECT SCHEDULES (SMALL PROJECTS- DESIGN/BUILD)
- G. Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES
- H. Section 01 81 13 SUSTAINABLE CONSTRUCTION REQUIREMENTS
- I. Section 07 08 00 FACILITY EXTERIOR CLOSURE COMMISSIONING.
- J. Section 21 08 00 COMMISSIONING OF FIRE PROTECTION SYSTEMS.
- K. Section 22 08 00 COMMISSIONING OF PLUMBING SYSTEMS.
- L. Section 23 08 00 COMMISSIONING OF HVAC SYSTEMS.
- M. Section 26 08 00 COMMISSIONING OF ELECTRICAL SYSTEMS.
- N. Section 27 08 00 COMMISSIONING OF COMMUNICATIONS SYSTEMS.
- O. Section 28 08 00 COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS.
- P. 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
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

List of Acronyms	
Acronym	Meaning
VA CFM	VA Office of Construction and Facilities Management
VACO	VA Central Office
VA PM	VA Project Manager
VA-RE	VA COR
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>)

Commission ability: 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 commission ability, operability, maintainability, or functionality of a system, equipment, or component. A condition that is in conflict 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 of 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 course of 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 owner's 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 in order 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
Plumbing	
Domestic Water Distribution	New water lines
Water Metering	New secondary Armstrong DRV - 80
Communications	
Grounding & Bonding System	Witness 2rd party testing, review reports
Structured Cabling System	Witness 2rd party testing, review reports

Systems To Be Commissioned	
System	Description
Wireless Network	Witness 2rd party testing, review reports
Online Continuous Water Quality Monitoring System	Witness 2rd party testing, review reports

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).
- 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.

1.9 VA'S COMMISSIONING RESPONSIBILITIES

- A. Assign COR to participate in Commissioning activities
- 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 and approved by VA, to the Contractor and his 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 operating 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 an 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 COR 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 15 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 15 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 Contractor and 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	L = Lead
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Commissioning Roles & Responsibilities		Agent RE = COR A/E = Design Arch/Engineer PC = Prime Contractor O&M = Gov't Facility O&M					P = Participate A = Approve R = Review O = Optional
Category	Task Description	CxA	RE	A/ E	PC	O& M	Notes
Meetings	Construction Commissioning Kick Off meeting	L	A		P	O	
	Commissioning Meetings	L	A		P	O	
	Project Progress Meetings	P	A		L	O	
	Controls Meeting	L	A		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	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	
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	

Construction Phase		CxA = Commissioning Agent RE = COR A/E = Design Arch/Engineer PC = Prime Contractor O&M = Gov't Facility O&M					L = Lead P = Participate A = Approve R = Review O = Optional
Commissioning Roles & Responsibilities							
Category	Task Description	CxA	RE	A/E	PC	O&M	Notes
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	
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 RE = COR A/E = Design Arch/Engineer PC = Prime Contractor O&M = Gov't Facility O&M					L = Lead P = Participate A = Approve R = Review 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	

Acceptance Phase		CxA = Commissioning Agent RE = COR A/E = Design Arch/Engineer PC = Prime Contractor O&M = Gov't Facility O&M					L = Lead P = Participate A = Approve R = Review O = Optional
Commissioning Roles & Responsibilities							
Category	Task Description	CxA	RE	A/E	PC	O&M	Notes
	Lessons Learned and Commissioning Report Review 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 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	
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	

Acceptance Phase		CxA = Commissioning Agent RE = COR A/E = Design Arch/Engineer PC = Prime Contractor O&M = Gov't Facility O&M					L = Lead P = Participate A = Approve R = Review O = Optional
Commissioning Roles & Responsibilities							
Category	Task Description	CxA	RE	A/E	PC	O&M	Notes
	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 RE = COR A/E = Design Arch/Engineer PC = Prime Contractor O&M = Gov't Facility O&M					L = Lead P = Participate A = Approve R = Review O = Optional
Commissioning Roles & Responsibilities							
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.

3.4 PHASED COMMISSIONING

- A. The project may require startup and initial checkout to be executed in phases. This phasing shall be planned and scheduled in a coordination meeting of the VA, Commissioning Agent, and the Contractor. Results will be added to the master construction schedule and the commissioning schedule.

3.5 DDC SYSTEM TRENDING FOR COMMISSIONING - NOT USED

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 or not 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 over using 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 COR, 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.

SECTION 02 41 00
DEMOLITION

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies demolition and removal of sidewalks, roadways, utilities, other structures and debris.

1.2 RELATED WORK:

- A. Demolition and removal of roads, walks, curbs, and on-grade slabs outside buildings to be demolished: Section 31 20 00, EARTH MOVING.
- B. Safety Requirements: GENERAL CONDITIONS Article, ACCIDENT PREVENTION.
- C. Disconnecting utility services prior to demolition: Section 01 00 00, GENERAL REQUIREMENTS.
- D. Reserved items that are to remain the property of the Government: Section 01 00 00, GENERAL REQUIREMENTS.

1.3 PROTECTION:

- A. Perform demolition in such manner as to eliminate hazards to persons and property; to minimize interference with use of adjacent areas, utilities and structures or interruption of use of such utilities; and to provide free passage to and from such adjacent areas of structures. Comply with requirements of GENERAL CONDITIONS Article, ACCIDENT PREVENTION.
- B. Provide safeguards, including warning signs, barricades, temporary fences, warning lights, and other similar items that are required for protection of all personnel during demolition and removal operations. Comply with requirements of Section 01 00 00, GENERAL REQUIREMENTS, Article 1.9 PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES AND IMPROVEMENTS.
- C. Maintain fences, barricades, lights, and other similar items around exposed excavations until such excavations have been completely filled.
- D. Provide enclosed dust chutes with control gates from each floor to carry debris to truck beds and govern flow of material into truck. Provide overhead bridges of tight board or prefabricated metal construction at dust chutes to protect persons and property from falling debris.
- E. Prevent spread of flying particles and dust. Sprinkle rubbish and debris with water to keep dust to a minimum. Do not use water if it results in hazardous or objectionable condition such as, but not limited to; ice, flooding, or pollution. Vacuum and dust the work area daily.
- F. In addition to previously listed fire and safety rules to be observed in performance of work, include following:
 - 1. No wall or part of wall shall be permitted to fall outwardly from structures.

2. Wherever a cutting torch or other equipment that might cause a fire is used, provide and maintain fire extinguishers nearby ready for immediate use. Instruct all possible users in use of fire extinguishers.
 3. Keep hydrants clear and accessible at all times. Prohibit debris from accumulating within a radius of 4500 mm (15 feet) of fire hydrants.
- G. Before beginning any demolition work, the Contractor shall survey the site and examine the drawings and specifications to determine the extent of the work. The contractor shall take necessary precautions to avoid damages to existing items to remain in place, to be reused, or to remain the property of the Medical Center; any damaged items shall be repaired or replaced as approved by the COTR. The Contractor shall coordinate the work of this section with all other work and shall construct and maintain shoring, bracing, and supports as required. The Contractor shall ensure that structural elements are not overloaded and shall be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract. Do not overload structural elements. Provide new supports and reinforcement for existing construction weakened by demolition or removal works. Repairs, reinforcement, or structural replacement must have COTR's approval.
- H. The work shall comply with the requirements of Section 01 00 00, General Requirements, Article 1.8 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 COTR. 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. 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 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 COTR. When Utility lines are encountered that are not indicated on the drawings, the COTR shall be notified prior to further work in that area. Utilities that are encountered that are not noted on drawings shall remain in operation unless told otherwise by COTR.

3.2 CLEAN-UP:

On completion of work of this section and after removal of all debris, leave site in clean condition satisfactory to COTR. 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.

SECTION 07 84 00
FIRESTOPPING

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. Provide UL or equivalent approved firestopping system for the closures of openings in walls, floors, and roof decks against penetration of flame, heat, and smoke or gases in fire resistant rated construction.
- B. Provide UL or equivalent approved firestopping system for the closure of openings in walls against penetration of gases or smoke in smoke partitions.

1.2 RELATED WORK:

- A. Sustainable Design Requirements: Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS. - NOT USED
- B. Expansion and seismic joint firestopping: Section 07 95 13, EXPANSION JOINT COVER ASSEMBLIES. - NOT USED
- C. Spray applied fireproofing: Section 07 81 00, APPLIED FIREPROOFING - NOT USED
- D. Sealants and application: Section 07 92 00, JOINT SEALANTS. - NOT USED
- E. Fire and smoke damper assemblies in ductwork: Section 23 31 00, HVAC DUCTS AND CASINGS, Section 23 37 00, AIR OUTLETS AND INLETS. - NOT USED

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: NOT USED
- C. Installer qualifications.
- D. Inspector qualifications.
- E. Manufacturers literature, data, and installation instructions for types of firestopping and smoke stopping used.
- F. List of FM, UL, or WH classification number of systems installed.
- G. Certified laboratory test reports for ASTM E814 tests for systems not listed by FM, UL, or WH proposed for use.
- H. Submit certificates from manufacturer attesting that firestopping materials comply with the specified requirements.

1.4 DELIVERY AND STORAGE:

- A. Deliver materials in their original unopened containers with manufacturer's name and product identification.
- B. Store in a location providing protection from damage and exposure to the elements.

1.5 QUALITY ASSURANCE:

- A. FM, UL, or WH or other approved laboratory tested products will be acceptable.

- B. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991 or been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements." Submit qualification data.
- C. Inspector Qualifications: Contractor to engage a qualified inspector to perform inspections and final reports. The inspector to meet the criteria contained in ASTM E699 for agencies involved in quality assurance and to have a minimum of two years' experience in construction field inspections of firestopping systems, products, and assemblies. The inspector to be completely independent of, and divested from, the Contractor, the installer, the manufacturer, and the supplier of material or item being inspected. Submit inspector qualifications.

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 the basic designation only.
- B. ASTM International (ASTM):
 - E84-14Surface Burning Characteristics of Building Materials
 - E699-09Standard Practice for Evaluation of Agencies Involved in Testing, Quality Assurance, and Evaluating of Building Components
 - E814-13aFire Tests of Through-Penetration Fire Stops
 - E2174-14Standard Practice for On-Site Inspection of Installed Firestops
 - E2393-10aStandard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers
- C. FM Global (FM):
 - Annual Issue Approval Guide Building Materials
 - 4991-13Approval of Firestop Contractors
- D. Underwriters Laboratories, Inc. (UL):
 - Annual Issue Building Materials Directory
 - Annual Issue Fire Resistance Directory
 - 723-10(2008)Standard for Test for Surface Burning Characteristics of Building Materials
 - 1479-04(R2014)Fire Tests of Through-Penetration Firestops
- E. Intertek Testing Services - Warnock Hersey (ITS-WH):
 - Annual Issue Certification Listings
- F. Environmental Protection Agency (EPA):
 - 40 CFR 59(2014)National Volatile Organic Compound Emission Standards for Consumer and Commercial Products

PART 2 - PRODUCTS

2.1 FIRESTOP SYSTEMS:

- A. Provide either factory built (Firestop Devices) or field erected (through-Penetration Firestop Systems) to form a specific building system maintaining

required integrity of the fire barrier and stop the passage of gases or smoke. Firestop systems to accommodate building movements without impairing their integrity.

- B. Through-penetration firestop systems and firestop devices tested in accordance with ASTM E814 or UL 1479 using the "F" or "T" rating to maintain the same rating and integrity as the fire barrier being sealed. "T" ratings are not required for penetrations smaller than or equal to 101 mm (4 in.) nominal pipe or 0.01 sq. m (16 sq. in.) in overall cross-sectional area.
- C. Firestop sealants used for firestopping or smoke sealing to have the following properties:
 - 1. Contain no flammable or toxic solvents.
 - 2. Release no dangerous or flammable out gassing during the drying or curing of products.
 - 3. Water-resistant after drying or curing and unaffected by high humidity, condensation or transient water exposure.
 - 4. When installed in exposed areas, capable of being sanded and finished with similar surface treatments as used on the surrounding wall or floor surface.
 - 5. VOC Content: Firestopping sealants and sealant primers to comply with the following limits for VOC content when calculated according to 40 CFR 59, (EPA Method 24):
 - a. Sealants: 250 g/L.
 - b. Sealant Primers for Nonporous Substrates: 250 g/L.
 - c. Sealant Primers for Porous Substrates: 775 g/L.
- D. Firestopping system or devices used for penetrations by glass pipe, plastic pipe or conduits, unenclosed cables, or other non-metallic materials to have following properties:
 - 1. Classified for use with the particular type of penetrating material used.
 - 2. Penetrations containing loose electrical cables, computer data cables, and communications cables protected using firestopping systems that allow unrestricted cable changes without damage to the seal.
- E. Maximum flame spread of 25 and smoke development of 50 when tested in accordance with ASTM E84 or UL 723. Material to be an approved firestopping material as listed in UL Fire Resistance Directory or by a nationally recognized testing laboratory.
- F. FM, UL, or WH rated or tested by an approved laboratory in accordance with ASTM E814.
- G. Materials to be nontoxic and noncarcinogen at all stages of application or during fire conditions and to not contain hazardous chemicals. Provide firestop material that is free from Ethylene Glycol, PCB, MEK, and asbestos.
- H. For firestopping exposed to view, traffic, moisture, and physical damage, provide products that do not deteriorate when exposed to these conditions.
 - 1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.

2. For floor penetrations with annular spaces exceeding 101 mm (4 in.) or more in width and exposed to possible loading and traffic, provide firestop systems capable of supporting the floor loads involved either by installing floor plates or by other means acceptable to the firestop manufacturer.
3. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.

2.2 SMOKE STOPPING IN SMOKE PARTITIONS:

- A. Section 07 92 00, JOINT SEALANTS. - NOT USED
- B. Provide mineral fiber filler and bond breaker behind sealant.
- C. Sealants to have a maximum flame spread of 25 and smoke developed of 50 when tested in accordance with ASTM E84.
- D. When used in exposed areas capable of being sanded and finished with similar surface treatments as used on the surrounding wall or floor surface.

PART 3 - EXECUTION

3.1 EXAMINATION:

- A. Submit product data and installation instructions, as required by article, submittals, after an on-site examination of areas to receive firestopping.
- B. Examine substrates and conditions with installer present for compliance with requirements for opening configuration, penetrating items, substrates, and other conditions affecting performance of firestopping. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION:

- A. Remove dirt, grease, oil, laitance and form-release agents from concrete, loose materials, or other substances that prevent adherence and bonding or application of the firestopping or smoke stopping materials.
- B. Remove insulation on insulated pipe for a distance of 150 mm (6 inches) on each side of the fire rated assembly prior to applying the firestopping materials unless the firestopping materials are tested and approved for use on insulated pipes.
- C. Prime substrates where required by joint firestopping system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- D. Masking Tape: Apply masking tape to prevent firestopping from contacting adjoining surfaces that will remain exposed upon completion of work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestopping materials. Remove tape as soon as it is possible to do so without disturbing seal of firestopping with substrates.

3.3 INSTALLATION:

- A. Do not begin firestopping work until the specified material data and installation instructions of the proposed firestopping systems have been submitted and approved.

- B. Install firestopping systems with smoke stopping in accordance with FM, UL, WH, or other approved system details and installation instructions.
- C. Install smoke stopping seals in smoke partitions.

3.4 CLEAN-UP:

- A. As work on each floor is completed, remove materials, litter, and debris.
- B. Clean up spills of liquid type materials.
- C. Clean off excess fill materials and sealants adjacent to openings and joints as work progresses by methods and with cleaning materials approved by manufacturers of firestopping products and of products in which opening and joints occur.
- D. Protect firestopping during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated firestopping immediately and install new materials to provide firestopping complying with specified requirements.

3.5 INSPECTIONS AND ACCEPTANCE OF WORK:

- A. Do not conceal or enclose firestop assemblies until inspection is complete and approved by the Contracting Officer Representative (COR).
- B. Furnish service of approved inspector to inspect firestopping in accordance with ASTM E2393 and ASTM E2174 for firestop inspection, and document inspection results. Submit written reports indicating locations of and types of penetrations and type of firestopping used at each location; type is to be recorded by UL listed printed numbers.

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 NOT USED, Division 08 - OPENINGS, Division 10 - SPECIALTIES, Division 11 - EQUIPMENT - NOT USED, Division 12 - FURNISHINGS - NOT USED, Division 13 - SPECIAL CONSTRUCTION - NOT USED, Division 14 - CONVEYING EQUIPMENT -NOT USED, Division 21 - FIRE SUPPRESSION - Division 22 - PLUMBING - Division 23 - VENTILATION AND AIR-CONDITIONING,- Division 26 - ELECTRICAL, Division 27 - COMMUNICATIONS - Division 28 - ELECTRONIC SAFETY AND SECURITY sections - NOT USED.
- B. Contractor option: Prefinished flush doors with transparent finishes: Section 08 14 00, WOOD DOORS - NOT USED
- C. Type of Finish, Color, and Gloss Level of Finish Coat: Section 09 06 00, SCHEDULE FOR FINISHES - NOT USED.
- D. Glazed wall surfacing or tile like coatings: Section 09 96 59, HIGH-BUILD GLAZED COATINGS.
- E. Multi-color Textured Wall Finish: Section 09 94 19, MULTICOLOR INTERIOR FINISHING - NOT USED.
- F. Asphalt and concrete pavement marking: Section 32 17 23, PAVEMENT MARKINGS - NOT USED.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. 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.

- C. Sample Panels: _ NOT USED
- D. Sample of identity markers if used.
- E. Manufacturers' Certificates indicating compliance with specified requirements:
 - 1. Manufacturer's paint substituted for Federal Specification paints meets or exceeds performance of paint specified.
 - 2. High temperature aluminum paint.
 - 3. Epoxy coating.
 - 4. Intumescent clear coating or fire-retardant paint.
 - 5. Plastic floor coating.

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. NOT USED

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-2012Threshold Limit Values (TLV) for Chemical Substances and Physical Agents and Biological Exposure Indices (BEIs)
 - ACGIH TLV-DOC-2012Documentation of Threshold Limit Values and Biological Exposure Indices, (Seventh Edition)
- C. American National Standards Institute (ANSI):
 - A13.1-07Scheme 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-1555Water Paint, Powder (Cementitious, White and Colors) (WPC)
(cancelled)

A-A-3120Paint, For Swimming Pools (RF) (cancelled)

F. Federal Specifications (Fed Spec):

TT-P-1411APaint, Copolymer-Resin, Cementitious (For Waterproofing
Concrete and Masonry Walls) (CEP)

G. Master Painters Institute (MPI):

No. 1-12Aluminum Paint (AP)

No. 4-12Interior/ Exterior Latex Block Filler

No. 5-12Exterior Alkyd Wood Primer

No. 7-12Exterior Oil Wood Primer

No. 8-12Exterior Alkyd, Flat MPI Gloss Level 1 (EO)

No. 9-12Exterior Alkyd Enamel MPI Gloss Level 6 (EO)

No. 10-12Exterior Latex, Flat (AE)

No. 11-12Exterior Latex, Semi-Gloss (AE)

No. 18-12Organic Zinc Rich Primer

No. 22-12Aluminum Paint, High Heat (up to 590° - 1100F) (HR)

No. 26-12Cementitious Galvanized Metal Primer

No. 27-12Exterior / Interior Alkyd Floor Enamel, Gloss (FE)

No. 31-12Polyurethane, Moisture Cured, Clear Gloss (PV)

No. 36-12Knot Sealer

No. 43-12Interior Satin Latex, MPI Gloss Level 4

No. 44-12Interior Low Sheen Latex, MPI Gloss Level 2

No. 45-12Interior Primer Sealer

No. 46-12Interior Enamel Undercoat

No. 47-12Interior Alkyd, Semi-Gloss, MPI Gloss Level 5 (AK)

No. 48-12Interior Alkyd, Gloss, MPI Gloss Level 6 (AK)

No. 49-12Interior Alkyd, Flat, MPI Gloss Level 1 (AK)

No. 50-12Interior Latex Primer Sealer

No. 51-12Interior Alkyd, Eggshell, MPI Gloss Level 3

No. 52-12Interior Latex, MPI Gloss Level 3 (LE)

No. 53-12Interior Latex, Flat, MPI Gloss Level 1 (LE)

No. 54-12Interior Latex, Semi-Gloss, MPI Gloss Level 5 (LE)

No. 59-12Interior/Exterior Alkyd Porch & Floor Enamel, Low Gloss
(FE)

No. 60-12Interior/Exterior Latex Porch & Floor Paint, Low Gloss

No. 66-12Interior Alkyd Fire Retardant, Clear Top-Coat (ULC
Approved) (FC)

No. 67-12Interior Latex Fire Retardant, Top-Coat (ULC Approved) (FR)

No. 68-12Interior/ Exterior Latex Porch & Floor Paint, Gloss

No. 71-12Polyurethane, Moisture Cured, Clear, Flat (PV)

- No. 74-12Interior Alkyd Varnish, Semi-Gloss
 - No. 77-12Epoxy Cold Cured, Gloss (EC)
 - No. 79-12Marine Alkyd Metal Primer
 - No. 90-12Interior Wood Stain, Semi-Transparent (WS)
 - No. 91-12Wood Filler Paste
 - No. 94-12Exterior Alkyd, Semi-Gloss (EO)
 - No. 95-12Fast Drying Metal Primer
 - No. 98-12High Build Epoxy Coating
 - No. 101-12Epoxy Anti-Corrosive Metal Primer
 - No. 108-12High Build Epoxy Coating, Low Gloss (EC)
 - No. 114-12Interior Latex, Gloss (LE) and (LG)
 - No. 119-12Exterior Latex, High Gloss (acrylic) (AE)
 - No. 135-12Non-Cementitious Galvanized Primer
 - No. 138-12Interior High Performance Latex, MPI Gloss Level 2 (LF)
 - No. 139-12Interior High Performance Latex, MPI Gloss Level 3 (LL)
 - No. 140-12Interior High Performance Latex, MPI Gloss Level 4
 - No. 141-12Interior 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 specified in Section 09 06 00, SCHEDULE FOR FINISHES - NOT USED.
 - 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 Alkyd Wood Primer: MPI 5.
- H. Exterior Oil Wood Primer: MPI 7.
- I. Exterior Alkyd, Flat (EO): MPI 8.

J. Exterior Alkyd Enamel (EO): MPI 9.
K. Exterior Latex, Flat (AE): MPI 10.
L. Exterior Latex, Semi-Gloss (AE): MPI 11.
M. Organic Zinc Rich Coating (HR): MPI 22.
N. High Heat Resistant Coating (HR): MPI 22.
O. Cementitious Galvanized Metal Primer: MPI 26.
P. Exterior/ interior Alkyd Floor Enamel, Gloss (FE): MPI 27.
Q. Knot Sealer: MPI 36.
R. Interior Satin Latex: MPI 43.
S. Interior Low Sheen Latex: MPI 44.
T. Interior Primer Sealer: MPI 45.
U. Interior Enamel Undercoat: MPI 47.
V. Interior Alkyd, Semi-Gloss (AK): MPI 47.
W. Interior Alkyd, Gloss (AK): MPI 49.
x. Interior Latex Primer Sealer: MPI 50.
Y. Interior Alkyd, Eggshell: MPI 51
Z. Interior Latex, MPI Gloss Level 3 (LE): MPI 52.
AA. Interior Latex, Flat, MPI Gloss Level 1 (LE): MPI 53.
BB. Interior Latex, Semi-Gloss, MPI Gloss Level 5 (LE): MPI 54.
DD. Interior / Exterior Alkyd Porch & Floor Enamel, Low Gloss (FE): MPI 59.
EE. Interior/ Exterior Latex Porch & Floor Paint, Low Gloss: MPI 60.
FF. Interior Alkyd Fire Retardant, Clear Top-Coat (ULC Approved) (FC): MPI 66.
GG. Interior Latex Fire Retardant, Top-Coat (ULC Approved) (FR): MPI 67.
HH. Interior/ Exterior Latex Porch & Floor Paint, gloss: MPI 68.
II. Epoxy Cold Cured, Gloss (EC): MPI 77.
JJ. Marine Alkyd Metal primer: MPI 79.
KK. Interior Wood Stain, Semi-Transparent (WS): MPI 90.
LL. Wood Filler Paste: MPI 91.
MM. Exterior Alkyd, Semi-Gloss (EO): MPI 94.
NN. Fast Drying Metal Primer: MPI 95.
OO. High Build Epoxy Coating: MPI 98.
PP. Epoxy Anti-Corrosive Metal Primer: MPI 101.
QQ. High Build Epoxy Marine Coating (EC): MPI 108.
RR. Interior latex, Gloss (LE) and (LG): MPI 114.
SS. Exterior Latex, High Gloss (acrylic) (AE): MPI 119.
TT. Waterborne Galvanized Primer: MPI 134.
UU. Non-Cementitious Galvanized Primer: MPI 135.
VV. Interior High Performance Latex, MPI Gloss Level 2 (LF): MPI 138.
WW. Interior High Performance Latex, MPI Gloss Level 3 (LL): MPI 139.
XX. Interior High Performance Latex, MPI Gloss Level 4: MPI 140.
YY. Interior High Performance Latex (SG), MPI Gloss Level 5: MPI 141.

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. Volatile Organic Compounds (VOC): VOC content of paint materials shall not exceed 10g/l for interior latex paints/primers and 50g/l for exterior latex paints and primers.
 - 2. Lead-Based 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 day's work.

B. Atmospheric and Surface Conditions:

1. Do not apply coating when air or substrate conditions are:
 - a. Less than 3 degrees C (5 degrees F) above dew point.
 - b. Below 10 degrees C (50 degrees F) or over 35 degrees C (95 degrees F), unless specifically pre-approved by the Contracting Officer and the product manufacturer. Under no circumstances shall application conditions exceed manufacturer recommendations.
2. Maintain interior temperatures until paint dries hard.
3. Do no exterior painting when it is windy and dusty.
4. Do not paint in direct sunlight or on surfaces that the sun will soon warm.
5. Apply only on clean, dry and frost-free surfaces except as follows:
 - a. Apply water thinned acrylic and cementitious paints to damp (not wet) surfaces where allowed by manufacturer's printed instructions.
 - b. Dampened with a fine mist of water on hot dry days concrete and masonry surfaces to which water thinned acrylic and cementitious paints are applied to prevent excessive suction and to cool surface.
6. Varnishing:
 - a. Apply in clean areas and in still air.
 - b. Before varnishing vacuum and dust area.
 - c. Immediately before varnishing wipe down surfaces with a tack rag.

3.2 SURFACE PREPARATION

A. Method of surface preparation is optional, provided results of finish painting produce solid even color and texture specified with no overlays.

B. General:

1. Remove prefinished items not to be painted such as lighting fixtures, escutcheon plates, hardware, trim, and similar items for reinstallation after paint is dried.
2. Remove items for reinstallation and complete painting of such items and adjacent areas when item or adjacent surface is not accessible or finish is different.
3. See other sections of specifications for specified surface conditions and prime coat.
4. Clean surfaces for painting with materials and methods compatible with substrate and specified finish. Remove any residue remaining from cleaning agents used. Do not use solvents, acid, or steam on concrete and masonry.

C. Wood:

1. Sand to a smooth even surface and then dust off.
2. Sand surfaces showing raised grain smooth between each coat.
3. Wipe surface with a tack rag prior to applying finish.
4. Surface painted with an opaque finish:
 - a. Coat knots, sap and pitch streaks with MPI 36 (Knot Sealer) before applying paint.

- b. Apply two coats of MPI 36 (Knot Sealer) over large knots.
- 5. After application of prime or first coat of stain, fill cracks, nail and screw holes, depressions and similar defects with wood filler paste. Sand the surface to make smooth and finish flush with adjacent surface.
- 6. Before applying finish coat, reapply wood filler paste if required, and sand surface to remove surface blemishes. Finish flush with adjacent surfaces.
- 7. Fill open grained wood such as oak, walnut, ash and mahogany with MPI 91 (Wood Filler Paste), colored to match wood color.
 - a. Thin filler in accordance with manufacturer's instructions for application.
 - b. Remove excess filler, wipe as clean as possible, dry, and sand as specified.
- D. Ferrous Metals:
 - 1. Remove oil, grease, soil, drawing and cutting compounds, flux and other detrimental foreign matter in accordance with SSPC-SP 1 (Solvent Cleaning).
 - 2. Remove loose mill scale, rust, and paint, by hand or power tool cleaning, as defined in SSPC-SP 2 (Hand Tool Cleaning) and SSPC-SP 3 (Power Tool Cleaning). Exception: where high temperature aluminum paint is used, prepare surface in accordance with paint manufacturer's instructions.
 - 3. Fill dents, holes and similar voids and depressions in flat exposed surfaces of hollow steel doors and frames, access panels, roll-up steel doors and similar items specified to have semi-gloss or gloss finish with TT-F-322D (Filler, Two-Component Type, For Dents, Small Holes and Blow-Holes). Finish flush with adjacent surfaces.
 - a. This includes flat head countersunk screws used for permanent anchors.
 - b. Do not fill screws of item intended for removal such as glazing beads.
 - 4. Spot prime abraded and damaged areas in shop prime coat which expose bare metal with same type of paint used for prime coat. Feather edge of spot prime to produce smooth finish coat.
 - 5. Spot prime abraded and damaged areas which expose bare metal of factory finished items with paint as recommended by manufacturer of item.
- E. Zinc-Coated (Galvanized) Metal, Aluminum, Copper and Copper Alloys 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 Board, Cement Plaster and Stucco: NOT USED
- G. Gypsum Plaster and Gypsum Board:
 - 1. Remove efflorescence, loose and chalking plaster or finishing materials.
 - 2. Remove dust, dirt, and other deterrents to paint adhesion.

3. Fill holes, cracks, and other depressions with CID-A-A-1272A [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 COR.
- E. Finish surfaces to show solid even color, free from runs, lumps, brush marks, 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 COR, 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 and Wood Particleboard:
 1. Use same kind of primer specified for exposed face surface.
 - a. Exterior wood: MPI 7 (Exterior Oil Wood Primer) for new construction and MPI 5 (Exterior Alkyd Wood Primer) for repainting bare wood primer except where MPI 90 (Interior Wood Stain, Semi-Transparent (WS)) is scheduled.
 - b. Interior wood except for transparent finish: MPI 45 (Interior Primer Sealer) or MPI 46 (Interior Enamel Undercoat), thinned if recommended by manufacturer.
 - c. Transparent finishes as specified under Transparent Finishes on Wood except Floors and Finish for Wood Floors.
 2. Apply two coats of primer MPI 7 (Exterior Oil Wood Primer) or MPI 5 (Exterior Alkyd Wood Primer) or sealer MPI 45 (Interior Primer Sealer) or MPI 46 (Interior Enamel Undercoat) to surfaces of wood doors, including top and bottom edges, which are cut for fitting or for other reason.
 3. Apply one coat of primer MPI 7 (Exterior Oil Wood Primer) or MPI 5 (Exterior Alkyd Wood Primer) or sealer MPI 45 (Interior Primer Sealer) or MPI 46 (Interior Enamel Undercoat) as soon as delivered to site to surfaces of unfinished woodwork, except concealed surfaces of shop fabricated or assembled millwork and surfaces specified to have varnish, stain or natural finish.
 4. Back prime and seal ends of exterior woodwork, and edges of exterior plywood specified to be finished.
 5. Apply MPI 67 (Interior Latex Fire Retardant, Top-Coat (ULC Approved) (FR) to wood for fire retardant finish.
- F. Metals except boilers, incinerator stacks, and engine exhaust pipes: NOT USED
- G. Gypsum Board
 1. Surfaces scheduled to have (Interior Latex, SATIN 99)
 2. Primer: MPI 50 (Interior Latex Primer Sealer) except use MPI 45 (Interior Primer Sealer), MPI 46 (Interior Enamel Undercoat) in shower and bathrooms.
 3. Surfaces scheduled to receive vinyl coated fabric wallcovering:

Use MPI 45 (Interior Primer Sealer) MPI 46 (Interior Enamel Undercoat).

4. Use MPI 101 (Cold Curing Epoxy Primer) for surfaces scheduled to receive MPI 77 (Epoxy Cold Cured, Gloss (EC)).

H. Gypsum Plaster and Veneer Plaster: NOT MUSED

I. Concrete Masonry Units except glazed or integrally colored and decorative units:
NOT USED

J. Cement Plaster or stucco, Concrete Masonry, Brick Masonry and Cement board,
Interior Surfaces of Ceilings and Walls: NOT USED

K. Concrete Floors: NOT USED

3.6 EXTERIOR FINISHES: NOT USED

3.7 INTERIOR FINISHES

A. Apply following finish coats over prime coats in spaces or on surfaces specified in
Section 09 06 00, SCHEDULE FOR FINISHES.

B. Metal Work:

1. Apply to exposed surfaces.
2. Omit body and finish coats on surfaces concealed after installation except
electrical conduit containing conductors over 600 volts.
3. Ferrous Metal, Galvanized Metal, and Other Metals Scheduled: NOT USED

C. Gypsum Board: NOT USED

D. Plaster: NOT USED

E. Masonry and Concrete Walls: NOT USED

F. 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) plus one coat of MPI 47 (Interior
Alkyd, Semi-Gloss (AK)) (SG).

- b. One coat MPI 66 (Interior Alkyd Fire retardant, Clear Top-Coat (ULC Approved) (FC) on exposed wood in attics with floors used for mechanical equipment and above ceilings where shown.
- c. One coat of MPI 45 Interior Primer Sealer) plus one coat of MPI 48 (Interior Alkyd Gloss (AK)).
- d. Two coats of MPI 51 (Interior Alkyd, Eggshell) (AK)).
- 4. Transparent Finishes on Wood Except Floors.
 - a. Natural Finish:
 - 1) One coat of sealer as written in 2.1 E.
 - 2) Two coats of MPI 71 (Polyurethane, Moisture Cured, Clear Flat (PV)//MPI 31 (Polyurethane, Moisture Cured, Clear Gloss (PV)).
 - b. Stain Finish:
 - 1) One coat of MPI 90 (Interior Wood Stain, Semi-Transparent (WS)).
 - 2) Use wood stain of type and color required to achieve finish specified. Do not use varnish type stains.
 - 3) One coat of sealer as written in 2.1 E.
 - 4) Two coats of MPI 71 (Polyurethane, Moisture Cured, Clear Flat (PV)).
 - c. Varnish Finish: NOT USED
- 5. Finish for Wood Floors: NOT USED
- G. Cement Board: NOT USED
- H. Concrete Floors: NOT USED
- I. Miscellaneous: NOT USED

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 31 (Polyurethane, Moisture Cured, Clear Gloss).
- 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 is specified in Section 09 06 00, SCHEDULE FOR FINISHES. NOT USED
- 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: NOT USED

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 by Hospital.
 - 2. Painting of disturbed, damaged and repaired or patched surfaces when entire space is not scheduled for complete repainting or refinishing.
 - 3. Painting of ferrous metal and galvanized metal.
 - 4. Painting of wood with fire retardant paint exposed in attics, when used as mechanical equipment space except shingles.
 - 5. Identity painting and safety painting.
- B. Building and Structural Work Not Painted:

3.12 IDENTITY PAINTING SCHEDULE: NOT USED

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.

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.

C. Abbreviations/Acronyms:

1. ABS: Acrylonitrile Butadiene Styrene

2. AC: Alternating Current

3. ACR: Air Conditioning and Refrigeration

4. AI: Analog Input

5. AISI: American Iron and Steel Institute

6. AO: Analog Output

7. AWG: American Wire Gauge

8. BACnet: Building Automation and Control Network

9. BAg: Silver-Copper-Zinc Brazing Alloy

10. BAS: Building Automation System

11. BCuP: Silver-Copper-Phosphorus Brazing Alloy

12. BSG: Borosilicate Glass Pipe

13. CDA: Copper Development Association

14. C: Celsius

15. CLR: Color

16. CO: Carbon Monoxide

17. COR: Contracting Officer's Representative

18. CPVC: Chlorinated Polyvinyl Chloride

19. CR: Chloroprene

20. CRS: Corrosion Resistant Steel

21. CWP: Cold Working Pressure

22. CxA: Commissioning Agent

23. db(A): Decibels (A weighted)

24. DDC: Direct Digital Control

25. DI: Digital Input

26. DISS: Diameter Index Safety System

27. DO: Digital Output

28. DVD: Digital Video Disc

29. DN: Diameter Nominal

30. DWV: Drainage, Waste and Vent

31. ECC: Engineering Control Center

32. EPDM: Ethylene Propylene Diene Monomer

- 33. EPT: Ethylene Propylene Terpolymer
- 34. ETO: Ethylene Oxide
- 35. F: Fahrenheit
- 36. FAR: Federal Acquisition Regulations
- 37. FD: Floor Drain
- 38. FED: Federal
- 39. FG: Fiberglass
- 40. FNPT: Female National Pipe Thread
- 41. FPM: Fluoroelastomer Polymer
- 42. GPM: Gallons Per Minute
- 43. HDPE: High Density Polyethylene
- 44. Hg: Mercury
- 45. HOA: Hands-Off-Automatic
- 46. HP: Horsepower
- 47. HVE: High Volume Evacuation
- 48. ID: Inside Diameter
- 49. IPS: Iron Pipe Size
- 50. Kg: Kilogram
- 51. kPa: Kilopascal
- 52. lb: Pound
- 53. L/s: Liters Per Second
- 54. L/min: Liters Per Minute
- 55. MAWP: Maximum Allowable Working Pressure
- 56. MAX: Maximum
- 57. MED: Medical
- 58. m: Meter
- 59. MFG: Manufacturer
- 60. mg: Milligram
- 61. mg/L: Milligrams per Liter
- 62. ml: Milliliter
- 63. mm: Millimeter
- 64. MIN: Minimum
- 65. NF: Oil Free Dry (Nitrogen)
- 66. NPTF: National Pipe Thread Female
- 67. NPS: Nominal Pipe Size
- 68. NPT: Nominal Pipe Thread
- 69. OD: Outside Diameter
- 70. OSD: Open Sight Drain
- 71. OS&Y: Outside Stem and Yoke
- 72. OXY: Oxygen
- 73. PBPU: Prefabricated Bedside Patient Units
- 74. PH: Power of Hydrogen

- 75. PLC: Programmable Logic Controllers
- 76. PP: Polypropylene
- 77. PPM: Parts per Million
- 78. PSIG: Pounds per Square Inch
- 79. PTFE: Polytetrafluoroethylene
- 80. PVC: Polyvinyl Chloride
- 81. PVDF: Polyvinylidene Fluoride
- 82. RAD: Radians
- 83. RO: Reverse Osmosis
- 84. RPM: Revolutions Per Minute
- 85. RTRP: Reinforced Thermosetting Resin Pipe
- 86. SCFM: Standard Cubic Feet Per Minute
- 87. SDI: Silt Density Index
- 88. SPEC: Specification
- 89. SPS: Sterile Processing Services
- 90. STD: Standard
- 91. SUS: Saybolt Universal Second
- 92. SWP: Steam Working Pressure
- 93. TEFC: Totally Enclosed Fan-Cooled
- 94. TFE: Tetrafluoroethylene
- 95. THHN: Thermoplastic High-Heat Resistant Nylon Coated Wire
- 96. THWN: Thermoplastic Heat & Water-Resistant Nylon Coated Wire
- 97. T/P: Temperature and Pressure
- 98. USDA: U.S. Department of Agriculture
- 99. V: Volt
- 100. VAC: Vacuum
- 101. VA: Veterans Administration
- 102. VAMC: Veterans Administration Medical Center
- 103. VAC: Voltage in Alternating Current
- 104. WAGD: Waste Anesthesia Gas Disposal
- 105. WOG: Water, Oil, Ga

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 09 91 00, PAINTING.
- E. Section 22 07 11, PLUMBING INSULATION.
- F. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- G. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES.

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.
- B. American Society of Mechanical Engineers (ASME):
 - ASME Boiler and Pressure Vessel Code -
 - BPVC Section IX-2013 ...Welding, Brazing, and Fusing Qualifications
 - B31.1-2012Power Piping
- C. American Society for Testing and Materials (ASTM):
 - A36/A36M-2012Standard Specification for Carbon Structural Steel
 - A575-96 (R2013)e1Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades
 - E84-2013aStandard Test Method for Surface Burning Characteristics of Building Materials
 - E119-2012aStandard Test Methods for Fire Tests of Building Construction and Materials
 - F1760-01 (R2011)Standard Specification for Coextruded Poly (Vinyl Chloride) (PVC) Non-Pressure Plastic Pipe Having Reprocessed-Recycled Content
- D. International Code Council, (ICC):
 - IBC-2012International Building Code
 - IPC-2012International Plumbing Code
- E. Manufacturers Standardization Society (MSS) of the Valve and Fittings Industry, Inc:
 - SP-58-2009Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application and Installation
 - SP-69-2003Pipe Hangers and Supports - Selection and Application
- F. Military Specifications (MIL):
 - P-21035BPaint High Zinc Dust Content, Galvanizing Repair (Metric)
- G. National Electrical Manufacturers Association (NEMA):
 - MG 1-2011Motors and Generators
- H. National Fire Protection Association (NFPA):
 - 51B-2014Standard for Fire Prevention During Welding, Cutting and Other Hot Work
 - 54-2012National Fuel Gas Code
 - 70-2014National Electrical Code (NEC)
- I. NSF International (NSF):
 - 5-2012Water Heaters, Hot Water Supply Boilers, and Heat Recovery Equipment
 - 14-2012Plastic Piping System Components and Related Materials
 - 61-2012Drinking Water System Components - Health Effects
 - 372-2011Drinking Water System Components - Lead Content

J. Department of Veterans Affairs (VA):
PG-18-10Plumbing Design Manual
PG-18-13-2011Barrier 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. Contractor shall make all necessary field measurements and investigations to assure that the equipment and assemblies will meet contract requirements and will fit the space available.
- D. If equipment is submitted which differs in arrangement from that shown, provide drawings that show the rearrangement of all associated systems. Approval will be given only if all features of the equipment and associated systems, including accessibility, are equivalent to that required by the contract.
- E. 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.
- F. Installing Contractor shall provide lists of previous installations for selected items of equipment. Contact persons who will serve as references, with telephone numbers and e-mail addresses shall be submitted with the references.
- G. Manufacturer's Literature and Data: 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.
 - 4. Hangers, inserts, supports and bracing. Provide load calculations for variable spring and constant support hangers.
 - 5. Wall, floor, and ceiling plates.
- H. 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.
- I. Coordination Drawings: Complete consolidated and coordinated layout drawings shall be submitted for all new systems, and for existing systems that are in the same areas. The drawings shall include plan views, elevations and sections of all systems and shall be on a scale of not less than 1:32 (3/8 inch equal to one foot).

Clearly identify and dimension the proposed locations of the principal items of equipment. The drawings shall clearly show the proposed location and adequate clearance for all equipment, controls, piping, pumps, valves and other items. All valves, trap primer valves, water hammer arrestors, strainers, and equipment requiring service shall be provided with an access door sized for the complete removal of plumbing device, component, or equipment. Equipment foundations shall not be installed until equipment or piping layout drawings have been approved. Detailed layout drawings shall be provided for all piping systems. In addition, details of the following shall be provided.

1. Mechanical equipment rooms.
2. Interstitial space.
3. Hangers, inserts, supports, and bracing.
4. Pipe sleeves.
5. Equipment penetrations of floors, walls, ceilings, or roofs.

J. 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. Include complete list indicating all components of the systems with diagrams of the internal wiring for each item of equipment.
2. Include listing of recommended replacement parts for keeping in stock supply, including sources of supply, for equipment shall be provided. The listing shall include belts for equipment: Belt manufacturer, model number, size and style, and distinguished whether of multiple belt sets.

1.5 QUALITY ASSURANCE

A. 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 four 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 products of one manufacturer.
 6. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.
 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 shall not be used.
 9. 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>.
- B. Welding: Before any welding is performed, contractor shall submit a certificate certifying that welders comply with the following requirements:
1. Qualify welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code", Section IX, "Welding and Brazing Qualifications".
 2. Comply with provisions of ASME B31 series "Code for Pressure Piping".
 3. Certify that each welder 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 American Welding Society.
- C. 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.

D. 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.
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. If an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no additional cost or additional time to the Government.

E. Guaranty: Warranty of Construction, FAR clause 52.246-21.

F. 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.

G. 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.
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.

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 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 on Auto-Cad version 2013 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 a certification that all results of tests were within limits specified.

PART 2 - PRODUCTS

2.1 MATERIALS FOR VARIOUS SERVICES

- A. Non-pressure PVC pipe shall contain a minimum of 25 percent recycled content. Steel pipe shall contain a minimum of 25 percent recycled content.
- B. Plastic pipe, fittings and solvent cement shall meet NSF 14 and shall bear the NSF seal "NSF-PW". Polypropylene pipe and fittings shall comply with NSF 14 and NSF 61. Solder or flux containing lead shall not be used with copper pipe.
- C. 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.
- D. 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.
- E. 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 SAFETY GUARDS

- A. Pump shafts and couplings shall be fully guarded by a sheet steel guard, covering coupling and shaft but not bearings. Material shall be minimum 16-gage sheet steel; ends shall be braked and drilled and attached to pump base with minimum of four 8 mm (1/4 inch) bolts. Reinforce guard as necessary to prevent side play forcing guard onto couplings.
- B. All Equipment shall have moving parts protected from personal injury.

2.5 LIFTING ATTACHMENTS

- A. Equipment shall be provided with suitable lifting attachments to enable equipment to be lifted in its normal position. Lifting attachments shall withstand any handling conditions that might be encountered, without bending or distortion of shape, such as rapid lowering and braking of load.

2.6 ELECTRIC MOTORS, MOTOR CONTROL, CONTROL WIRING

- A. All material and equipment furnished and installation methods used shall conform to the requirements of Section 22 05 12, GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT; Section 26 29 11, MOTOR CONTROLLERS; and, Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES. All electrical wiring, conduit, and devices necessary for the proper connection, protection and operation of the systems shall be provided. Premium efficient motors shall be provided. Unless otherwise specified for a particular application, electric motors shall have the following requirements.
- B. Special Requirements:
 - 1. Where motor power requirements of equipment furnished deviate from power shown on plans, provide electrical service designed under the requirements of NFPA 70 without additional cost or time to the Government.
 - 2. Assemblies of motors, starters, and controls and interlocks on factory assembled and wired devices shall be in accordance with the requirements of this specification.
 - 3. Wire and cable materials specified in the electrical division of the specifications shall be modified as follows:
 - a. Wiring material located where temperatures can exceed 71° C (160° F) shall be stranded copper with Teflon FEP insulation with jacket. This includes wiring on the boilers and water heaters.

- b. Other wiring at boilers and water heaters, and to control panels, shall be NFPA 70 designation THWN.
- c. Shielded conductors or wiring in separate conduits for all instrumentation and control systems shall be provided where recommended by manufacturer of equipment.
- 4. Motor sizes shall be selected so that the motors do not operate into the service factor at maximum required loads on the driven equipment. Motors on pumps shall be sized for non-overloading at all points on the pump performance curves.
- 5. Motors utilized with variable frequency drives shall be rated "inverter-ready" per NEMA Standard, MG1.
- C. Motor Efficiency and Power Factor: All motors, when specified as "high efficiency or Premium Efficiency" by the project specifications on driven equipment, shall conform to efficiency and power factor requirements in Section 22 05 12, GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT, with no consideration of annual service hours. Motor manufacturers generally define these efficiency requirements as "NEMA premium efficient" and the requirements generally exceed those of the Energy Policy Act (EPACT), revised 2005. Motors not specified as "high efficiency or premium efficient" shall comply with EPACT.
- D. Single-phase Motors: Capacitor-start type for hard starting applications. Motors for centrifugal pumps may be split phase or permanent split capacitor (PSC).
- E. Poly-phase Motors: NEMA Design B, Squirrel cage, induction type. Each two-speed motor shall have two separate windings. A time delay (20 seconds minimum) relay shall be provided for switching from high to low speed.
- F. Rating: Rating shall be continuous duty at 100 percent capacity in an ambient temperature of 40° C (104° F); minimum horsepower as shown on drawings; maximum horsepower in normal operation shall not exceed nameplate rating without service factor.
- G. Insulation Resistance: Not less than one-half meg-ohm between stator conductors and frame shall be measured at the time of final inspection.

2.7 VARIABLE SPEED MOTOR CONTROLLERS - NOT USED

2.8 EQUIPMENT AND MATERIALS IDENTIFICATION

- A. Use symbols, nomenclature and equipment numbers specified, shown on 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. Exterior (Outdoor) Equipment: Brass nameplates, with engraved black filled letters, not less than 7 mm (3/16 inch) high riveted or bolted to the equipment.
- D. 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.
- E. 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 gage, 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.

2.9 FIRESTOPPING

- A. Section 07 84 00, FIRESTOPPING specifies an effective barrier against the spread of fire, smoke and gases where penetrations occur for piping. Refer to Section 22 07 11, PLUMBING INSULATION, for pipe insulation.

2.10 GALVANIZED REPAIR COMPOUND

- A. Mil. Spec. DOD-P-21035B, paint.

2.11 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)
- B. Type Numbers Specified: For materials, design, manufacture, selection, application, and installation refer to MSS SP-58. For selection and application refer to MSS SP-69. Refer to Section 05 50 00, METAL FABRICATIONS, for miscellaneous metal support materials and prime coat painting.

- C. 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.
- D. 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.
- E. Attachment to Metal Pan or Deck: As required F. For Attachment to Wood Construction: Wood screws or lag bolts.
- G. 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.
- H. 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 gage), designed to accept special spring held, hardened steel nuts.
 - 1. Allowable hanger load: Manufacturers rating less 91kg (200 pounds).
 - 2. Guide individual pipes on the horizontal member of every other trapeze hanger with 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.
- I. 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.

i. Supports for plastic or glass piping: As recommended by the pipe manufacturer with black rubber tape extending one inch beyond steel support or clamp.

j. Spring hangers are required on all plumbing system pumps one horsepower and greater.

2. Plumbing Piping (Other Than General Types):

- a. Horizontal piping: Type 1, 5, 7, 9, and 10.
- b. Chrome plated piping: Chrome plated supports.
- c. Hangers and supports in pipe chase: Prefabricated system ABS self-extinguishing material, not subject to electrolytic action, to hold piping, prevent vibration and compensate for all static and operational conditions.
- d. Blocking, stays and bracing: Angle iron or preformed metal channel shapes, 1.3 mm (18 gage) minimum.

J. Pre-insulated Calcium Silicate Shields:

1. Provide 360-degree water resistant high density 965 kPa (140 psig) compressive strength calcium silicate shields encased in galvanized metal.
2. Pre-insulated calcium silicate shields to be installed at the point of support during erection.
3. Shield thickness shall match the pipe insulation.
4. The type of shield is selected by the temperature of the pipe, the load it must carry, and the type of support it will be used with.
 - a. Shields for supporting cold water shall have insulation that extends a minimum of 25 mm (1 inch) past the sheet metal.
 - b. The insulated calcium silicate shield shall support the maximum allowable water filled span as indicated in MSS SP-69. To support the load, the shields shall have one or more of the following features: structural inserts 4138 kPa (600 psig) compressive strength, an extra bottom metal shield, or formed structural steel (ASTM A36/A36M) wear plates welded to the bottom sheet metal jacket.
5. Shields may be used on steel clevis hanger type supports, trapeze hangers, roller supports or flat surfaces.

K. Seismic Restraint of Piping: Refer to Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

2.12 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 not allowed 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.
- 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. Pipe passing through roof shall be installed through a 4.9 kg per square meter copper flashing with an integral skirt or flange. Skirt or flange shall extend not less than 200 mm (8 inches) from the pipe and set in a solid coating of bituminous

cement. Extend flashing a minimum of 250 mm (10 inches) up the pipe. Pipe passing through a waterproofing membrane shall be provided with a clamping flange. The annular space between the sleeve and pipe shall be sealed watertight.

2.13 TOOLS AND LUBRICANTS

- A. Furnish, and turn over to the COR, special tools not readily available commercially, that are required for disassembly or adjustment of equipment and machinery furnished.
- B. Grease Guns with Attachments for Applicable Fittings: One for each type of grease required for each motor or other equipment.
- C. Tool Containers: metal, permanently identified for intended service and mounted, or located, where directed by the COR.
- D. 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. Bio-based materials shall be utilized when possible.

2.14 WALL, FLOOR AND CEILING PLATES

- A. Material and Type: Chrome plated brass or chrome plated steel, one piece or split type with concealed hinge, with set screw for fastening to pipe, or sleeve. Use plates that fit tight around pipes, cover openings around pipes and cover the entire pipe sleeve projection.
- B. Thickness: Not less than 2.4 mm (3/32 inch) for floor plates. For wall and ceiling plates, not less than 0.64 mm (0.025 inch) for up to 75 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. Wall plates shall be used where insulation ends on exposed water supply pipe drop from overhead. A watertight joint shall be provided in spaces where brass or steel pipe sleeves are specified.

2.15 ASBESTOS

- A. Materials containing asbestos are not permitted.

PART 3 - EXECUTION

3.1 ARRANGEMENT AND INSTALLATION OF EQUIPMENT AND PIPING

- A. 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 gages 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 on 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. Minor Piping: Generally, small diameter pipe runs from drips and drains, water cooling, and other service are not shown but must be provided.
- I. Protection and Cleaning:
 - 1. Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations and as approved by the COR. Damaged or defective items in the opinion of the COR, shall be replaced 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.

- J. 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.
- K. Gages, thermometers, valves and other devices shall be installed with due regard for ease in reading or operating and maintaining said devices. Thermometers and gages 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.
- L. 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.
- M. Many plumbing systems interface with the HVAC control system. See the HVAC control points list and Section 23 09 23, DIRECT DIGITAL CONTROL SYSTEM FOR HVAC.
- N. 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 cause the least interfere with normal operation of the facility.
- O. Work in Animal Research Areas: - NOT USED
- P. Work in bathrooms, restrooms, housekeeping closets: All pipe penetrations behind escutcheons shall be sealed with plumber's putty.
- Q. 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.
- R. 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 not allowed in potable water systems. Necessary blind flanges and caps shall be provided to seal open piping remaining in service.

3.3 RIGGING

- A. Openings in building structures shall be planned to accommodate design scheme.
- B. Alternative methods of equipment delivery may be offered and will be considered by Government under specified restrictions of phasing and service requirements as well as structural integrity of the building.
- C. All openings in the building shall be closed when not required for rigging operations to maintain proper environment in the facility for Government operation and maintenance of service.
- D. Contractor shall provide all facilities required to deliver specified equipment and place on foundations. Attachments to structures for rigging purposes and support of equipment on structures shall be Contractor's full responsibility.
- E. Contractor shall check all clearances, weight limitations and shall provide a rigging plan designed by a Registered Professional Engineer. All modifications to structures, including reinforcement thereof, shall be at Contractor's cost, time and responsibility.
- F. Rigging plan and methods shall be referred to COR for evaluation prior to actual work.

3.4 PIPE AND EQUIPMENT SUPPORTS

- A. Where hanger spacing does not correspond with joist or rib spacing, use structural steel channels secured directly to joist and rib structure that will correspond to the required hanger spacing, and then suspend the equipment and piping from the channels. 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.

F. Floor Supports:

1. Provide concrete bases, concrete anchor blocks and pedestals, and structural steel systems for support of equipment and piping. Concrete bases and structural systems shall be anchored and doweled to resist forces under operating and seismic conditions (if applicable) without excessive displacement or structural failure.
2. Bases and supports shall not be located and installed until equipment mounted thereon has been approved. Bases shall be sized to match equipment mounted thereon plus 50 mm (2 inch) excess on all edges. Structural drawings shall be reviewed for additional requirements. Bases shall be neatly finished and smoothed, shall have chamfered edges at the top, and shall be suitable for painting.
3. All equipment shall be shimmed, leveled, firmly anchored, and grouted with epoxy grout. Anchor bolts shall be placed in sleeves, anchored to the bases. Fill the annular space between sleeves and bolts with a grout material to permit alignment and realignment.

3.5 LUBRICATION

- A. All equipment and devices requiring lubrication shall be lubricated prior to initial operation. All devices and equipment shall be field checked for proper lubrication.
- B. All devices and equipment shall be equipped with required lubrication fittings. A minimum of one liter (one quart) of oil and 0.45 kg (1 pound) of grease of manufacturer's recommended grade and type for each different application shall be provided. All materials shall be delivered to COR in unopened containers that are properly identified as to application.
- C. A separate grease gun with attachments for applicable fittings shall be provided for each type of grease applied.
- D. All lubrication points shall be accessible without disassembling equipment, except to remove access plates.
- E. All lubrication points shall be extended to one side of the equipment.

3.6 PLUMBING SYSTEMS DEMOLITION

- A. Rigging access, other than indicated on the drawings, shall be provided after approval for structural integrity by the COR. Such access shall be provided without additional cost or time to the Government. Where work is in an operating plant, approved protection from dust and debris shall be provided at all times for the safety of plant personnel and maintenance of plant operation and environment of the plant.
- B. In an operating plant, cleanliness and safety shall be maintained. The plant shall be kept in an operating condition. Government personnel will be carrying on their normal duties of operating, cleaning and maintaining equipment and plant operation. Work shall be confined to the immediate area concerned; maintain cleanliness and wet down demolished materials to eliminate dust. Dust and debris shall not be permitted to accumulate in the area to the detriment of plant operation. All flame cutting shall be performed to maintain the fire safety integrity of this plant. Adequate fire extinguishing facilities shall be available at all times. All work shall be performed in accordance with recognized fire protection standards including NFPA 51B. Inspections will be made by personnel of the VA Medical Center, and the Contractor shall follow all directives of the COR with regard to rigging, safety, fire safety, and maintenance of operations.
- C. 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.
- D. All valves including gate, globe, ball, butterfly and check, all pressure gages and thermometers with wells shall remain Government property and shall be removed and delivered to COR and stored as directed. The Contractor shall remove all other material and equipment, devices and demolition debris under these plans and specifications. Such material shall be removed from Government property expeditiously and shall not be allowed to accumulate. Coordinate with the COR and Infection Control.

3.7 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. 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 gages 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. Temporary Facilities: Apply paint to surfaces that do not have existing finish coats per Section 09 91 00, Painting.
 - 6. 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.

3.8 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.

3.9 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.

3.10 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.

3.11 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.

SECTION 22 05 19
METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section describes the requirements for gages primarily used for troubleshooting the system and to indicate system performance.
- 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.
- C. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

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):
 - B40.100-2013.....Pressure Gauges and Gauge Attachments
 - B40.200-2008 (R2013)....Thermometers, Direct Reading and Remote Reading
- C. Institute of Electrical and Electronics Engineers (IEEE): C2-2012.....National Electrical Safety Code (NESC)
- D. International Code Council (ICC):
 - IPC-2015.....International Plumbing Code
- E. National Fire Protection Association (NFPA): 70-2014.....National Electrical Code (NEC)
- F. NSF International (NSF):
 - 61-2014a.....Drinking Water System Components - Health Effects
 - 372-2011.....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 GAGES 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 Gages.
 2. Thermometers.
 3. Product certificates for each type of meter and gage.
- D. Operations and Maintenance manual shall include:
1. System Description.
 2. Major assembly block diagrams.
 3. Troubleshooting and preventive maintenance guidelines.
 4. Spare parts information.
- E. Shop Drawings shall include the following: One line, wiring and terminal diagrams including terminals identified, protocol or communication modules, and Ethernet connections.

PART 2 - PRODUCTS

2.1 PRESSURE GAGES FOR WATER USAGE

- A. ASME B40.100 all metal case 115 mm (4-1/2 inches) diameter, bottom connected throughout, graduated as required for service, and identity labeled. Range shall be 0 to 1380 kPa (0 to 200 psig) gage.
- B. The pressure element assembly shall be bourdon tube. The mechanical movement shall be lined to pressure element and connected to pointer.
- C. The dial shall be non-reflective aluminum with permanently etched scale markings graduated in kPa and psig.
- D. The pointer shall be dark colored metal.
- E. The window shall be glass.
- F. The ring shall be brass or stainless steel.
- G. The accuracy shall be grade A, plus or minus 1 percent of middle half of scale range.
- H. The pressure gage for water domestic use shall conform to NSF 61 and NSF 372.

2.2 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 gages shall be installed in piping tees with pressure gage located on pipe at the most readable position.

- B. Valves and snubbers shall be installed in piping for each pressure gage.
- 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 gages shall be installed where indicated on the drawings and at the following locations:
 - 1. Building water service entrance into building.
- E. 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.
- F. If an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no cost to the Government.

3.2 FIELD QUALITY CONTROL

- A. The meter assembly shall be visually inspected and operationally tested. The correct multiplier placement on the face of the meter shall be verified.

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 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.
- C. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

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):
 - A112.14.1-2003Backwater Valves
- C. American Society of Sanitary Engineering (ASSE):
 - 1001-2008Performance Requirements for Atmospheric Type Vacuum Breakers
 - 1003-2009Performance Requirements for Water Pressure Reducing Valves for Domestic Water Distribution Systems
 - 1011-2004Performance Requirements for Hose Connection Vacuum Breakers
 - 1013-2011Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Principle Fire Protection Backflow Preventers
 - 1015-2011Performance Requirements for Double Check Backflow Prevention Assemblies and Double Check Fire Protection Backflow Prevention Assemblies
 - 1017-2009Performance Requirements for Temperature Actuated Mixing Valves for Hot Water Distribution Systems
 - 1020-2004Performance Requirements for Pressure Vacuum Breaker Assembly

- 1035-2008Performance Requirements for Laboratory Faucet Backflow Preventers
- 1069-2005Performance Requirements for Automatic Temperature Control Mixing Valves
- 1070-2004Performance Requirements for Water Temperature Limiting Devices
- 1071-2012Performance Requirements for Temperature Actuated Mixing Valves for Plumbed Emergency Equipment
- D. American Society for Testing and Materials (ASTM):
 - A126-2004 (R2009)Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
 - A276-2013aStandard Specification for Stainless Steel Bars and Shapes
 - A536-1984 (R2009)Standard Specification for Ductile Iron Castings
 - B62-2009Standard Specification for Composition Bronze or Ounce Metal Castings
 - B584-2013Standard Specification for Copper Alloy Sand Castings for General Applications
- E. International Code Council (ICC):
 - IPC-2012International Plumbing Code
- F. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS):
 - SP-25-2008Standard Marking Systems for Valves, Fittings, Flanges and Unions
 - SP-67-2011Butterfly Valves
 - SP-70-2011Gray Iron Gate Valves, Flanged and Threaded Ends
 - SP-71-2011Gray Iron Swing Check Valves, Flanged and Threaded Ends
 - SP-80-2013Bronze Gate, Globe, Angle, and Check Valves
 - SP-85-2011Gray Iron Globe & Angle Valves, Flanged and Threaded Ends
 - SP-110-2010Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends
- G. National Environmental Balancing Bureau (NEBB):
 - 7th Edition 2005 Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems
- H. NSF International (NSF):
 - 61-2012Drinking Water System Components - Health Effects
 - 372-2011Drinking Water System Components - Lead Content
- I. University of Southern California Foundation for Cross Connection Control and Hydraulic Research (USC FCCCHR):
 - 9th EditionManual 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. Gate Valves.
 - 3. Butterfly Valves.
 - 4. Balancing Valves.
 - 5. Check Valves.
 - 6. Globe Valves.
 - 7. Water Pressure Reducing Valves and Connections.
 - 8. Backwater Valves.
 - 9. Backflow Preventers.
 - 10. Chain wheels.
 - 11. Thermostatic Mixing Valves.
- D. Test and Balance reports for balancing valves.
- E. Complete operating and maintenance manuals including wiring diagrams, technical data sheets and information for ordering replaceable 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.
 - 4. Piping diagrams of thermostatic mixing valves to be installed.

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.

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 more 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-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.
 - 2. Less than 100 mm DN100 (4 inches): Butterfly shall have an iron body with EPDM seal and aluminum bronze disc. The butterfly valve shall meet MSS SP-67, type I standard. The butterfly valve shall have a SWP rating of 1380 kPa (200 psig). The valve design shall be lug type suitable for bidirectional dead-end service at rated pressure. The body material shall meet ASTM A536, ductile iron.
 - 3. 100 mm DN100 (4 inches) and larger:
 - a. Class 125, OS&Y, Cast Iron Gate Valve. The gate valve shall meet MSS SP-70 type I standard. The gate valve shall have a CWP rating of 1380 kPa (200 psig). The valve materials shall meet ASTM A126, grey iron with bolted bonnet, flanged ends, bronze trim, and positive-seal resilient solid wedge

- disc. The gate valve shall be gear operated for sizes under 200 mm or DN200 (8 inches) and crank operated for sizes 200 mm or DN200 (8 inches) and above.
- b. Single flange, ductile iron butterfly valves: The single flanged butterfly valve shall meet the MSS SP-67 standard. The butterfly valve shall have a CWP rating of 1380 kPa (200 psig). The butterfly valve shall be lug type, suitable for bidirectional dead-end service at rated pressure without use of downstream flange. The body material shall comply with ASTM A536 ductile iron. The seat shall be EPDM with stainless steel disc and stem.
 - c. Grooved end, ductile iron butterfly valves. The grooved butterfly valve shall meet the MSS SP-67 standard. The grooved butterfly valve shall have a CWP rating of 1380 kPa (200 psig). The valve materials shall be epoxy coated ductile iron conforming to ASTM A536 with two-piece stainless-steel stem, encapsulated ductile iron disc, and EPDM seal. The butterfly valve shall be gear operated.
- 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 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 fitting 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.
- B. Larger than 75 mm or DN75 (3 inches): Manual balancing valves shall be of heavy duty cast iron flanged construction with 861 kPa (125 psig) flange connections. The flanged manual balancing valves shall have either a brass ball with glass and carbon filled TFE seal rings or fitted with a bronze seat, replaceable bronze disc with EPDM seal insert and stainless-steel stem. The design pressure shall be 1200 kPa (175 psig) at 121 degrees C (250 degrees F).

2.4 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.

B. 100 mm or DN100 (4 inches) and larger:

1. Check valves shall be Class 125, iron swing check valve with lever and weight closure control. The check valve shall meet MSS SP-71 Type I standard. The check valve shall have a CWP rating of 1380 kPa (200 psig). The check valve shall have a clear or full waterway body design with gray iron body material conforming to ASTM A126, bolted bonnet, flanged ends, bronze trim.
2. All check valves on the discharge side of submersible sump pumps shall have factory installed exterior level and weight with sufficient weight to prevent the check valve from hammering against the seat when the sump pump stops.

2.5 GLOBE VALVES

- A. 75 mm or DN75 (3 inches) or smaller: Class 150, bronze globe valve with non-metallic disc. The globe valve shall meet MSS SP-80, Type 2 standard. The globe valve shall have a CWP rating of 2070 kPa (300 psig). The valve material shall be bronze with integral seal and union ring bonnet conforming to ASTM B62 with solder ends, copper-silicon bronze stem, PTFE or TFE disc, and malleable iron hand wheel.
- B. Larger than 75 mm or DN75 (3 inches): Similar to above, except with cast iron body and bronze trim, Class 125, iron globe valve. The globe valve shall meet MSS SP-85, Type 1 standard. The globe valve shall have a CWP rating of 1380 kPa (200 psig). The valve material shall be gray iron with bolted bonnet conforming to ASTM A126 with flanged ends, bronze trim, and malleable iron handwheel.

2.6 WATER PRESSURE REDUCING VALVE AND CONNECTIONS

- A. 75 mm or DN75 (3 inches) or smaller: The pressure reducing valve shall consist of a bronze body and bell housing, a separate access cover for the plunger, and a bolt to adjust the downstream pressure. The pressure reducing valve shall meet ASSE 1003. The bronze bell housing and access cap shall be threaded to the body and shall not require the use of ferrous screws. The assembly shall be of the balanced piston design and shall reduce pressure in both flow and no flow conditions. The assembly shall be accessible for maintenance without having to remove the body from the line.
- B. 100 mm or DN100 (4 inches) and larger: The pressure reducing valve shall consist of a flanged cast iron body and rated to 1380 kPa (200 psig). The valve shall have a large elastomer diaphragm for sensitive response. The pressure reducing valve shall meet ASSE 1003.
- C. The regulator shall have a tap for pressure gauge.
- D. The regulator shall have a temperature rating of 100 degrees C (212 degrees F) for hot water or hot water return service. Pressure regulators shall have accurate pressure regulation to 6.9 kPa (+/- 1 psig).
- E. Setting: Entering water pressure, discharge pressure, capacity, size, and related measurements shall be as shown on the drawings.

- F. Connections Valves and Strainers: Shut off valves shall be installed on each side of reducing valve and a bypass line equal in size to the regulator inlet pipe shall be installed with a normally closed globe valve. A strainer shall be installed on inlet side of, and same size as pressure reducing valve. A pressure gage shall be installed on the inlet and outlet of the valve.

2.7 BACKWATER VALVE

- A. The backwater valve shall have a cast iron body, automatic thermoplastic type valve seat and flapper suited for water service. The flapper shall be slightly open during periods of non-operation. The pressure reducing valve shall meet ASME A112.14.1. The cleanout shall be extended to the finish floor and fit with a threaded countersunk plug. A clamping device shall be included when the cleanout extends through the waterproofing membrane.
- B. When the backwater valve is installed greater than 600 mm (24 inches) below the finish floor elevation, a pit or manhole large enough for a repair person can enter to service the backwater valve shall be installed.

2.8 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. 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. Stills.
 4. Dialysis, Deionized or Reverse Osmosis Water Systems.
 5. Water make up to heating systems, cooling tower, chilled water system, generators, and similar equipment consuming water.
 6. Water service entrance from loop system.
 7. Dental equipment.
 8. Power washer.

9. Medical equipment.
 10. Process equipment.
 11. Autopsy, on each hot and cold-water outlet at each table or sink.
 12. 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 bibs and wall hydrants.
- E. The pressure vacuum breaker shall be ASSE listed 1020. The main body shall be brass. The disc and O-ring seal shall be the elastomer type. The valve seat and disc float shall be the thermoplastic type. Tee handle or lever handle shut-off ball valves. Test cocks for testing and draining where freezing conditions occur. All materials shall be suitable 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. Pressure vacuum breakers shall be installed in the following locations requiring continuous pressure and no backpressure including equipment with submerged inlet connections:
1. Lawn Irrigation.

- F. 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.
- G. The double check backflow prevention assembly shall be ASSE listed 1015 and supply with full port, OS&Y, positive-seal, resilient gate valves. The main body and access cover shall be epoxy coated ductile iron conforming to ASTM A536 grade. 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. The seat disc shall be the elastomer type suited for water service. The first and second check valve shall be accessible for maintenance without removing the device from the line. Double check valves shall be installed in the following location requiring continuous pressure subject to backpressure and backsiphonage conditions.
1. Lawn Irrigation.
 2. Food Processing Equipment.
 3. Laundry equipment.

2.9 CHAINWHEELS - NOT USED

2.10 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. Master Thermostatic Water Mixing Valves:
1. Application: Tempered water distribution from hot water source.
 2. Standard: ASSE 1017.
 3. Pressure Rating: 861 kPa (125 psig).
 4. Type: Exposed-mounting or Cabinet-type, as indicated, thermostatically controlled water mixing valve.
 5. Connections: Flanged or threaded union inlets and outlet.
- C. Hi-Lo Water-Mixing-Valve Assemblies:
1. Application: Tempered water distribution from hot water source covering a wide range of flow.
 2. Description: Factory-fabricated, cabinet-type or exposed-mounting, thermostatically controlled, water-mixing-valve assembly in two-valve parallel arrangement including pressure regulators, pressure gages and thermometer.
 3. Large-Flow Parallel: Master thermostatic water mixing valve and downstream pressure regulator with pressure gages on inlet and outlet.
 4. Small-Flow Parallel: Master thermostatic water mixing valve.
 5. Master Thermostatic Mixing Valves: Comply with ASSE 1017.
 6. Water Regulator(s): Comply with ASSE 1003. Include pressure gage on inlet and outlet.
 7. Component Pressure Ratings: 861 kPa (125 psig) minimum, unless otherwise indicated.
 8. Connections: Soldered or threaded union inlets and outlet.
 9. Thermometers shall be provided to indicate mixed water temperature.
- D. Automatic Water Temperature Control Mixing Valves:
1. Application: Gang plumbing fixtures point-of-use when no other mixing at fixtures occurs.
 2. Standard: ASSE 1069.
 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 or soldered inlets and outlet.
 6. Thermometers shall be provided to indicate mixed water temperature.
 7. Upon cold water supply failure, the hot water flow shall automatically be reduced to 0.5 gpm maximum.
- E. 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.
- F. 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. Thermometers shall be provided to indicate mixed water temperature.
 7. 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 valves NPS 100 mm or DN100 (4 inches) and larger and more than 3.6 m (12 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 may 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 not acceptable for this application.
- H. Install pressure gages 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 cost to the Government.

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).

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. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS: NOT USED
- D. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.
- E. Section 02 82 11, TRADITIONAL ASBESTOS ABATEMENT: NOT USED
- 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. Section 11 41 21, WALK-IN COOLERS AND FREEZERS: Insulation used in refrigerators and freezers. NOT USED
- 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: NOT USED
- K. Section 22 05 23, GENERAL-DUTY VALVES FOR PLUMBING PIPING: Hot and cold-water piping.
- L. Section 22 05 33, HEAT TRACING FOR PLUMBING PIPING: NOT USED
- M. Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.
- N. Section 23 21 13, HYDRONIC PIPING: NOT USED
- O. Section 26 32 13, ENGINE GENERATORS: NOT USED

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):
 - B209-2014Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
 - C411-2011Standard 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 C450Compilation of Tables that Provide Recommended Dimensions
for Prefab and Field Thermal Insulating Covers, etc.
- C533-2013Standard Specification for Calcium Silicate Block and Pipe
Thermal Insulation
- C534/C534M-2014Standard Specification for Preformed Flexible Elastomeric
Cellular Thermal Insulation in Sheet and Tubular Form
- C547-2015Standard Specification for Mineral Fiber Pipe Insulation
- C552-2014Standard Specification for Cellular Glass Thermal
Insulation
- C553-2013Standard Specification for Mineral Fiber Blanket Thermal
Insulation for Commercial and Industrial Applications
- C591-2013Standard Specification for Unfaced Preformed Rigid Cellular
Polyisocyanurate Thermal Insulation
- C680-2014Standard 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
- C612-2014Standard Specification for Mineral Fiber Block and Board
Thermal Insulation
- C1126-2014Standard Specification for Faced or Unfaced Rigid Cellular
Phenolic Thermal Insulation
- C1136-2012Standard Specification for Flexible, Low Permeance Vapor
Retarders for Thermal Insulation
- C1710-2011Standard Guide for Installation of Flexible Closed Cell
Preformed Insulation in Tube and Sheet Form
- D1668/D1668M-1997aStandard Specification for Glass Fabrics (Woven and
(2014)e1 Treated) for Roofing and Waterproofing
- E84-2015aStandard Test Method for Surface Burning Characteristics of
Building Materials
- E2231-2015Standard Practice for Specimen Preparation and Mounting of
Pipe and Duct Insulation to Assess Surface Burning
Characteristics
- C. Federal Specifications (Fed. Spec.):
- L-P-535E-1979Plastic Sheet (Sheeting): Plastic Strip; Poly (Vinyl
Chloride) and Poly (Vinyl Chloride - Vinyl Acetate), Rigid.
- D. International Code Council, (ICC):
- IMC-2012International 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-1987Cloth, Glass; Tape, Textile Glass; and Thread, Glass and Wire-Reinforced Glass
- F. National Fire Protection Association (NFPA):
- 90A-2015Standard 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; <http://www.pipeinsulation.net>

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.
- All insulation fittings (exception flexible unicellular insulation) shall be fabricated in accordance with ASTM C450 and the referenced Adjunct to ASTM C450.
- E. Samples:
1. Each type of insulation: Minimum size 100 mm (4 inches) square for board/block/blanket; 150 mm (6 inches) long, full diameter for round types.
 2. Each type of facing and jacket: Minimum size 100 mm (4 inches square).
 3. Each accessory material: Minimum 120 ml (4 ounce) liquid container or 120 gram (4 ounce) dry weight for adhesives / cement / mastic.

- 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 MEP 2018 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 - PRODUCT

2.1 MINERAL FIBER OR FIBER GLASS

- A. ASTM C612 (Board, Block), Class 1 or 2, density 48 kg/m³ (nominal 3 pcf), $k = 0.037$ (0.26) at 24 degrees C (75 degrees F), external insulation for temperatures up to 204 degrees C (400 degrees F).
- B. ASTM C553 (Blanket, Flexible) Type I, Class B-3, Density 16 kg/m³ (nominal 1 pcf), $k = 0.045$ (0.31) Class B-5, Density 32 kg/m³ (nominal 2 pcf), $k = 0.04$ (0.27) t 24 degrees C (75 degrees F), for use at temperatures up to 204 degrees C (400 degrees F).
- C. ASTM C547 (Pipe Fitting Insulation and Preformed Pipe Insulation), Class 1, $k = 0.037$ (0.26) 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.

2.2 MINERAL WOOL OR REFRACTORY FIBER

- A. Comply with Standard ASTM C612, Class 3, 450 degrees C (842 degrees F).

2.3 RIGID CELLULAR PHENOLIC FOAM

- A. Preformed (molded) pipe insulation, ASTM C1126, Type III, grade 1, $k = 0.021$ (0.15) at 10 degrees C (50 degrees F), for use at temperatures up to 121 degrees C (250 degrees F) with vapor retarder and all service vapor retarder jacket (ASJ) and with PVC premolded fitting covering.
- B. Equipment Insulation, ASTM C1126, Type II, grade 1, $k = 0.021$ (0.15) at 10 degrees C (50 degrees F), for use at temperatures up to 121 degrees C (250 degrees F) with rigid cellular phenolic insulation and covering, and all service vapor retarder jacket (ASJ).

2.4 CELLULAR GLASS CLOSED-CELL

- A. Comply with Standard ASTM C552, density 120 kg/m³ (7.5 pcf) nominal, $k = 0.033$ (0.29) at 24 degrees C (75 degrees F).
- B. Pipe insulation for use at process temperatures below ambient air to 482 degrees C (900 degrees F) with or without all service vapor retarder jacket (ASJ).
- C. Pipe insulation for use at process temperatures for pipe and tube below ambient air temperatures or where condensation control is necessary are to be installed with a vapor retarder/barrier system of with or without all service vapor retarder sealed jacket (ASJ) system. Without ASJ shall require all longitudinal and circumferential joints to be vapor sealed with vapor barrier mastic.
- D. Cellular glass thermal insulation intended for use on surfaces operating at temperatures between -268 and 482 degrees C (-450 and 900 degrees F). It is possible that special fabrication or techniques for pipe insulation, or both, shall

be required for application in the temperature range from 121 to 427 degrees C (250 to 800 degrees F).

2.5 POLYISOCYANURATE CLOSED-CELL RIGID

- A. Preformed (fabricated) pipe insulation, ASTM C591, Type IV, K=0.027(0.19) at 24 degrees C (75 degrees F), flame spread not over 25, smoke developed not over 50, for use at temperatures up to 149 degree C (300 degree F) with factory applied PVDC or all service vapor retarder jacket with PVC premolded fitting covers.
- B. Equipment and duct insulation, ASTM C591, Type IV, K=0.027(0.19) at 24 degrees C (75 degrees F), for use at temperatures up to 149 degrees C (300 degrees F) with PVDC or all service jacket vapor retarder jacket.

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.

2.7 CALCIUM SILICATE

- A. Preformed pipe Insulation: ASTM C533, Type I and Type II with indicator denoting asbestos-free material.
- B. Premolded Pipe Fitting Insulation: ASTM C533, Type I and Type II with indicator denoting asbestos-free material.
- C. Equipment Insulation: ASTM C533, Type I and Type II.
- D. Characteristics:

Insulation Characteristics		
ITEMS	TYPE I	TYPE II
Surface Temperature, maximum degrees C (degrees F)	649 (1200)	927 (1700)
Density (dry), Kg/m ³ (lb./ ft ³)	240 (15)	352 (22)
Thermal conductivity: Min W/ m K (Btu in/h ft ² degrees F) @ mean temperature of 93 degrees C (199 degrees F)	0.065 (0.45)	0.078 (0.540)
Surface burning characteristics: Flame spread Index, Maximum	0	0
Smoke Density index, Maximum	0	0

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. Glass Cloth Jackets: Presized, minimum 0.18 kg per square meter (7.8 ounces per square yard), 2070 kPa (300 psig) bursting strength with integral vapor retarder where required or specified. Weather proof if utilized for outside service.

- 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.
- H. Aluminum Jacket-Piping systems and circular breeching and stacks: ASTM B209, 3003 alloy, H-14 temper, 0.6 mm (0.023 inch) minimum thickness with locking longitudinal joints. Jackets for elbows, tees and other fittings shall be factory-fabricated or with cut aluminum gores to match shape of fitting and of 0.6 mm (0.024 inch) minimum thickness aluminum. Aluminum fittings shall be of same construction with an internal moisture barrier as straight run jackets but need not be of the same alloy. Factory-fabricated stainless-steel bands with wing seals shall be installed on all circumferential joints. Bands shall be 15 mm (0.5 inch) wide on 450 mm (18 inch) centers. System shall be weatherproof if utilized for outside service.
- I. Aluminum Jacket-Rectangular breeching: ASTM B209, 3003 alloy, H-14 temper, 0.5 mm (0.020 inches) thick with 32 mm (1-1/4 inch) corrugations or 0.8 mm (0.032 inches) thick with no corrugations. System shall be weatherproof if used for outside service.

2.9 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/m³ (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/m³ (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. Glass fabric, open weave: ASTM D1668/D1668M, Type III (resin treated) and Type I (asphalt or white resin treated).
- B. Glass fiber fitting tape: Mil. Spec MIL-C-20079H, Type II, Class 1.
- C. Tape for Flexible Elastomeric Cellular Insulation: As recommended by the insulation manufacturer.
- D. Hexagonal wire netting: 25 mm (one inch) mesh, 0.85 mm thick (22 gage) galvanized steel.
- E. Corner beads: 50 mm (2 inch) by 50 mm (2 inch), 0.55 mm thick (26 gage) galvanized steel; or, 25 mm (1 inch) by 25 mm (1 inch), 0.47 mm thick (28 gage) aluminum angle adhered to 50 mm (2 inch) by 50 mm (2 inch) Kraft paper.

- F. PVC fitting cover: Fed. Spec L-P-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
 - N. Freeze protection of above grade outdoor piping (over heat tracing tape): 20 mm (3/4 inch) thick insulation, for all pipe sizes 75 mm (3 inches) and smaller and 25 mm (1 inch) thick insulation for larger pipes. Provide metal jackets for all pipe insulations. Provide freeze protection for cold water make-up piping and equipment

where indicated on the drawings as described in Section 23 21 13, HYDRONIC PIPING (electrical heat tracing systems).

O. Provide vapor barrier systems as follows:

1. All piping exposed to outdoor weather.
2. All interior piping conveying fluids exposed to outdoor air (i.e. in attics, ventilated (not air conditioned) spaces, etc.) below ambient air temperature in high humidity locations.

P. Provide metal jackets over insulation as follows:

1. All plumbing piping exposed to outdoor weather.
2. Piping exposed in building, within 1829 mm (6 feet) of the floor, that connects to sterilizers, kitchen and laundry equipment. Jackets may be applied with pop rivets except for cold pipe or tubing applications. Provide aluminum angle ring escutcheons at wall, ceiling or floor penetrations.
3. A 50 mm (2 inch) jacket overlap is required at longitudinal and circumferential joints with the overlap at the bottom.

Q. 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

A. Mineral Fiber Board:

1. Vapor retarder faced board: Apply board on pins spaced not more than 300 mm (12 inches) on center each way, and not less than 75 mm (3 inches) from each edge of board. In addition to pins, apply insulation bonding adhesive to entire underside of horizontal metal surfaces. (Bio-based materials shall be utilized when possible.) Butt insulation edges tightly and seal all joints with laps and butt strips. After applying speed clips cut pins off flush and apply vapor seal patches over clips.
2. Plain unfaced board:
 - a. Insulation shall be scored, beveled or mitered to provide tight joints and be secured to equipment with bands spaced 225 mm (9 inches) on center for irregular surfaces or with pins and clips on flat surfaces. Use corner beads to protect edges of insulation.
 - b. For hot equipment: Stretch 25 mm (1 inch) mesh wire, with edges wire laced together, over insulation and finish with insulating and finishing cement applied in one coat, 6 mm (1/4 inch) thick, troweled to a smooth finish.
 - c. For cold equipment: Apply meshed glass fabric in a tack coat 1.5 to 1.7 square meter per liter (60 to 70 square feet per gallon) of vapor mastic and finish with mastic at 0.3 to 0.4 square meter per liter (12 to 15 square feet per gallon) over the entire fabric surface.

3. Cold equipment: 40 mm (1-1/2inch) thick insulation faced with vapor retarder ASJ or FSK. Seal all facings, laps, and termination points and do not use staples or other attachments that may puncture ASJ or FSK.
 - a. Water filter, chemical feeder pot or tank.
 - b. Pneumatic, cold storage water and surge tanks.
 4. Hot equipment: 40 mm (1-1/2 inch) thick insulation faced with unsealed ASJ or FSK.
 - a. Domestic water heaters and hot water storage tanks (not factory insulated).
 - b. Booster water heaters for dietetics dish and pot washers and for wash-down grease-extracting hoods.
- 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.
- C. Rigid Cellular Phenolic Foam:
1. Rigid closed cell phenolic insulation may be provided, exterior only, for piping, ductwork and equipment for temperatures up to 121 degrees C (250 degrees F).

2. Note the ASTM E84 or UL 723 surface burning characteristics requirements of maximum 25/50 indexes in paragraph "Quality Assurance".
 3. Provide secure attachment facilities such as welding pins.
 4. Apply insulation with joints tightly drawn together.
 5. Apply adhesives, coverings, neatly finished at fittings, and valves.
 6. Final installation shall be smooth, tight, neatly finished at all edges.
 7. Minimum thickness in millimeters (inches) specified in the schedule at the end of this section.
 8. Condensation control insulation: Minimum 25 mm (1 inch) thick for all pipe sizes depending on high humidity exposures.
 - a. Body of roof and overflow drains horizontal runs and offsets (including elbows) of interior downspout piping in all areas above pipe basement.
 - b. Waste piping from electric water coolers and icemakers to drainage system.
 - c. Waste piping located above basement floor from ice making and film developing equipment and air handling units, from equipment (including trap) to main vertical waste pipe.
 - d. MRI quench vent piping.
 - e. Bedpan sanitizer atmospheric vent
 - f. Reagent grade water piping.
 - g. Cold water piping, exterior only.
- D. Cellular Glass Insulation:
1. Pipe and tubing, covering nominal thickness in millimeters and inches as specified in the schedule at the end of this section.
 2. Underground piping other than or in lieu of that specified in Section 22 11 00, FACILITY WATER DISTRIBUTION: Type II, factory jacketed with a 3-mm laminate jacketing consisting of 3000 mm x 3000 mm (10 ft. x 10 ft.) asphalt impregnated glass fabric, bituminous mastic and outside protective plastic film.
 - a. 75 mm (3 inches) thick for hot water piping.
 - b. As scheduled at the end of this section for chilled water piping.
 - c. Underground piping: Apply insulation with joints tightly butted. Seal longitudinal self-sealing lap. Use field fabricated or factory-made fittings. Seal butt joints and fitting with jacketing as recommended by the insulation manufacturer. Use 100 mm (4 inch) wide strips to seal butt joints.
 - d. Provide expansion chambers for pipe loops, anchors and wall penetrations as recommended by the insulation manufacturer.
 - e. Underground insulation shall be inspected and approved by the COR as follows:
 - 1) Insulation in place before coating.
 - 2) After coating.
 - f. Sand bed and backfill: Minimum 75 mm (3 inches) all around insulated pipe or tank, applied after coating has dried.

- g. All piping up to 482 degrees C (900 degrees F) requiring protection from physical heavy contact/abuse including in mechanical rooms and exposures to the public.
- 3. Cold equipment: 50 mm (2 inch) thick insulation faced with ASJ.
- E. Polyisocyanurate Closed-Cell Rigid Insulation:
 - 1. Polyisocyanurate closed-cell rigid insulation (PIR) may be provided for exterior piping and equipment for temperature up to 149-degree C (300-degree F).
 - 2. Install insulation, vapor retarder and jacketing per manufacturer's recommendations. Particular attention should be paid to recommendations for joint staggering, adhesive application, external hanger design, expansion/contraction joint design and spacing and vapor retarder integrity.
 - 3. Install insulation with all joints tightly butted (except expansion) joints in hot applications). Provide insulation contractions joints for very cold process temperatures.
 - 4. If insulation thickness exceeds 65 mm (2-1/2 inches), install as a double layer system with longitudinal (lap) and butt joint staggering as recommended by manufacturer.
 - 5. For cold applications, vapor retarder shall be installed in a continuous manner. No staples, rivets, screws or any other attachment device capable of penetrating the vapor retarder shall be used to attach the vapor retarder or jacketing. No wire ties capable of penetrating the vapor retarder shall be used to hold the insulation in place. Stainless steel banding shall be used for cold applications to attach PVC or metal jacketing.
 - 6. Elbows, flanges and other fittings shall be insulated with the same material as is used on the pipe straights. The elbow/ fitting insulation shall be field-fabricated, mitered or factory prefabricated to the necessary size and shape to fit on the elbow/ fitting. Use of polyurethane or polyisocyanurate spray-foam to fill PVC elbow jacket is prohibited on cold applications.
 - 7. For cold applications, the vapor retarder on elbows/fittings shall be either mastic-fabric-mastic or 2 mil thick PVDC vapor retarder adhesive tape. Bio-based materials shall be utilized when possible.
 - 8. All PVC and metal jacketing shall be installed so as to naturally shed water. Joints shall point down and shall be sealed with either adhesive or caulking (except for periodic slip joints). Bio-based materials shall be utilized when possible.
 - 9. Note the NFPA 90A burning characteristic requirements of 25/50 in paragraph "Quality Assurance". Refer to paragraph "General Requirements" for items not to be insulated.
 - 10. Minimum thickness in millimeter (inches) specified in the schedule at the end of this section.

F. Flexible Elastomeric Cellular Thermal Insulation:

1. Apply insulation and fabricate fittings in accordance with the manufacturer's installation instructions and finish with two coats of weather resistant finish as recommended by the insulation manufacturer. External vapor barrier jacketing may be required for expected or anticipated high humidity exposures. See ASTM C1710.
2. Pipe and tubing insulation:
 - a. Use proper size material. Do not stretch or strain insulation.
 - b. To avoid undue compression of insulation, use supports as recommended by the elastomeric insulation manufacturer. Insulation shields are specified under Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
 - c. Where possible, slip insulation over the pipe or tubing prior to connection, and seal the butt joints with adhesive. Where the slip-on technique is not possible, slit the insulation and apply it to the pipe sealing the seam and joints with contact adhesive. Optional tape sealing, as recommended by the manufacturer, may be employed. Bio-based materials shall be utilized when possible.
3. Apply sheet insulation to flat or large curved surfaces with 100 percent adhesive coverage. For fittings and large pipe, apply adhesive to seams only.
4. Pipe insulation: nominal thickness in millimeters (inches as specified in the schedule at the end of this section.

G. Calcium Silicate:

1. Minimum thickness in millimeter (inches) specified below for piping other than in boiler plant.

Nominal Thickness Of Calcium Silicate Insulation (Non-Boiler Plant)				
Nominal Pipe Size Millimeters (Inches)	Thru 25 (1)	32 to 75 (1- 1/4 to 3)	100-200 (4 to 8)	Greater than 200 (8)
93-260 degrees C (199-500 degrees F) (HPS, HPR)	100 (4)	125 (5)	150 (6)	Greater than 150 (6)

2. MRI Quench Vent Insulation: Type I, class D, 150 mm (6 inch) nominal thickness.

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)
38-60 degrees C (100-140 degrees F) (Domestic Hot Water Supply and Return)	Rigid Cellular Phenolic Foam (Above ground piping only) (exterior locations only)	38 (1.5)	38 (1.5)	50 (2.0)	50 (2.0)
38-60 degrees C (100-140 degrees F) (Domestic Hot Water Supply and Return)	Polyiso-cyanurate Closed-Cell Rigid (Exterior Locations only)	38 (1.5)	38 (1.5)	50 (2.0)	50 (2.0)
38-60 degrees C (100-140 degrees F) (Domestic Hot Water Supply and Return)	Flexible Elastomeric Cellular Thermal (Above ground piping only)	38 (1.5)	38 (1.5)	50 (2.0)	50 (2.0)
38-60 degrees C (100-140 degrees F) (Domestic Hot Water Supply and Return)	Cellular Glass Thermal	38 (1.5)	38 (1.5)	50 (2.0)	50 (2.0)
4-15 degrees C (40-60 degrees F) (//Ice water piping//)	Rigid Cellular Phenolic Foam (Above ground piping only) (exterior locations only)	25 (1.0)	25 (1.0)	25 (1.0)	25 (1.0)
4-15 degrees C (40-60 degrees F) (//Ice water piping//)	Polyiso-cyanurate Closed-Cell Rigid (Exterior Locations only)	25 (1.0)	25 (1.0)	25 (1.0)	25 (1.0)
4-15 degrees C (40-60 degrees F) (//Ice water piping//)	Flexible Elastomeric Cellular Thermal (Above ground piping only)	25 (1.0)	25 (1.0)	25 (1.0)	25 (1.0)

4-15 degrees C (40-60 degrees F) Ice water piping	Cellular Glass Thermal	38 (1.5)	38 (1.5)	38 (1.5)	38 (1.5)
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SECTION 22 08 00

COMMISSIONING OF PLUMBING SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The requirements of this Section apply to all sections of Division 22.
- B. This project will have selected building systems commissioned. The complete list of equipment and systems to be commissioned are 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 REQUIREMENTS. A Commissioning Agent (CxA) appointed by the Department of Veterans Affairs 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 plumbing systems, 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 specifics 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 22 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 22, is required in cooperation with the VA and the Commissioning Agent.
- B. The Plumbing 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. 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 the Building Plumbing Systems will require inspection of individual elements of the Plumbing 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 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 22 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 COR. 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 COR 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 COR after submission and approval of formal training plans. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS and Division 22 Sections for additional Contractor training requirements.

----- **END** -----

**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.
- C. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- D. Section 22 07 11, PLUMBING INSULATION.

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):
 - A13.1-2015.....Scheme for Identification of Piping Systems
 - B16.3-2011.....Malleable Iron Threaded Fittings: Classes 150 and 300
 - B16.11-2011.....Forged Fittings, Socket-Welding and Threaded
 - B16.12-2009(R2014)..... Cast Iron Threaded Drainage Fittings
 - B16.15-2013Cast 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
- C. American Society for Testing and Materials (ASTM):
 - A53/A53M-2012.....Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

- 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
- B61-2015.....Standard Specification for Steam or Valve
Bronze Castings
- B62-2015.....Standard Specification for Composition Bronze
or Ounce Metal Castings
- B88-2014.....Standard Specification for Seamless Copper
Water Tube
- B687-1999 (R2011).....Standard Specification for Brass, Copper, and
Chromium-Plated Pipe Nipples
- 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
- D4101-2014.....Standard Specification for Polypropylene
Injection and Extrusion Materials
- D. American Welding Society (AWS):
- A5.8M/A5.8-2011-AMD1....Specification for Filler Metals for Brazing and
Braze Welding
- E. International Code Council (ICC):
- IPC-2015.....International Plumbing Code
- F. 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
- G. 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
- H. 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.

1.5 QUALITY ASSURANCE

- A. All pipe, couplings, fittings, and specialties shall bear the identification of the manufacturer and any markings required by the applicable referenced standards.

1.6 SPARE PARTS

- A. For mechanical press-connect fittings, provide tools required for each pipe size used at the facility.

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.

2.2 ABOVE GROUND (INTERIOR) WATER PIPING

- A. Pipe: Copper tube, ASTM B88, Type K or L, drawn.
- 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. 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 unpressed fitting identification feature.
 - 3. Mechanically formed tee connection: 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. Braze joints.
 - 4. Flanged fittings, bronze, class 150, solder-joint ends conforming to ASME B16.24.
- C. Adapters: Provide adapters for joining pipe or tubing with dissimilar end connections.
- D. Solder: ASTM B32 alloy type Sb5, HA or HB. Provide non-corrosive flux.
- E. 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.

2.3 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.

2.4 DIELECTRIC FITTINGS

- A. Provide dielectric couplings or unions between pipe of dissimilar metals.

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.
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. Completely fill and seal clearances between raceways and openings with the firestopping materials.
 8. Mechanical press-connect fitting connections shall be made in accordance with the manufacturer's installation instructions. The tubing shall be fully inserted into the fitting and the tubing marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing to assure the tubing is fully engaged (inserted) in the fitting. Ensure the tube is completely inserted to the fitting stop (appropriate depth) and

squared with the fitting prior to applying the pressing jaws onto the fitting. The joints shall be pressed using the tool(s) approved by the manufacturer. Minimum distance between fittings shall be in accordance with the manufacturer's requirements. When the pressing cycle is complete, visually inspect the joint to ensure the tube has remained fully inserted, as evidenced by the visible insertion mark.

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.

SECTION 22 40 00

PLUMBING FIXTURES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Plumbing fixtures, associated trim and fittings necessary to make a complete installation from wall or floor connections to rough piping, and certain accessories.
- 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.
- 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.

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. The American Society of Mechanical Engineers (ASME):
 - A112.6.1M-1997 (R2012) .Supports for Off-the-Floor Plumbing Fixtures for Public Use
 - A112.19.1-2013Enameled Cast Iron and Enameled Steel Plumbing Fixtures
 - A112.19.2-2013Ceramic Plumbing Fixtures
 - A112.19.3-2008Stainless Steel Plumbing Fixtures
- C. American Society for Testing and Materials (ASTM):
 - A276-2013aStandard Specification for Stainless Steel Bars and Shapes
 - B584-2008Standard Specification for Copper Alloy Sand Castings for General Applications
- D. CSA Group:
 - B45.4-2008 (R2013)Stainless Steel Plumbing Fixtures
- E. National Association of Architectural Metal Manufacturers (NAAMM):
 - AMP 500-2006Metal Finishes Manual
- F. American Society of Sanitary Engineering (ASSE):
 - 1016-2011Automatic Compensating Valves for Individual Showers and Tub/Shower Combinations
- G. NSF International (NSF):
 - 14-2013Plastics Piping System Components and Related Materials
 - 61-2013Drinking Water System Components - Health Effects

- 372-2011Drinking Water System Components - Lead Content
- H. American with Disabilities Act (A.D.A)
- I. International Code Council (ICC):
- IPC-2015International Plumbing Code

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 40 00, PLUMBING FIXTURES", 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, connections, and capacity.
- D. Operating Instructions: Comply with requirements in Section 01 00 00, GENERAL REQUIREMENTS.

1.5 QUALITY ASSURANCE

- A. 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 AutoCAD version MEP 2018 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 Contracting Officer 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 certification that all results of tests were within limits specified.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Material or equipment containing a weighted average of greater than 0.25 percent lead is 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.
- B. Plastic pipe, fittings, and solvent cement shall meet NSF 14 and shall be NSF listed for the service intended.

2.2 STAINLESS STEEL

- A. Corrosion-resistant Steel (CRS):
 - 1. Plate, Sheet and Strip: CRS flat products shall conform to chemical composition requirements of any 300 series steel specified in ASTM A276.
 - 2. Finish: Exposed surfaces shall have standard polish (ground and polished) equal to NAAMM finish Number 4.
- B. Die-cast zinc alloy products are prohibited.

2.3 STOPS

- A. Provide angle stops, straight stops or stops integral with faucet, as indicated on the project drawings.
- B. Furnish keys for lock shield stops to the COR.
- C. Supply from stops not integral with faucet shall be chrome plated copper flexible tubing or flexible stainless steel with inner core of non-toxic polymer.
- D. Supply pipe from wall to valve stop shall be rigid threaded IPS copper alloy pipe, i.e. red brass pipe nipple, chrome plated where exposed.
- E. Mental Health Area: Provide stainless steel drain guard for all lavatories not installed in casework.

2.4 ESCUTCHEONS

- A. Heavy type, chrome plated, with set screws. Provide for piping serving plumbing fixtures and at each wall, ceiling and floor penetrations in exposed finished locations and within cabinets and millwork.

2.5 LAMINAR FLOW CONTROL DEVICE

- A. Smooth, bright stainless steel or satin finish, chrome plated metal laminar flow device shall provide non-aeration, clear, coherent laminar flow that will not splash in basin. Device shall also have a flow control restrictor and have vandal resistant housing. **Aerators are prohibited.**

B. Flow Control Restrictor:

1. Capable of restricting flow from 32 ml/s to 95 ml/s (0.5 gpm to 1.5 gpm) for lavatories; 125 ml/s to 140 ml/s (2.0 gpm to 2.2 gpm) for sinks P-505 through P-520, P-524 and P-528; and 174 ml/s to 190 ml/s (2.75 gpm to 3.0 gpm) for dietary food preparation and rinse sinks or as specified.
2. Compensates for pressure fluctuation maintaining flow rate specified above within 10 percent between 170 kPa and 550 kPa (25 psig and 80 psig).
3. Operates by expansion and contraction, eliminates mineral/sediment build-up with self-cleaning action, and is capable of easy manual cleaning.

2.6 CARRIERS- NOT USED

2.7 WATER CLOSETS - NOT USED

2.8 URINALS - NOT USED

2.9 BATHTUBS - NOT USED

2.10 LAVATORIES - NOT USED

2.11 SINKS AND LAUNDRY TUBS

- A. (P-530) Sink (CRS, Single Compartment with Drainboard, Wall Hung, Sensor Controls) 14 gauge CRS approximately 457 mm by 381 mm (18 inches by 15 inches) by 254 mm (10 inches) deep with 203 mm (8 inches) or paddle type faucet with splash back and drainboard at right or left as shown on the drawings. Overall dimensions (sink and drainboard), approximately 1219 mm (48 inches) long by 610 mm (24 inches) wide. Slope drainboard to bead, not less than 6 mm (1/4 inch) high, on front and ends. Corners and edges shall be well rounded. Support sink with 3.5 mm thick (10 gauge) CRS brackets on ASME A112.6.1M, Type I, chair carrier and secure fixture with minimum 10 mm (3/8 inch) all-thread bracket studs and nuts. Set rim of sink 914 mm (36 inches) above finished floor.
1. Drain: Drain plug with cup strainers.
 2. Trap: Cast copper alloy, 38 mm (1 1/2 inches) P-trap. Adjustable with connected elbow and nipple the wall and escutcheon.
 3. Sensor Control: Provide an infra-red photocell sensor and solenoid valve to control flow automatically, thermostatic control valve with check stops, 24 volt transformer, wire box and steel access door with key operated cylinder lock see specification ACCESS DOORS. Operation: Breaking the light beam shall activate the water flow. Flow shall stop when the user moves from the light beam.
 4. Gooseneck spout: Spout and trim shall be solid brass construction and be chromium plated with smooth bright finish. Provide laminar flow device.
 5. Provide cover for exposed piping, drain, stops and trap per A.D.A.

2.12 DISPENSER, DRINKING WATER - NOT USED

2.13 SHOWER BATH FIXTURE NOT USED

2.14 EMERGENCY FIXTURES - NOT USED

2.15 HYDRANT, HOSE BIBB AND MISCELLANEOUS DEVICES - NOT USED

2.16 MENTAL HEALTH PLUMBING FIXTURES - NOT USED

.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Fixture Setting: Opening between fixture and floor and wall finish shall be sealed as specified under Section 07 92 00, JOINT SEALANTS. Bio-based materials shall be utilized when possible.
- B. Supports and Fastening: Secure all fixtures, equipment and trimmings to partitions, walls and related finish surfaces. Exposed heads of bolts and nuts in finished rooms shall be hexagonal, polished chrome plated brass with rounded tops.
- C. Through Bolts: For free standing marble and metal stud partitions refer to Section 10 21 13, TOILET COMPARTMENTS.
- D. Toggle Bolts: For hollow masonry units, finished or unfinished.
- E. Expansion Bolts: For brick or concrete or other solid masonry. Shall be 6 mm (1/4 inch) diameter bolts, and to extend at least 76 mm (3 inches) into masonry and be fitted with loose tubing or sleeves extending into masonry. Wood plugs, fiber plugs, lead or other soft metal shields are prohibited.
- F. Power Set Fasteners: May be used for concrete walls, shall be 6 mm (1/4 inch) threaded studs, and shall extend at least 32 mm (1 1/4 inches) into wall.
- G. Tightly cover and protect fixtures and equipment against dirt, water and chemical or mechanical injury.
- H. Where water closet waste pipe has to be offset due to beam interference, provide correct and additional piping necessary to eliminate relocation of water closet.
- I. Aerators are prohibited on lavatories and sinks.
- J. If an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no cost or additional time to the Government.

3.2 CLEANING

- A. At completion of all work, fixtures, exposed materials and equipment shall be thoroughly cleaned.

3.3 WATERLESS URINAL - NOT USED

- A. Manufacturer shall provide an operating manual and onsite training for the proper care and maintenance of the urinals.

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 - NOT USED

- - - E N D - - -

SECTION 23 09 24
CONTINUOUS WATER QUALITY MONITORING AND INSTRUMENTATION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Provide a continuous water monitoring system as indicated on the project documents, point list, interoperability tables, drawings, and as described in these specifications. Provide a complete and working water monitoring system. Include all engineering, programming, controls and installation materials, installation labor, commissioning and start-up, training, final project documentation and warranty.
1. The water monitoring system shall consist of high-speed, peer-to-peer network of sensors, a system server, and Intelligent Water Solutions Architecture (IWSA) that provides data analytics to identify water quality anomalies.
 2. The information shall be displayed on a geo-spatial dashboard with trending and alerting capabilities. Report generation functionalities shall be included in the system.
 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 items required for complete and fully functional Controls Systems.
 4. The water monitoring system shall be designed such that each testing location shall operate under stand-alone mode. In the event of a network communication failure, or the loss of any other monitor, the water monitoring system shall continue to operate independently. Failure of the central server shall have no effect on the monitoring stations.
- 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 the following:

1. Sensor wells and sockets in piping.

C. Responsibility Table:

Work/Item/System	Furnish	Install	Low Voltage Wiring	Line Power
Water monitoring system low voltage and communication wiring	23 09 24	23 09 24	23 09 24	N/A
Thermowells	22	22	N/A	N/A
Pipe Insertion Devices and Taps	23 09 24	23	23 09 24	26
Online Water Quality Monitoring Stations (OWQM)	23 09 24	23 09 24	23 09 24	26
Piping and Valves to and from (OWQM)	22	22	N/A	N/A
LAN Conduit and Raceway	23 09 24	23 09 24	N/A	N/A

1.2 RELATED WORK

- A. Section 26 05 11, Requirements for Electrical Installations.
- B. Section 26 05 19, Low-Voltage Electrical Power Conductors and Cables.
- C. Section 26 05 26, Grounding and Bonding for Electrical Systems.
- D. Section 26 05 33, Raceway and Boxes for Electrical Systems.
- E. Section 26 27 26, Wiring Devices.
- F. Section 27 15 00, Communications Structured Cabling

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. 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.
- D. 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).
- E. Device: a control system component that communicates with other devices.

- F. 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.
- G. DXF: An AutoCAD 2-D graphics file format. Many CAD systems import and export the DXF format for graphics interchange.
- H. Ethernet: A trademark for a system for exchanging messages between computers on a local area network using coaxial, fiber optic, or twisted-pair cables.
- I. 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.
- J. Intelligent Water Solutions Architecture (IWSA): Advanced software that provides data analytics to identify water quality anomalies.
- K. Local Area Network (LAN): A communication bus that interconnects operator workstation and digital controllers for peer-to-peer communications, sharing resources and exchanging information.
- L. Peripheral: Different components that make the control system function as one unit. Peripherals include monitor, printer, and I/O unit.
- M. 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.
- N. Repeater: A network component that connects two or more physical segments at the physical layer.
- O. Router: a component that joins together two or more networks using different LAN technologies.
- P. Sensors: devices measuring state points or flows, which are then transmitted back to the continuous water monitoring system.
- Q. Online Water Quality Monitoring (OWQM) station: Measurement station for water quality indicators (e.g. temperature, pH, Dissolved Solids, Oxidant Residual, etc.)

1.4 QUALITY ASSURANCE

A. Criteria:

1. Single Source Responsibility of subcontractor: The Contractor shall obtain hardware and software supplied under this Section and

- delegate the responsibility to a single source continuous water monitoring system installation subcontractor. The continuous water monitoring system subcontractor shall be responsible for the complete design, installation, and commissioning of the system.
2. Equipment and Materials: Equipment and materials shall be cataloged products of manufacturers regularly engaged in production and installation of continuous water monitoring systems. Products shall be manufacturer's latest standard design and have been tested and proven in actual use.
 3. The continuous water monitoring system 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 would observe the continuous water monitoring system in full operation.
 4. The continuous water monitoring system subcontractor shall have in-place facility within 50 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 continuous water monitoring system subcontractor shall have minimum of three years' experience in design and installation of continuous water monitoring 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 continuous water monitoring 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 continuous water monitoring system 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 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.
4. 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.
5. 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.
6. Multiple Alarm Annunciations: All workstations on the network shall receive alarms within five (5) seconds of each other.
7. Reporting Accuracy: Listed below are minimum acceptable reporting end-to-end accuracies for all values reported by the specified system:

Measured Variable	Reported Accuracy
Water temperature	$\pm 0.5^{\circ}\text{C}$ [$\pm 1^{\circ}\text{F}$]
Water flow	$\pm 1\%$ of reading
Water pressure	$\pm 2\%$ of full scale *Note 1

Note 1: for both absolute and differential pressure

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. Continuous water monitoring 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 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 be extended to 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 24 hours after the problem is reported.

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 the following:
 - 1. A wiring diagram for each type of input device and output device including OWQM stations, 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, temperature, pressure, flow sensors, and transmitters.
 - 2. Catalog cut sheets of all equipment used. This includes, but is not limited to software (by manufacturer and by third parties), OWQM stations, panels, peripherals, associated components, and auxiliary control devices such as sensors. 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.
 - 3. Color prints of proposed graphics with a list of points for display.

4. 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.
 5. Scaled plan drawings showing routing of LAN and locations of control panels, controllers, routers, and larger controlled devices.
 6. Construction details for all installed conduit, cabling, raceway, cabinets, and similar. Construction details of all penetrations and their protection.
 7. Quantities of submitted items may be reviewed but are the responsibility of the contractor administered by this Section of the technical specifications.
- C. Product Certificates: Compliance with Article, QUALITY ASSURANCE.
- D. Licenses: Provide licenses for all software residing on and used by the continuous water monitoring system 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 continuous water monitoring system. The documents shall be submitted for approval prior to final completion.
 2. 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 continuous water monitoring 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.
- 1. Formal instructions to the VA facilities personnel for a total of 16 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 continuous water monitoring system, at a time mutually agreeable to the Contractor and the VA.
 - 2. The O/M Manuals shall contain approved submittals as outlined in Article 1.7, SUBMITTALS. The continuous water monitoring system subcontractor will review the manual contents with VA facilities personnel.
 - 3. Training shall be given by direct employees of the continuous water monitoring system subcontractor.

1.9 PROJECT CONDITIONS (ENVIRONMENTAL CONDITIONS OF OPERATION)

- A. The OWQM 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. All electronic equipment shall operate properly with power fluctuations of plus 10 percent to minus 15 percent of nominal supply voltage.

- C. 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 Mechanical Engineers (ASME):
 - B16.18-01.....Cast Copper Alloy Solder Joint Pressure Fittings.
 - B16.22-01.....Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- C. American Society of Testing Materials (ASTM):
 - B32-08.....Standard Specification for Solder Metal
 - B88-09.....Standard Specifications for Seamless Copper Water Tube
 - B88M-09.....Standard Specification for Seamless Copper Water Tube (Metric)
 - B280-08.....Standard Specification for Seamless Copper Tube for Air-Conditioning and Refrigeration Field Service
 - D2737-03.....Standard Specification for Polyethylene (PE) Plastic Tubing
- D. Federal Communication Commission (FCC):
 - Rules and Regulations Title 47 Chapter 1-2001 Part 15: Radio Frequency Devices.
- E. Institute of Electrical and Electronic Engineers (IEEE):
 - 802.3-11.....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
- F. Underwriter Laboratories Inc (UL):
 - 94-10.....Tests for Flammability of Plastic Materials for Parts and Devices and Appliances
 - 294-10.....Access Control System Units
 - 486A/486B-10.....Wire Connectors
 - 555S-11.....Standard for Smoke Dampers

916-10.....	Energy Management Equipment
1076-10.....	Proprietary Burglar Alarm Units and Systems

PART 2 - PRODUCTS

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 ONLINE WATER QUALITY MONITORING (OWQM) STATION

A. General

1. The OWQM station shall consist of a high-performance, power efficient industrial PC controller with a minimum of 4 GB of onboard memory, wide (7-inch minimum) color graphic display and touch screen, low power operation (less than 3 watts @ 15-minute measuring interval), WIFI interface, and the ability to integrate third part sensors via 4-20 mA inputs.
2. The OWQM shall be factory assembled with required flow cells, mounting fittings and pipework on a compact panel. The OWQM shall measure pH, total dissolved solids, and oxidant residual. The OWQM shall receive an input of water temperature from a remote mounted sensor.

2.3 INTELLIGENT WATER SOLUTIONS ARCHITECTURE (IWSA)

- A. The IWSA server shall reside on a high-speed network with OWQM stations as shown on system drawings. The IWSA and each standard browser connected to server shall be able to access all system information.

B. IWSA Software:

1. Provide for automatic system database save and restore on the IWSA's hard disk a copy of the current database of each OWQM. 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 IWSA 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. 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.
5. 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.
6. 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.
7. 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 IWSA. The operating system shall be Windows XP or better, and shall support the third-party software.
8. 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.

9. 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.
10. 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.
11. Provide functionality such that using the least amount 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.
12. 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. Custom reports.
 - d. System diagnostic reports, including, list of digital controllers on the network.
13. 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 of time. 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.
14. 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.

2.4 SENSORS (WATER)

- A. Sensors' measurements shall be read back to the continuous water monitoring system, and shall be visible by the IWSA.
- B. Temperature Sensors shall be electronic, vibration and corrosion resistant for immersion mounting. Provide all remote sensors as required for the systems.
 - 1. Temperature Sensors: Resistance Temperature Device (RTD) with an integral transmitter type for all sensors.
 - a. 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.
- C. Water flow sensors:
 - 1. Type: Insertion vortex type with retractable probe assembly and 2-inch full port gate valve.
 - a. Pipe size: 3 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 BMCS: Digital pulse type.
 - 3. Performance:
 - a. Turndown: 20:1
 - b. Response time: Adjustable from 1 to 100 seconds.
 - c. Power: 24-volt DC
- D. Electronic Pressure Transducer: Solid state pressure transducer with all stainless steel wetted parts and environmentally sealed electronics for 0 to 100 PSIG service. Overpressure 300 PSIG, accuracy +/- 1.5% of span.

- E. pH Sensor: Measuring range 0 to 14. Resolution 0.01. Wetted Material 316 stainless steel with 316 stainless steel body.
- F. Dissolved Solids: Total dissolved solids shall be extrapolated from conductivity measurement and calibrated to the local water conditions.
- G. Oxidant Residual: Measuring range 0 to 10 ppm. Wetted Parts; norly, viton, silicone, platinum, and polyethersufone. Sensor shall be two-electrode, membrane-covered amperometric sensor which requires no pretreatment.

2.5 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.
 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, with thermoplastic insulated conductors as specified in Section 26 05 19.
- C. Copper digital communication cable between the IWSA server and the OWQM 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. 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.

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 Engineer 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 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 plum.

B. Electrical Wiring Installation:

1. All wiring 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 Section 26 05 19. Install digital communication cables in conduit and in accordance with Specification Section 27 15 00, Communications Structured Cabling.
 3. Install conduit and wiring between operator workstation(s), digital controllers, electrical panels, indicating devices, instrumentation, miscellaneous alarm points, 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. Mount sensors rigidly and adequately for the environment within which the sensor operates. Separate extended-bulb sensors from contact with metal casings and coils using insulated standoffs.
 - d. 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.
 - e. All pipe mounted temperature sensors shall be installed in wells.
 - f. 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.
 - g. 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: Install high-pressure side of the differential switch between the pump discharge and the check valve.

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 IWSA server and the OWQM.
 - 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 modular in design, 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. Provide factory authorized calibration of all sensors.

SECTION 26 05 11
REQUIREMENTS FOR ELECTRICAL INSTALLATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section applies to all sections of Division 26.
- B. Furnish and install electrical systems, materials, equipment, and accessories in accordance with the specifications and drawings. Capacities and ratings of motors, transformers, conductors and cable, switchboards, switchgear, panelboards, motor control centers, generators, automatic transfer switches, and other items and arrangements for the specified items are shown on the drawings.
- C. Electrical service entrance equipment and arrangements for temporary and permanent connections to the electric utility company's system shall conform to the electric utility company's requirements. Coordinate fuses, circuit breakers and relays with the electric utility company's system, and obtain electric utility company approval for sizes and settings of these devices.
- D. 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 who's 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 eight hours of receipt of notification that service is needed. Submit name and address of service organizations.

1.5 APPLICABLE PUBLICATIONS

- A. Applicable publications listed in all Sections of Division 26 shall be the latest issue, unless otherwise noted.

- B. Products specified in all sections of Division 26 shall comply with the applicable publications listed in each section.

1.6 MANUFACTURED PRODUCTS

- A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, and for which replacement parts shall be available. Materials and equipment furnished shall be new, and shall have superior quality and freshness.
- B. When more than one unit of the same class or type of materials and equipment is required, such units shall be the product of a single manufacturer.
- C. Equipment Assemblies and Components:
 - 1. Components of an assembled unit need not be products of the same manufacturer.
 - 2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
 - 3. Components shall be compatible with each other and with the total assembly for the intended service.
 - 4. Constituent parts which are similar shall be the product of a single manufacturer.
- D. Factory wiring and terminals shall be identified on the equipment being furnished and on all wiring diagrams.
- E. When Factory Tests are specified, Factory Tests shall be performed in the factory by the equipment manufacturer, and witnessed by the contractor. In addition, the following requirements shall be complied with:
 - 1. The Government shall have the option of witnessing factory tests. The Contractor shall notify the Government through the COR a minimum of thirty (30) days prior to the manufacturer's performing of the factory tests.
 - 2. When factory tests are successful, contractor shall furnish four (4) copies of the equipment manufacturer's certified test reports to the COR fourteen (14) days prior to shipment of the equipment, and not more than ninety (90) days after completion of the factory tests.
 - 3. When factory tests are not successful, factory tests shall be repeated in the factory by the equipment manufacturer, and witnessed by the Contractor. The Contractor shall be liable for all additional expenses for the Government to witness factory re-testing.

1.7 VARIATIONS FROM CONTRACT REQUIREMENTS

- A. Where the Government or the Contractor requests variations from the contract requirements, the connecting work and related components shall include, but not be limited to additions or changes to branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels and installation methods.

1.8 MATERIALS AND EQUIPMENT PROTECTION

- A. Materials and equipment shall be protected during shipment and storage against physical damage, vermin, dirt, corrosive substances, fumes, moisture, cold and rain.
 - 1. Store materials and equipment indoors in clean dry space with uniform temperature to prevent condensation.
 - 2. During installation, equipment shall be protected against entry of foreign matter, and be vacuum-cleaned both inside and outside before testing and operating. Compressed air shall not be used to clean equipment. Remove loose packing and flammable materials from inside equipment.
 - 3. Damaged equipment shall be repaired or replaced, as determined by the COR.
 - 4. Painted surfaces shall be protected with factory installed removable heavy kraft paper, sheet vinyl or equal.
 - 5. Damaged paint on equipment shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious.

1.9 WORK PERFORMANCE

- A. All electrical work shall comply with requirements of the latest NFPA 70 (NEC), NFPA 70B, NFPA 70E, NFPA 99, NFPA 110, OSHA Part 1910 subpart J - General Environmental Controls, OSHA Part 1910 subpart K - Medical and First Aid, and OSHA Part 1910 subpart S - Electrical, in addition to other references required by contract.
- B. Job site safety and worker safety is the responsibility of the Contractor.
- C. Electrical work shall be accomplished with all affected circuits or equipment de-energized. However, energized electrical work may be performed only for the non-destructive and non-invasive diagnostic testing(s), or when scheduled outage poses an imminent hazard to patient care, safety, or physical security. In such case, all aspects of energized electrical work, such as the availability of appropriate/correct personal protective equipment (PPE) and the use of PPE, shall comply with the latest NFPA 70E, as well as the following requirements:
 - 1. Only Qualified Person(s) shall perform energized electrical work. Supervisor of Qualified Person(s) shall witness the work of its entirety to ensure compliance with safety requirements and approved work plan.
 - 2. At least two weeks before initiating any energized electrical work, the Contractor and the Qualified Person(s) who is designated to perform the work shall visually inspect, verify and confirm that the work area and electrical equipment can safely accommodate the work involved.
 - 3. At least two weeks before initiating any energized electrical work, the Contractor shall develop and submit a job specific work plan, and energized electrical work request to the COR, and Medical Center's Chief Engineer or his/her designee. At the minimum, the work plan must include relevant information such as proposed work schedule, area of work, description of work,

- name(s) of Supervisor and Qualified Person(s) performing the work, equipment to be used, procedures to be used on and near the live electrical equipment, barriers to be installed, safety equipment to be used, and exit pathways.
4. Energized electrical work shall begin only after the Contractor has obtained written approval of the work plan, and the energized electrical work request from the COR, and Medical Center's Chief Engineer or his/her designee. The Contractor shall make these approved documents present and available at the time and place of energized electrical work.
 5. Energized electrical work shall begin only after the Contractor has invited and received acknowledgment from the COR, and Medical Center's Chief Engineer or his/her designee to witness the work.
- D. For work that affects existing electrical systems, arrange, phase and perform work to assure minimal interference with normal functioning of the facility. Refer to Article OPERATIONS AND STORAGE AREAS under Section 01 00 00, GENERAL REQUIREMENTS.
 - E. New work shall be installed and connected to existing work neatly, safely and professionally. Disturbed or damaged work shall be replaced or repaired to its prior conditions, as required by Section 01 00 00, GENERAL REQUIREMENTS.
 - F. Coordinate location of equipment and conduit with other trades to minimize interference.

1.10 EQUIPMENT INSTALLATION AND REQUIREMENTS

- A. Equipment location shall be as close as practical to locations shown on the drawings.
- B. Working clearances shall not be less than specified in the NEC.
- C. Inaccessible Equipment:
 1. Where the Government determines that the Contractor has installed equipment not readily accessible for operation and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to the Government.
 2. "Readily accessible" is defined as being capable of being reached quickly for operation, maintenance, or inspections without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.
- D. Electrical service entrance equipment and arrangements for temporary and permanent connections to the electric utility company's system shall conform to the electric utility company's requirements. Coordinate fuses, circuit breakers and relays with the electric utility company's system, and obtain electric utility company approval for sizes and settings of these devices.

1.11 EQUIPMENT IDENTIFICATION

- A. In addition to the requirements of the NEC, install an identification sign which clearly indicates information required for use and maintenance of items such as

switchboards and switchgear, panelboards, cabinets, motor controllers, fused and non-fused safety switches, generators, automatic transfer switches, separately enclosed circuit breakers, individual breakers and controllers in switchboards, switchgear and motor control assemblies, control devices and other significant equipment.

- B. Identification signs for Normal Power System equipment shall be laminated black phenolic resin with a white core with engraved lettering. Identification signs for Essential Electrical System (EES) equipment, as defined in the NEC, shall be laminated red phenolic resin with a white core with engraved lettering. Lettering shall be a minimum of 12 mm (1/2 inch) high. Identification signs shall indicate equipment designation, rated bus amperage, voltage, number of phases, number of wires, and type of EES power branch as applicable. Secure nameplates with screws.
- C. Install adhesive arc flash warning labels on all equipment as required by the latest NFPA 70E. Label shall show specific and correct information for specific equipment based on its arc flash calculations. Label shall show the followings:
 - 1. Nominal system voltage.
 - 2. Equipment/bus name, date prepared, and manufacturer name and address.
 - 3. Arc flash boundary.
 - 4. Available arc flash incident energy and the corresponding working distance.
 - 5. Minimum arc rating of clothing.
 - 6. Site-specific level of PPE.

1.12 SUBMITTALS

- A. Submit to the COR in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. The Government's approval shall be obtained for all materials and equipment before delivery to the job site. Delivery, storage or installation of materials and equipment which has not had prior approval will not be permitted.
- C. All submittals shall include six copies of adequate descriptive literature, catalog cuts, shop drawings, test reports, certifications, samples, and other data necessary for the Government to ascertain that the proposed materials and equipment comply with drawing and specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify specific materials and equipment being submitted.
- D. Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered for approval.
 - 1. Mark the submittals, "SUBMITTED UNDER SECTION_____".
 - 2. Submittals shall be marked to show specification reference including the section and paragraph numbers.
 - 3. Submit each section separately.
- E. The submittals shall include the following:

1. Information that confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, manuals, pictures, nameplate data, and test reports as required.
 2. Submittals are required for all equipment anchors and supports. Submittals shall include weights, dimensions, center of gravity, standard connections, manufacturer's recommendations and behavior problems (e.g., vibration, thermal expansion, etc.) associated with equipment or piping so that the proposed installation can be properly reviewed. Include sufficient fabrication information so that appropriate mounting and securing provisions may be designed and attached to the equipment.
 3. Elementary and interconnection wiring diagrams for communication and signal systems, control systems, and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.
 4. Parts list which shall include information for replacement parts and ordering instructions, as recommended by the equipment manufacturer.
- F. Maintenance and Operation Manuals:
1. Submit as required for systems and equipment specified in the technical sections. Furnish in hardcover binders or an approved equivalent.
 2. Inscribe the following identification on the cover: the words "MAINTENANCE AND OPERATION MANUAL," the name and location of the system, material, equipment, building, name of Contractor, and contract name and number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the material or equipment.
 3. Provide a table of contents and assemble the manual to conform to the table of contents, with tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in.
 4. The manuals shall include:
 - a. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.
 - b. A control sequence describing start-up, operation, and shutdown.
 - c. Description of the function of each principal item of equipment.
 - d. Installation instructions.
 - e. Safety precautions for operation and maintenance.
 - f. Diagrams and illustrations.
 - g. Periodic maintenance and testing procedures and frequencies, including replacement parts numbers.
 - h. Performance data.

- i. Pictorial "exploded" parts list with part numbers. Emphasis shall be placed on the use of special tools and instruments. The list recommended spare and replacement parts, and name of servicing organization.
 - j. List of factory approved or qualified permanent servicing organizations for equipment repair and periodic testing and maintenance, including addresses and factory certification qualifications.
- G. Approvals will be based on complete submission of shop drawings, manuals, test reports, certifications, and samples as applicable.
- H. After approval and prior to installation, furnish the COR with one sample of each of the following:
- 1. A minimum 300 mm (12 inches) length of each type and size of wire and cable along with the tag from the coils or reels from which the sample was taken. The length of the sample shall be sufficient to show all markings provided by the manufacturer.
 - 2. Each type of conduit coupling, bushing, and termination fitting.
 - 3. Conduit hangers, clamps, and supports.
 - 4. Duct sealing compound.
 - 5. Each type of receptacle, toggle switch, lighting control sensor, outlet box, manual motor starter, device wall plate, engraved nameplate, wire and cable splicing and terminating material, and branch circuit single pole molded case circuit breaker.

1.13 SINGULAR NUMBER

- A. Where any device or part of equipment is referred to in these specifications in the singular number (e.g., "the switch"), this reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the drawings.

1.14 POLYCHLORINATED BIPHENYL (PCB) EQUIPMENT - NOT USED

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 COR at least 30 days prior to the planned training.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

SECTION 26 05 19
LOW-VOLTAGE ELECTRICAL

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):
- D2301-10Standard Specification for Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape
 - D2304-10Test Method for Thermal Endurance of Rigid Electrical Insulating Materials
 - D3005-10Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape
- C. National Electrical Manufacturers Association (NEMA):
- WC 70-09Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy
- D. National Fire Protection Association (NFPA):
- 70-17National Electrical Code (NEC)
- E. Underwriters Laboratories, Inc. (UL):
- 44-14Thermoset-Insulated Wires and Cables
 - 83-14Thermoplastic-Insulated Wires and Cables
 - 467-13Grounding and Bonding Equipment
 - 486A-486B-13Wire Connectors
 - 486C-13Splicing Wire Connectors
 - 486D-15Sealed Wire Connector Systems
 - 486E-15Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors
 - 493-07Thermoplastic-Insulated Underground Feeder and Branch Circuit Cables
 - 514B-12Conduit, 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.

D. Direct Burial Cable: UF or USE cable.

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 COR.
7. Color code for isolated power system wiring shall be in accordance with the NEC.

2.2 SPLICES

- A. Splices shall be in accordance with NEC and UL.
- B. Above Ground Splices for No. 10 AWG and Smaller:
 1. Solderless, screw-on, reusable pressure cable type, with integral insulation, approved for copper and aluminum conductors.
 2. The integral insulator shall have a skirt to completely cover the stripped conductors.
 3. The number, size, and combination of conductors used with the connector, as listed on the manufacturer's packaging, shall be strictly followed.
- C. Above Ground Splices for No. 8 AWG to No. 4/0 AWG:
 1. Compression, hex screw, or bolt clamp-type of high conductivity and corrosion-resistant material, listed for use with copper and aluminum conductors.
 2. Insulate with materials approved for the particular use, location, voltage, and temperature. Insulation level shall be not less than the insulation level of the conductors being joined.
 3. Splice and insulation shall be product of the same manufacturer.
 4. All bolts, nuts, and washers used with splices shall be zinc-plated.

D. Above Ground Splices for 250 kcmil and Larger:

1. Long barrel "butt-splice" or "sleeve" type compression connectors, with minimum of two compression indents per wire, listed for use with copper and aluminum conductors.
2. Insulate with materials approved for the particular use, location, voltage, and temperature. Insulation level shall be not less than the insulation level of the conductors being joined.
3. Splice and insulation shall be product of the same manufacturer.

E. Underground Splices for No. 10 AWG and Smaller:

1. Solderless, screw-on, reusable pressure cable type, with integral insulation. Listed for wet locations, and approved for copper and aluminum conductors.
2. The integral insulator shall have a skirt to completely cover the stripped conductors.
3. The number, size, and combination of conductors used with the connector, as listed on the manufacturer's packaging, shall be strictly followed.

F. Underground Splices for No. 8 AWG and Larger:

1. Mechanical type, of high conductivity and corrosion-resistant material. Listed for wet locations, and approved for copper and aluminum conductors.
2. Insulate with materials approved for the particular use, location, voltage, and temperature. Insulation level shall be not less than the insulation level of the conductors being joined.
3. Splice and insulation shall be product of the same manufacturer.

G. Plastic electrical insulating tape: Per ASTM D2304, flame-retardant, cold and weather resistant.

2.3 CONNECTORS AND TERMINATIONS

- A. Mechanical type of high conductivity and corrosion-resistant material, listed for use with copper and aluminum conductors.
- B. Long barrel compression type of high conductivity and corrosion-resistant material, with minimum of two compression indents per wire, listed for use with copper and aluminum conductors.
- C. All bolts, nuts, and washers used to connect connections and terminations to bus bars or other termination points shall be 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 INSTALLATION IN MANHOLES - NOT USED

3.3 SPLICE AND TERMINATION INSTALLATION

- A. Splices and terminations shall be mechanically and electrically secure, and tightened to manufacturer's published torque values using a torque screwdriver or wrench.
- B. Where the Government determines that unsatisfactory splices or terminations have been installed, replace the splices or terminations at no additional cost to the Government.

3.4 CONDUCTOR IDENTIFICATION

- A. When using colored tape to identify phase, neutral, and ground conductors larger than No. 8 AWG, apply tape in half-overlapping turns for a minimum of 75 mm (3 inches) from terminal points, and in junction boxes, pull boxes, and manholes. Apply the last two laps of tape with no tension to prevent possible unwinding. Where cable markings are covered by tape, apply tags to cable, stating size and insulation type.

3.5 FEEDER CONDUCTOR IDENTIFICATION

- A. In each interior pull box and each underground manhole and handhole, install brass tags on all feeder conductors to clearly designate their circuit identification and voltage. The tags shall be the embossed type, 40 mm (1-1/2 inches) in diameter and 40 mils thick. Attach tags with plastic ties.

3.6 EXISTING CONDUCTORS

- A. Unless specifically indicated on the plans, existing conductors shall not be reused.

3.7 CONTROL WIRING INSTALLATION

- A. Unless otherwise specified in other sections, install control wiring and connect to equipment to perform the required functions as specified or as shown on the drawings.
- B. Install a separate power supply circuit for each system, except where otherwise shown on the drawings.

3.8 CONTROL WIRING IDENTIFICATION

- A. Install a permanent wire marker on each wire at each termination.
- B. Identifying numbers and letters on the wire markers shall correspond to those on the wiring diagrams used for installing the systems.
- C. Wire markers shall retain their markings after cleaning.

- D. In each manhole and handhole, install embossed brass tags to identify the system served and function.

3.9 DIRECT BURIAL CABLE INSTALLATION - NOT USED

3.10 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.

SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installation, connection, and testing of grounding and bonding equipment, indicated as grounding equipment in this section.
- B. "Grounding electrode system" refers to grounding electrode conductors and all electrodes required or allowed by NEC, as well as made, supplementary, and lightning protection system grounding electrodes.
- C. The terms "connect" and "bond" are used interchangeably in this section and have the same meaning.

1.2 RELATED WORK

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
- B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.
- C. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduit and boxes.

1.3 QUALITY ASSURANCE

- A. 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 COR.
 - 3. Certifications:
 - a. Certification by the Contractor that the grounding equipment has been properly installed and tested.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. American Society for Testing and Materials (ASTM):
- B1-13Standard Specification for Hard-Drawn Copper Wire
 - B3-13Standard Specification for Soft or Annealed Copper Wire
 - B8-11Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
- C. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
- 81-12IEEE 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):
- 70-17National Electrical Code (NEC)
 - 70E-15National Electrical Safety Code
 - 99-15Health Care Facilities
- E. Underwriters Laboratories, Inc. (UL):
- 44-14Thermoset-Insulated Wires and Cables
 - 83-14Thermoplastic-Insulated Wires and Cables
 - 467-13Grounding 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. XHHW-2 shall be used for isolated power systems.

2.2 GROUND RODS

- A. copper clad steel, 19 mm (0.75 inch) diameter by 3 M (10 feet) long.
- B. Quantity of rods shall be as shown on the drawings, and as required to obtain the specified ground resistance.

2.3 CONCRETE ENCASED ELECTRODE

- A. Concrete encased electrode shall be No. 4 AWG bare copper wire, installed per NEC.

2.4 GROUND CONNECTIONS

- A. Below Grade and Inaccessible Locations: Exothermic-welded type connectors.
- B. Above Grade:
 - 1. Bonding Jumpers: Listed for use with aluminum and copper conductors. For wire sizes No. 8 AWG and larger, use compression-type connectors. For wire sizes smaller than No. 8 AWG, use mechanical type lugs. Connectors or lugs shall use //zinc-plated//cadmium-plated// steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.
 - 2. Connection to Building Steel: Exothermic-welded type connectors.
 - 3. Connection to Grounding Bus Bars: Listed for use with aluminum and copper conductors. Use mechanical type lugs, with zinc-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.
 - 4. Connection to Equipment Rack and Cabinet Ground Bars: Listed for use with aluminum and copper conductors. Use mechanical type lugs, with zinc-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.

2.5 EQUIPMENT RACK AND CABINET GROUND BARS

- A. Provide solid copper ground bars designed for mounting on the framework of open or cabinet-enclosed equipment racks. Ground bars shall have minimum dimensions of 6.3 mm (0.25 inch) thick x 19 mm (0.75 inch) wide, with length as required or as shown on the drawings. Provide insulators and mounting brackets.

2.6 GROUND TERMINAL BLOCKS

- A. At any equipment mounting location (e.g., backboards and hinged cover enclosures) where rack-type ground bars cannot be mounted, provide mechanical type lugs, with zinc-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.

2.7 GROUNDING BUS BAR

- A. Pre-drilled rectangular copper bar with stand-off insulators, minimum 6.3 mm (0.25 inch) thick x 100 mm (4 inches) high in cross-section, length as shown on the drawings, with hole size, quantity, and spacing per detail shown on the drawings. Provide insulators and mounting brackets.

PART 3 - EXECUTION

3.1 GENERAL

- A. Installation shall be in accordance with the NEC, as shown on the drawings, and manufacturer's instructions.
- B. System Grounding:

1. Secondary service neutrals: Ground at the supply side of the secondary disconnecting means and at the related transformer.
 2. Separately derived systems (transformers downstream from the service entrance): Ground the secondary neutral.
 3. Isolation transformers and isolated power systems shall not be system grounded.
- C. Equipment Grounding: Metallic piping, building structural steel, electrical enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits, shall be bonded and grounded.
- D. For patient care area electrical power system grounding, conform to 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 MEDIUM-VOLTAGE EQUIPMENT AND CIRCUITS – NOT USED

- D. Lightning Arresters: Connect lightning arresters to the equipment ground bus or ground rods as applicable.

3.4 SECONDARY VOLTAGE EQUIPMENT AND CIRCUITS

- A. Main Bonding Jumper: Bond the secondary service neutral to the ground bus in the service equipment.
- B. Metallic Piping, Building Structural Steel, and Supplemental Electrode(s):
1. Provide a grounding electrode conductor sized per NEC between the service equipment ground bus and all metallic water pipe systems, building structural steel, and supplemental or made electrodes. Provide jumpers across insulating joints in the metallic piping.
 2. Provide a supplemental ground electrode as shown on the drawings and bond to the grounding electrode system.
- C. Switchgear, Switchboards, Unit Substations, Panelboards, Motor Control Centers, Engine-Generators, Automatic Transfer Switches, and other electrical equipment:
1. Connect the equipment grounding conductors to the ground bus.
 2. Connect metallic conduits by grounding bushings and equipment grounding conductor to the equipment ground bus.
- D. Transformers:
1. Exterior: Exterior transformers supplying interior service equipment shall have the neutral grounded at the transformer secondary. Provide a grounding electrode at the transformer.

2. Separately derived systems (transformers downstream from service equipment):
Ground the secondary neutral at the transformer. Provide a grounding electrode conductor from the transformer to the ground bar at the service equipment.

3.5 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 an equipment grounding conductor to the equipment ground bus.

B. Feeders and Branch Circuits: Install equipment grounding conductors with all feeders, and power and lighting branch circuits.

C. Boxes, Cabinets, Enclosures, and Panelboards:

1. Bond the equipment grounding conductor to each pullbox, junction box, outlet box, device box, cabinets, and other enclosures through which the conductor passes (except for special grounding systems for intensive care units and other critical units shown).
2. Provide lugs in each box and enclosure for equipment grounding conductor termination.

D. Wireway Systems:

1. Bond the metallic structures of wireway to provide electrical continuity throughout the wireway system, by connecting a No. 6 AWG bonding jumper at all intermediate metallic enclosures and across all section junctions.
2. Install insulated No. 6 AWG bonding jumpers between the wireway system, bonded as required above, and the closest building ground at each end and approximately every 16 M (50 feet).
3. Use insulated No. 6 AWG bonding jumpers to ground or bond metallic wireway at each end for all intermediate metallic enclosures and across all section junctions.
4. Use insulated No. 6 AWG bonding jumpers to ground cable tray to column-mounted building ground plates (pads) at each end and approximately every 15 M (49 feet).

- E. Receptacles shall not be grounded through their mounting screws. Ground receptacles with a jumper from the receptacle green ground terminal to the device box ground screw and a jumper to the branch circuit equipment grounding conductor.
- F. Ground lighting fixtures to the equipment grounding conductor of the wiring system. Fixtures connected with flexible conduit shall have a green ground wire included with the power wires from the fixture through the flexible conduit to the first outlet box.
- G. Fixed electrical appliances and equipment shall be provided with a ground lug for termination of the equipment grounding conductor.
- H. Raised Floors: Provide bonding for all raised floor components as shown on the drawings.
- I. Panelboard Bonding in Patient Care Areas: The equipment grounding terminal buses of the normal and essential branch circuit panel boards serving the same individual patient vicinity shall be bonded together with an insulated continuous copper conductor not less than No. 10 AWG, installed in rigid metal conduit.

3.6 OUTDOOR METALLIC FENCES AROUND ELECTRICAL EQUIPMENT - NOT USED

3.7 CORROSION INHIBITORS

- A. When making grounding and bonding connections, apply a corrosion inhibitor to all contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between the metals used.

3.8 CONDUCTIVE PIPING

- A. Bond all conductive piping systems, interior and exterior, to the grounding electrode system. Bonding connections shall be made as close as practical to the equipment ground bus.
- B. In operating rooms and at intensive care and coronary care type beds, bond the medical gas piping and medical vacuum piping at the outlets directly to the patient ground bus.

3.9 LIGHTNING PROTECTION SYSTEM - NOT USED

3.10 MAIN ELECTRICAL ROOM GROUNDING

- A. Provide ground bus bar and mounting hardware at each main electrical room where incoming feeders are terminated, as shown on the drawings. Connect to pigtail extensions of the building grounding ring, as shown on the drawings.

3.11 EXTERIOR LIGHT POLES - NOT USED

3.12 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.
- B. Grounding system resistance shall comply with the electric utility company ground resistance requirements.

3.13 GROUND ROD INSTALLATION

- A. For outdoor installations, drive each rod vertically in the earth, until top of rod is 610 mm (24 inches) below final grade.
- B. For indoor installations, leave 100 mm (4 inches) of each rod exposed.
- C. Where buried or permanently concealed ground connections are required, make the connections by the exothermic process, to form solid metal joints. Make accessible ground connections with mechanical pressure-type ground connectors.
- D. Where rock or impenetrable soil prevents the driving of vertical ground rods, install angled ground rods or grounding electrodes in horizontal trenches to achieve the specified ground resistance.

3.14 ACCEPTANCE CHECKS AND TESTS

- A. Resistance of the grounding electrode system shall be measured using a four-terminal fall-of-potential method as defined in IEEE 81. Ground resistance measurements shall be made before the electrical distribution system is energized or connected to the electric utility company ground system, and shall be made in normally dry conditions not fewer than 48 hours after the last rainfall.
- B. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.
- C. Below-grade connections shall be visually inspected by the COR prior to backfilling. The Contractor shall notify the COR 24 hours before the connections are ready for inspection.

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 09 91 00, PAINTING: Identification and painting of conduit and other devices.

1.3 QUALITY ASSURANCE

Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

- A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
 - 1. Shop Drawings:
 - a. Size and location of main feeders.
 - b. Size and location of panels and pull-boxes.
 - c. Layout of required conduit penetrations through structural elements.
 - d. Submit the following data for approval:
 - 1) Raceway types and sizes.
 - 2) Conduit bodies, connectors and fittings.
 - 3) Junction and pull boxes, types and sizes.
 - 2. Certifications: Two weeks prior to final inspection, submit the following:
 - a. Certification by the manufacturer that raceways, conduits, conduit bodies, connectors, fittings, junction and pull boxes, and all related equipment conform to the requirements of the drawings and specifications.
 - b. Certification by the Contractor that raceways, conduits, conduit bodies, connectors, fittings, junction and pull boxes, and all related equipment have been properly installed.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced.
Publications are referenced in the text by designation only.
- B. American National Standards Institute (ANSI):
- C80.1-05 Electrical Rigid Steel Conduit
 - C80.3-05 Steel Electrical Metal Tubing
 - C80.6-05 Electrical Intermediate Metal Conduit
- C. National Fire Protection Association (NFPA):
- 70-11 National Electrical Code (NEC)
- D. Underwriters Laboratories, Inc. (UL):
- 1-05Flexible Metal Conduit
 - 5-11Surface Metal Raceway and Fittings
 - 6-07Electrical Rigid Metal Conduit - Steel
 - 50-95Enclosures for Electrical Equipment
 - 360-13Liquid-Tight Flexible Steel Conduit
 - 467-13Grounding and Bonding Equipment
 - 514A-13Metallic Outlet Boxes
 - 514B-12Conduit, Tubing, and Cable Fittings
 - 514C-07Nonmetallic Outlet Boxes, Flush-Device Boxes and Covers
 - 651-11Schedule 40 and 80 Rigid PVC Conduit and Fittings
 - 651A-11Type EB and A Rigid PVC Conduit and HDPE Conduit
 - 797-07Electrical Metallic Tubing
 - 1242-06Electrical Intermediate Metal Conduit - Steel
- E. National Electrical Manufacturers Association (NEMA):
- TC-2-13Electrical Polyvinyl Chloride (PVC) Tubing and Conduit
 - TC-3-13PVC Fittings for Use with Rigid PVC Conduit and Tubing
 - FB1-12Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable
 - FB2.10-13Selection and Installation Guidelines for Fittings for use with Non-Flexible Conduit or Tubing (Rigid Metal Conduit, Intermediate Metallic Conduit, and Electrical Metallic Tubing)
 - FB2.20-12Selection and Installation Guidelines for Fittings for use with Flexible Electrical Conduit and Cable
- F. American Iron and Steel Institute (AISI):
- S100-2007North American Specification for the Design of Cold-Formed Steel Structural Members

PART 2 - PRODUCTS

2.1 MATERIAL

- A. Conduit Size: In accordance with the NEC, but not less than 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 ANSI C80.1.\
 - 3. Rigid aluminum: Shall conform to UL 6A and ANSI C80.5.
 - 4. Rigid Intermediate Steel Conduit (IMC): Shall conform to UL 1242 and ANSI C80.6.
 - 5. Electrical Metallic Tubing (EMT): Shall conform to UL 797 and ANSI C80.3. Maximum size not to exceed 105 mm (4 inches) and shall be permitted only with cable rated 600 V or less.
 - 6. Flexible Metal Conduit: Shall conform to UL 1.
 - 7. Liquid-tight Flexible Metal Conduit: Shall conform to UL 360.
 - 8. Direct Burial Plastic Conduit: Shall conform to UL 651 and UL 651A, heavy wall PVC or high-density polyethylene (PE).
 - 9. Surface Metal Raceway: Shall conform to UL 5.
- C. Conduit Fittings:
 - 1. Rigid Steel and Intermediate Metallic Conduit Fittings:
 - a. Fittings shall meet the requirements of UL 514B and NEMA FB1.
 - b. Standard threaded couplings, locknuts, bushings, conduit bodies, and elbows: Only steel or malleable iron materials are acceptable. Integral retractable type IMC couplings are also acceptable.
 - c. Locknuts: Bonding type with sharp edges for digging into the metal wall of an enclosure.
 - d. Bushings: Metallic insulating type, consisting of an insulating insert, molded or locked into the metallic body of the fitting. Bushings made entirely of metal or nonmetallic material are not permitted.
 - e. Erickson (Union-Type) and Set Screw Type Couplings: Approved for use in concrete are permitted for use to complete a conduit run where conduit is installed in concrete. Use set screws of case-hardened steel with hex head and cup point to firmly seat in conduit wall for positive ground. Tightening of set screws with pliers is prohibited.
 - f. Sealing Fittings: Threaded cast iron type. Use continuous drain-type sealing fittings to prevent passage of water vapor. In concealed work, install fittings in flush steel boxes with blank cover plates having the same finishes as that of other electrical plates in the room.
 - 2. Rigid Aluminum Conduit Fittings:
 - a. Standard threaded couplings, locknuts, bushings, conduit bodies, and elbows: Malleable iron, steel or aluminum alloy materials; Zinc or cadmium plate iron

- or steel fittings. Aluminum fittings containing more than 0.4% copper are prohibited.
- b. Locknuts and Bushings: As specified for rigid steel and IMC conduit.
 - c. Set Screw Fittings: Not permitted for use with aluminum conduit.
3. Electrical Metallic Tubing Fittings:
- a. Fittings and conduit bodies shall meet the requirements of UL 514B, ANSI C80.3, and NEMA FB1.
 - b. Only steel or malleable iron materials are acceptable.
 - c. Setscrew Couplings and Connectors: Use setscrews of case-hardened steel with hex head and cup point, to firmly seat in wall of conduit for positive grounding.
 - d. Indent-type connectors or couplings are prohibited.
 - e. Die-cast or pressure-cast zinc-alloy fittings or fittings made of "pot metal" are prohibited.
4. Flexible Metal Conduit Fittings:
- a. Conform to UL 514B. Only steel or malleable iron materials are acceptable.
 - b. Clamp-type, with insulated throat.
5. Liquid-tight Flexible Metal Conduit Fittings:
- a. Fittings shall meet the requirements of UL 514B and NEMA FB1.
 - b. Only steel or malleable iron materials are acceptable.
 - c. Fittings must incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening. Connectors shall have insulated throats.
6. Direct Burial Plastic Conduit Fittings: Fittings shall meet the requirements of UL 514C and NEMA TC3.
7. 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.
8. Expansion and Deflection Couplings:
- a. Conform to UL 467 and UL 514B.
 - b. Accommodate a 19 mm (0.75-inch) deflection, expansion, or contraction in any direction, and allow 30-degree angular deflections.
 - c. Include internal flexible metal braid, sized to guarantee conduit ground continuity and a low-impedance path for fault currents, in accordance with UL 467 and the NEC tables for equipment grounding conductors.
 - d. Jacket: Flexible, corrosion-resistant, watertight, moisture and heat-resistant molded rubber material with stainless steel jacket clamps.
- D. Conduit Supports:
- 1. Parts and Hardware: Zinc-coat or provide equivalent corrosion protection.
 - 2. Individual Conduit Hangers: Designed for the purpose, having a pre-assembled closure bolt and nut, and provisions for receiving a hanger rod.

3. Multiple Conduit (Trapeze) Hangers: Not less than 38 mm x 38 mm (1.5 x 1.5 inches), 12-gauge steel, cold-formed, lipped channels; with not less than 9 mm (0.375-inch) diameter steel hanger rods.
 4. Solid Masonry and Concrete Anchors: Self-drilling expansion shields, or machine bolt expansion.
- E. Outlet, Junction, and Pull Boxes:
1. UL-50 and UL-514A.
 2. Rustproof cast metal where required by the NEC or shown on drawings.
 3. Sheet Metal Boxes: Galvanized steel, except where shown on drawings.
- F. Metal Wireways: Equip with hinged covers, except as shown on drawings. Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for a complete system.

PART 3 - EXECUTION

3.1 PENETRATIONS

- A. Cutting or Holes:
1. Cut holes in advance where they should be placed in the structural elements, such as ribs or beams. Obtain the approval of the COR prior to drilling through structural elements.
 2. Cut holes through concrete and masonry in new and existing structures with a diamond core drill or concrete saw. Pneumatic hammers, impact electric, hand, or manual hammer-type drills are not allowed, except when permitted by the COR where working space is limited.
- B. Firestop: Where conduits, wireways, and other electrical raceways pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING.
- C. Waterproofing: At floor, exterior wall, and roof conduit penetrations, completely seal the gap around conduit to render it watertight, as specified in Section 07 92 00, JOINT SEALANTS.

3.2 INSTALLATION, GENERAL

- A. In accordance with UL, NEC, NEMA, as shown on drawings, and as specified herein.
- B. Raceway systems used for Essential Electrical Systems (EES) shall be entirely independent of other raceway systems.
- C. Install conduit as follows:
1. In complete mechanically and electrically continuous runs before pulling in cables or wires.
 2. Unless otherwise indicated on the drawings or specified herein, installation of all conduits shall be concealed within finished walls, floors, and ceilings.

3. Flattened, dented, or deformed conduit is not permitted. Remove and replace the damaged conduits with new conduits.
 4. Assure conduit installation does not encroach into the ceiling height head room, walkways, or doorways.
 5. Cut conduits square, ream, remove burrs, and draw up tight.
 6. Independently support conduit at 2.4 M (8 feet) on centers with specified materials and as shown on drawings.
 7. Do not use suspended ceilings, suspended ceiling supporting members, lighting fixtures, other conduits, cable tray, boxes, piping, or ducts to support conduits and conduit runs.
 8. Support within 300 mm (12 inches) of changes of direction, and within 300 mm (12 inches) of each enclosure to which connected.
 9. Close ends of empty conduits with plugs or caps at the rough-in stage until wires are pulled in, to prevent entry of debris.
 10. Conduit installations under fume and vent hoods are prohibited.
 11. Secure conduits to cabinets, junction boxes, pull-boxes, and outlet boxes with bonding type locknuts. For rigid steel and IMC conduit installations, provide a locknut on the inside of the enclosure, made up wrench tight. Do not make conduit connections to junction box covers.
 12. Flashing of penetrations of the roof membrane is specified in Section 07 60 00, FLASHING AND SHEET METAL. - NOT USED
 13. Conduit bodies shall only be used for changes in direction, and shall not contain splices.
 14. Do not use aluminum conduits in wet locations.
- D. Conduit Bends:
1. Make bends with standard conduit bending machines.
 2. Conduit hickey may be used for slight offsets and for straightening stubbed out conduits.
 3. Bending of conduits with a pipe tee or vise is prohibited.
- E. Layout and Homeruns:
1. Install conduit with wiring, including homeruns, as shown on drawings.
 2. Deviations: Make only where necessary to avoid interferences and only after drawings showing the proposed deviations have been submitted and approved by the COR.

3.3 CONCEALED WORK INSTALLATION

- A. In Concrete:
1. Conduit: Rigid steel, IMC, or EMT. Do not install EMT in concrete slabs that are in contact with soil, gravel, or vapor barriers.
 2. Align and run conduit in direct lines.
 3. Install conduit through concrete beams only:
 - a. Where shown on the structural drawings.

- b. As approved by the //COR// //COR// prior to construction, and after submittal of drawing showing location, size, and position of each penetration.
- 4. Installation of conduit in concrete that is less than 75 mm (3 inches) thick is prohibited.
 - a. Conduit outside diameter larger than one-third of the slab thickness is prohibited.
 - b. Space between conduits in slabs: Approximately six conduit diameters apart, and one conduit diameter at conduit crossings.
 - c. Install conduits approximately in the center of the slab so that there will be a minimum of 19 mm (0.75-inch) of concrete around the conduits.
- 5. Make couplings and connections watertight. Use thread compounds that are UL approved conductive type to ensure low resistance ground continuity through the conduits. Tightening setscrews with pliers is prohibited.
- B. Above Furred or Suspended Ceilings and in Walls:
 - 1. Conduit for Conductors Above 600 V: Rigid steel or rigid aluminum. Mixing different types of conduits in the same system is prohibited.
 - 2. Conduit for Conductors 600 V and Below: Rigid steel, IMC, rigid aluminum, or EMT. Mixing different types of conduits in the same system is prohibited.
 - 3. Align and run conduit parallel or perpendicular to the building lines.
 - 4. Connect recessed lighting fixtures to conduit runs with maximum 1.8 M (6 feet) of flexible metal conduit extending from a junction box to the fixture.
 - 5. Tightening set screws with pliers is prohibited.
 - 6. For conduits running through metal studs, limit field cut holes to no more than 70% of web depth. Spacing between holes shall be at least 457 mm (18 inches). Cuts or notches in flanges or return lips shall not be permitted.

3.4 EXPOSED WORK INSTALLATION

- A. Unless otherwise indicated on drawings, exposed conduit is only permitted in mechanical and electrical rooms.
- B. Conduit for Conductors Above 600 V: Rigid steel or rigid aluminum. Mixing different types of conduits in the system is prohibited.
- C. Conduit for Conductors 600 V and Below: Rigid steel, IMC, rigid aluminum, or EMT. Mixing different types of conduits in the system is prohibited.
- D. Align and run conduit parallel or perpendicular to the building lines.
- E. Install horizontal runs close to the ceiling or beams and secure with conduit straps.
- F. Support horizontal or vertical runs at not over 2.4 M (8 feet) intervals.
- G. Surface Metal Raceways: Use only where shown on drawings.
- H. Painting:
 - 1. Paint exposed conduit as specified in Section 09 91 00, PAINTING.
 - 2. Paint all conduits containing cables rated over 600 V safety orange. Refer to Section 09 91 00, PAINTING for preparation, paint type, and exact color. In

addition, paint legends, using 50 mm (2 inch) high black numerals and letters, showing the cable voltage rating. Provide legends where conduits pass through walls and floors and at maximum 6 M (20 feet) intervals in between.

3.5 DIRECT BURIAL INSTALLATION - NOT USED

3.6 HAZARDOUS LOCATIONS

- A. Use rigid steel conduit only.
- B. Install UL approved sealing fittings that prevent passage of explosive vapors in hazardous areas equipped with explosion-proof lighting fixtures, switches, and receptacles, as required by the NEC.

3.7 WET OR DAMP LOCATIONS

- A. Use rigid steel or IMC conduits unless as shown on drawings.
- B. Provide sealing fittings to prevent passage of water vapor where conduits pass from warm to cold locations, i.e., refrigerated spaces, constant-temperature rooms, air-conditioned spaces, building exterior walls, roofs, or similar spaces.
- C. Use rigid steel or IMC conduit within 1.5 M (5 feet) of the exterior and below concrete building slabs in contact with soil, gravel, or vapor barriers, unless as shown on drawings. Conduit shall be half-lapped with 10 mil PVC tape before installation. After installation, completely recoat or retape any damaged areas of coating.
- D. Conduits run on roof shall be supported with integral galvanized lipped steel channel, attached to UV-inhibited polycarbonate or polypropylene blocks every 2.4 M (8 feet) with 9 mm (3/8-inch) galvanized threaded rods, square washer and locknut. Conduits shall be attached to steel channel with conduit clamps.

3.8 MOTORS AND VIBRATING EQUIPMENT - NOT USED

3.9 EXPANSION JOINTS

- A. Conduits 75 mm (3 inch) and larger that are secured to the building structure on opposite sides of a building expansion joint require expansion and deflection couplings. Install the couplings in accordance with the manufacturer's recommendations.
- B. Provide conduits smaller than 75 mm (3 inch) with junction boxes on both sides of the expansion joint. Connect flexible metal conduits to junction boxes with sufficient slack to produce a 125 mm (5 inch) vertical drop midway between the ends of the flexible metal conduit. Flexible metal conduit shall have a green insulated copper bonding jumper installed. In lieu of this flexible metal conduit, expansion and deflection couplings as specified above are acceptable.
- C. Install expansion and deflection couplings where shown.

3.10 CONDUIT SUPPORTS

- A. Safe working load shall not exceed one-quarter of proof test load of fastening devices.
- B. Use pipe straps or individual conduit hangers for supporting individual conduits.
- C. Support multiple conduit runs with trapeze hangers. Use trapeze hangers that are designed to support a load equal to or greater than the sum of the weights of the conduits, wires, hanger itself, and an additional 90 kg (200 lbs.). Attach each conduit with U-bolts or other approved fasteners.
- D. Support conduit independently of junction boxes, pull-boxes, fixtures, suspended ceiling T-bars, angle supports, and similar items.
- E. Fasteners and Supports in Solid Masonry and Concrete:
 - 1. New Construction: Use steel or malleable iron concrete inserts set in place prior to placing the concrete.
 - 2. Existing Construction:
 - a. Steel expansion anchors not less than 6 mm (0.25-inch) bolt size and not less than 28 mm (1.125 inch) in embedment.
 - b. Power set fasteners not less than 6 mm (0.25-inch) diameter with depth of penetration not less than 75 mm (3 inch).
 - c. Use vibration and shock-resistant anchors and fasteners for attaching to concrete ceilings.
- F. Hollow Masonry: Toggle bolts.
- G. Bolts supported only by plaster or gypsum wallboard are not acceptable.
- H. Metal Structures: Use machine screw fasteners or other devices specifically designed and approved for the application.
- I. Attachment by wood plugs, rawl plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.
- J. Chain, wire, or perforated strap shall not be used to support or fasten conduit.
- K. Spring steel type supports or fasteners are prohibited for all uses except horizontal and vertical supports/fasteners within walls.
- L. Vertical Supports: Vertical conduit runs shall have riser clamps and supports in accordance with the NEC and as shown. Provide supports for cable and wire with fittings that include internal wedges and retaining collars.

3.11 BOX INSTALLATION

- A. Boxes for Concealed Conduits:
 - 1. Flush-mounted.
 - 2. Provide raised covers for boxes to suit the wall or ceiling, construction, and finish.
- B. In addition to boxes shown, install additional boxes where needed to prevent damage to cables and wires during pulling-in operations or where more than the equivalent of 4-90-degree bends are necessary.

- C. Locate pull boxes 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.

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.

1.3 QUALITY ASSURANCE

- A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

- A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
 - 1. Shop Drawings:
 - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
 - b. Include electrical ratings, dimensions, mounting details, construction materials, grade, and termination information.
 - 2. Manuals:
 - a. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals, including technical data sheets and information for ordering replacement parts.
 - b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
 - 3. Certifications: Two weeks prior to final inspection, submit the following.
 - a. Certification by the manufacturer that the wiring devices conform to the requirements of the drawings and specifications.
 - b. Certification by the Contractor that the wiring devices have been properly installed and adjusted.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by basic designation only.
- B. National Fire Protection Association (NFPA):
- 70-14 National Electrical Code (NEC)
 - 99-15 Health Care Facilities
- C. National Electrical Manufacturers Association (NEMA):
- WD 1-10 General Color Requirements for Wiring Devices
 - WD 6-12 Wiring Devices - Dimensional Specifications
- D. Underwriter's Laboratories, Inc. (UL):
- 5-11 Surface Metal Raceways and Fittings
 - 20-10 General-Use Snap Switches
 - 231-08 Power Outlets
 - 467-13 Grounding and Bonding Equipment
 - 498-12 Attachment Plugs and Receptacles
 - 943-15 Ground-Fault Circuit-Interrupters
 - 1449-14 Surge Protective Devices
 - 1472-15 Solid State Dimming Controls

PART 2 - PRODUCTS

2.1 RECEPTACLES

- A. General: All receptacles shall comply with NEMA, NFPA, UL, and as shown on the drawings.
1. Mounting straps shall be nickel plated brass, brass, nickel plated steel or galvanize steel with break-off plaster ears, and shall include a self-grounding feature. Terminal screws shall be brass, brass plated or a copper alloy metal.
 2. Receptacles shall have provisions for back wiring with separate metal clamp type terminals (four minimum) and side wiring from four captively held binding screws.
- B. Duplex Receptacles - Hospital-grade: shall be listed for hospital grade, single phase, 20 amperes, 120 volts, 2-pole, 3-wire, NEMA 5-20R, with break-off feature for two-circuit operation.
1. Bodies shall be ivory in color.
 2. Switched duplex receptacles shall be wired so that only the top receptacle is switched. The lower receptacle shall be unswitched.
 3. Duplex Receptacles on Emergency Circuit:
 - a. In rooms without emergency powered general lighting, the emergency receptacles shall be of the self-illuminated type.
 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.

5. Tamper-Resistant Duplex Receptacles:

- a. Bodies shall be in color.
 - 1) Shall permit current to flow only while a standard plug is in the proper position in the receptacle.
 - 2) Screws exposed while the wall plates are in place shall be the tamperproof type.

C. Duplex Receptacles - Non-hospital Grade: shall be the same as duplex receptacles - hospital grade in accordance with sections 2.1A and 2.1B of this specification, except for the hospital grade listing.

- a. Bodies shall be brown nylon.

D. Receptacles - 20, 30, and 50 amperes, 250 Volts: Shall be complete with appropriate cord grip plug.

E. Weatherproof Receptacles: Shall consist of a duplex receptacle, mounted in box with a gasketed, weatherproof, cast metal cover plate and cap over each receptacle opening. The cap shall be permanently attached to the cover plate by a spring-hinged flap. The weatherproof integrity shall not be affected when heavy duty specification or hospitalgrade attachment plug caps are inserted. Cover plates on outlet boxes mounted flush in the wall shall be gasketed to the wall in a watertight manner.

F. Surge Protective (TVSS) Receptacles shall have integral surge suppression in line to ground, line to neutral, and neutral to ground modes.

1. TVSS Components: Multiple metal-oxide varistors; with a nominal clamp-level rating of 400 Volts, and minimum single transient pulse energy dissipation of 210 Joules.
2. Active TVSS Indication: LED, visible in face of device to indicate device is active or no longer in service.

G. Cable Reel Receptacles: NOT USED

2.2 TOGGLE SWITCHES

- A. Toggle switches shall be totally enclosed tumbler type with nylon bodies. Handles shall be ivory in color unless otherwise specified or shown on the drawings.
 - 1. Switches installed in hazardous areas shall be explosion-proof type in accordance with the NEC and as shown on the drawings.
 - 2. Shall be single unit toggle, butt contact, quiet AC type, heavy-duty general-purpose use with an integral self-grounding mounting strap with break-off lugs 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

- A. Electronic full-wave manual slide dimmer with on/off switch and audible frequency and EMI/RFI suppression filters.
- B. Manual dimming controls shall be fully compatible with //fluorescent electronic dimming ballasts and approved by the ballast manufacturer// //LED dimming driver and be approved by the driver manufacturer//, shall operate over full specified dimming range, and shall not degrade the performance or rated life of the electronic dimming ballast and lamp.
- C. Provide single-pole, three-way or four-way, as shown on the drawings.
- D. Manual dimming control and faceplates shall be ivory in color unless otherwise specified.

2.4 WALL PLATES

- A. Wall plates for switches and receptacles shall be type smooth nylon. Oversize plates are not acceptable.
- B. Color shall be ivory unless otherwise specified.
- C. For receptacles or switches mounted adjacent to each other, wall plates shall be common for each group of receptacles or switches.
- D. In areas requiring tamperproof wiring devices, wall plates shall be type 302 stainless steel, and shall have tamperproof screws and beveled edges.
- E. Duplex Receptacles on Emergency Circuit: Wall plates shall be red nylon with the word "EMERGENCY" engraved in 6 mm (1/4 inch) white letters. Wall plates shall be type 302 stainless steel, with the word "EMERGENCY" engraved in 6 mm (1/4 inch) red letters.

2.5 SURFACE MULTIPLE-OUTLET ASSEMBLIES

- A. Shall have the following features:
 - 1. Enclosures:
 - a. Thickness of steel shall be not less than 1 mm (0.040 inch) for base and cover. Nominal dimensions shall be 40 mm x 70 mm (1-1/2 inches by 2-3/4 inches) with inside cross-sectional area not less than 2250 square mm (3-1/2

- square inches). The enclosures shall be thoroughly cleaned, phosphatized, and painted at the factory with primer and the manufacturer's standard baked enamel finish.
2. Receptacles shall be duplex, hospital grade See paragraph 'RECEPTACLES' in this Section. Device cover plates shall be the manufacturer's standard corrosion resistant finish and shall not exceed the dimensions of the enclosure.
 3. Unless otherwise shown on drawings, receptacle spacing shall be 600 mm (24 inches) on centers.
 4. Conductors shall be as specified in Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLE.
 5. Installation fittings shall be the manufacturer's standard bends, offsets, device brackets, inside couplings, wire clips, elbows, and other components as required for a complete system.
 6. Bond the assemblies to the branch circuit conduit system.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be in accordance with the NEC and as shown as on the drawings.
- B. Install wiring devices after wall construction and painting is complete.
- C. The ground terminal of each wiring device shall be bonded to the outlet box with an approved green bonding jumper, and 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.

SECTION 27 05 11
REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

This section includes common requirements to communications installations and applies to all sections of Division 27.

Provide completely functioning communications systems.

Comply with VAAR 852.236.91 and FAR clause 52.236-21 in circumstance of a need for additional detail or conflict between drawings, specifications, reference standards or code.

1.2 REFERENCES

A. Abbreviations and Acronyms

1. Refer to <http://www.cfm.va.gov/til/sdetail.asp> for Division 00, ARCHITECTURAL ABBREVIATIONS.

2. Additional Abbreviations and Acronyms:

A	Ampere
AC	Alternating Current
AE	Architect and Engineer
AFF	Above Finished Floor
AHJ	Authority Having Jurisdiction
ANSI	American National Standards Institute
AWG	American Wire Gauge (refer to STP and UTP)
AWS	Advanced Wireless Services
BCT	Bonding Conductor for Telecommunications (also Telecommunications Bonding Conductor (TBC))
BDA	Bi-Directional Amplifier
BICSI	Building Industry Consulting Service International
BIM	Building Information Modeling
BOM	Bill of Materials
BTU	British Thermal Units
BUCR	Back-up Computer Room
BTS	Base Transceiver Station
CAD	AutoCAD
CBOPC	Community Based Out Patient Clinic
CBC	Coupled Bonding Conductor
CBOC	Community Based Out Patient Clinic (refer to CBOPC, OPC, VAMC)
CCS	TIP's Cross Connection System (refer to VCCS and HCCS)
CFE	Contractor Furnished Equipment
CFM	US Department of Veterans Affairs Office of Construction and Facilities Management

CFR	Consolidated Federal Regulations
CIO	Communication Information Officer (Facility, VISN or Region)
cm	Centimeters
CO	Central Office
COR	Contracting Officer Representative
CPU	Central Processing Unit
CSU	Customer Service Unit
CUP	Conditional Use Permit(s) - Federal/GSA for VA
dB	Decibel
dBm	Decibel Measured
dBmV	Decibel per milli-Volt
DC	Direct Current
DEA	United States Drug Enforcement Administration
DSU	Data Service Unit
EBC	Equipment Bonding Conductor
ECC	Engineering Control Center (refer to DCR, EMCR)
EDGE	Enhanced Data (Rates) for GSM Evolution
EDM	Electrical Design Manual
EMCR	Emergency Management Control Room (refer to DCR, ECC)
EMI	Electromagnetic Interference (refer to RFI)
EMS	Emergency Medical Service
EMT	Electrical Metallic Tubing or thin wall conduit
ENTR	Utilities Entrance Location (refer to DEMARC, POTS, LEC)
EPBX	Electronic Digital Private Branch Exchange
ESR	Vendor's Engineering Service Report
FA	Fire Alarm
FAR	Federal Acquisition Regulations in Chapter 1 of Title 48 of Code of Federal Regulations
FMS	VA's Headquarters or Medical Center Facility's Management Service
FR	Frequency (refer to RF)
FTS	Federal Telephone Service
GFE	Government Furnished Equipment
GPS	Global Positioning System
GRC	Galvanized Rigid Metal Conduit
GSM	Global System (Station) for Mobile
HCCS	TIP's Horizontal Cross Connection System (refer to CCS & VCCS)
HDPE	High Density Polyethylene Conduit
HDTV	Advanced Television Standards Committee High-Definition

	Digital Television
HEC	Head End Cabinets (refer to HEIC, PA)
HEIC	Head End Interface Cabinets (refer to HEC, PA)
HF	High Frequency (Radio Band; Re FR, RF, VHF & UHF)
HSPA	High Speed Packet Access
HZ	Hertz
IBT	Intersystem Bonding Termination (NEC 250.94)
IC	Intercom
ICRA	Infectious Control Risk Assessment
IDEN	Integrated Digital Enhanced Network
IDC	Insulation Displacement Contact
IDF	Intermediate Distribution Frame
ILSM	Interim Life Safety Measures
IMC	Rigid Intermediate Steel Conduit
IRM	Department of Veterans Affairs Office of Information Resources Management
ISDN	Integrated Services Digital Network
ISM	Industrial, Scientific, Medical
IWS	Intra-Building Wireless System
LAN	Local Area Network
LBS	Location Based Services, Leased Based Systems
LEC	Local Exchange Carrier (refer to DEMARC, PBX & POTS)
LED	Light Emitting Diode
LMR	Land Mobile Radio
LTE	Long Term Evolution, or 4G Standard for Wireless Data Communications Technology
M	Meter
MAS	Medical Administration Service
MATV	Master Antenna Television
MCR	Main Computer Room
MCOR	Main Computer Operators Room
MDF	Main Distribution Frame
MH	Manholes or Maintenance Holes
MHz	Megahertz (10^6 Hz)
mm	Millimeter
MOU	Memorandum of Understanding
MW	Microwave (RF Band, Equipment or Services)
NID	Network Interface Device (refer to DEMARC)
NEC	National Electric Code
NOR	Network Operations Room
NRTL	OSHA Nationally Recognized Testing Laboratory

NS	Nurse Stations
NTIA	U.S. Department of Commerce National Telecommunications and Information Administration
OEM	Original Equipment Manufacturer
OI&T	Office of Information and Technology
OPC	VA's Outpatient Clinic (refer to CBOC, VAMC)
OSH	Department of Veterans Affairs Office of Occupational Safety and Health
OSHA	United States Department of Labor Occupational Safety and Health Administration
OTDR	Optical Time-Domain Reflectometer
PA	Public Address System (refer to HE, HEIC, RPEC)
PBX	Private Branch Exchange (refer to DEMARC, LEC, POTS)
PCR	Police Control Room (refer to SPCC, could be designated SCC)
PCS	Personal Communications Service (refer to UPCS)
PE	Professional Engineer
PM	Project Manager
PoE	Power over Ethernet
POTS	Plain Old Telephone Service (refer to DEMARC, LEC, PBX)
PSTN	Public Switched Telephone Network
PSRAS	Public Safety Radio Amplification Systems
PTS	Pay Telephone Station
PVC	Poly-Vinyl Chloride
PWR	Power (in Watts)
RAN	Radio Access Network
RBB	Rack Bonding Busbar
RE	COR or Senior COR
RF	Radio Frequency (refer to FR)
RFI	Radio Frequency Interference (refer to EMI)
RFID	RF Identification (Equipment, System or Personnel)
RMC	Rigid Metal Conduit
RMU	Rack Mounting Unit
RPEC	Radio Paging Equipment Cabinets (refer to HEC, HEIC, PA)
RTLS	Real Time Location Service or System
RUS	Rural Utilities Service
SCC	Security Control Console (refer to PCR, SPCC)
SMCS	Spectrum Management and Communications Security (COMSEC)
SFO	Solicitation for Offers
SME	Subject Matter Experts (refer to AHJ)
SMR	Specialized Mobile Radio

SMS	Security Management System
SNMP	Simple Network Management Protocol
SPCC	Security Police Control Center (refer to PCR, SMS)
STP	Shielded Balanced Twisted Pair (refer to UTP)
STR	Stacked Telecommunications Room
TAC	VA's Technology Acquisition Center, Austin, Texas
TCO	Telecommunications Outlet
TER	Telephone Equipment Room
TGB	Telecommunications Grounding Busbar (also Secondary Bonding Busbar (SBB))
TIP	Telecommunications Infrastructure Plant
TMGB	Telecommunications Main Grounding Busbar (also Primary Bonding Busbar (PBB))
TMS	Traffic Management System
TOR	Telephone Operators Room
TP	Balanced Twisted Pair (refer to STP and UTP)
TR	Telecommunications Room (refer to STR)
TWP	Twisted Pair
UHF	Ultra High Frequency (Radio)
UMTS	Universal Mobile Telecommunications System
UPCS	Unlicensed Personal Communications Service (refer to PCS)
UPS	Uninterruptible Power Supply
USC	United States Code
UTP	Unshielded Balanced Twisted Pair (refer to TP and STP)
UV	Ultraviolet
V	Volts
VAAR	Veterans Affairs Acquisition Regulation
VACO	Veterans Affairs Central Office
VAMC	VA Medical Center (refer to CBOC, OPC, VACO)
VCCS	TIP's Vertical Cross Connection System (refer to CCS and HCCS)
VHF	Very High Frequency (Radio)
VISN	Veterans Integrated Services Network (refers to geographical region)
VSWR	Voltage Standing Wave Ratio
W	Watts
WEB	World Electronic Broadcast
WiMAX	Worldwide Interoperability (for MW Access)
WI-FI	Wireless Fidelity
WMTS	Wireless Medical Telemetry Service
WSP	Wireless Service Providers

B. Definitions:

1. Access Floor: Pathway system of removable floor panels supported on adjustable pedestals to allow cable placement in area below.
2. BNC Connector (BNC): United States Military Standard MIL-C-39012/21 bayonet-type coaxial connector with quick twist mating/unmating, and two lugs preventing accidental disconnection from pulling forces on cable.
3. Bond: Permanent joining of metallic parts to form an electrically conductive path to ensure electrical continuity and capacity to safely conduct any currents likely to be imposed to earth ground.
4. Bundled Microducts: All forms of jacketed microducts.
5. Conduit: Includes all raceway types specified.
6. Conveniently Accessible: Capable of being reached without use of ladders, or without climbing or crawling under or over obstacles such as, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.
7. 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. //Additional units are typically provided in facility's emergency room, designated nurses stations, director's office, Disaster Control Center, SCC, ECC.
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
 - 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)

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)

Radio FIPS 199 Standards for Security Categorization of Federal Information
and Information Systems

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, Frequency,
(Series BNC (Uncabled), Socket Contact, Jam Nut Mounted,
Class 2)

3. US Department of Health and Human Services:

The Health Insurance Portability and Accountability Act of 1996 (HIPAA) Privacy,
Security and Breach Notification Rules

4. US Department of Justice:

2010 Americans with Disabilities Act Standards for Accessible Design (ADAAD).

5. US Department of Labor, (DoL) - Public Law 426-62 - CFR, Title 29, Part
1910, Chapter XVII - Occupational Safety and Health Administration (OSHA),
Occupational Safety and Health Standards):

Subpart 7 Approved NRTLs; obtain a copy at
http://www.osha.gov/dts/otpca/nrtl/faq_nrtl.html)

Subpart 35 Compliance with NFPA 101, Life Safety Code

Subpart 36 Design and Construction Requirements for Exit Routes

Subpart 268 Telecommunications

Subpart 305 Wiring Methods, Components, and Equipment for General Use

Subpart 508 Americans with Disabilities Act Accessibility Guidelines;
technical requirement for accessibility to buildings and
facilities by individuals with disabilities

6. 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.

7. 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.

FAA, FCC, and US Department of Commerce National Telecommunications and Information Administration, "VA wide RF Co-ordination, Compliance and Licensing."

Handbook 6100 - Telecommunications: Cyber and Information Security Office of Cyber and Information Security, and Handbook 6500 - Information Security Program.

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)."

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.

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.

VA's CEOSH, concurrence with warning identified in VA Directive 7700. Wireless and Handheld Devices, "Guidelines and Compliance,"

Office of Security and Law Enforcement: VA Directive 0730 and Health Special Presidential Directive (HSPD)-12.

NRTL Standards: Refer to <https://www.osha.gov/dts/otpc/nrtl/index.html>

Canadian Standards Association (CSA); same tests as presented by UL

Communications Certifications Laboratory (CEL); same tests as presented by UL.

Intertek Testing Services NA, Inc., (ITSNA), formerly Edison Testing Laboratory
(ETL) same tests as presented by UL).

Underwriters Laboratory (UL):

1-2005 Flexible Metal Conduit
5-2011 Surface Metal Raceway and Fittings
6-2007 Rigid Metal Conduit
44-010 Thermoset-Insulated Wires and Cables
50-1995 Enclosures for Electrical Equipment
65-2010 Wired Cabinets
83-2008 Thermoplastic-Insulated Wires and Cables
96-2005 Lightning Protection Components
96A-2007 Installation Requirements for Lightning Protection Systems
360-2013 Liquid-Tight Flexible Steel Conduit
444-2008 Communications Cables
467-2013 Grounding and Bonding Equipment
486A-486B-2013 Wire Connectors
486C-2013 Splicing Wire Connectors
486D-2005 Sealed Wire Connector Systems
486E-2009 Standard for Equipment Wiring Terminals for Use with
Aluminum and/or Copper Conductors
493-2007 Thermoplastic-Insulated Underground Feeder and Branch
Circuit Cable
497/497A/497B/497C
497D/497E Protectors for Paired Conductors/Communications
Circuits/Data Communications and Fire Alarm Circuits/coaxial
circuits/voltage protections/Antenna Lead In
510-2005 Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape
514A-2013 Metallic Outlet Boxes
514B-2012 Fittings for Cable and Conduit
514C-1996 Nonmetallic Outlet Boxes, Flush-Device Boxes and Covers
651-2011 Schedule 40 and 80 Rigid PVC Conduit
651A-2011 Type EB and A Rigid PVC Conduit and HDPE Conduit
797-2007 Electrical Metallic Tubing
884-2011 Underfloor Raceways and Fittings
1069-2007 Hospital Signaling and Nurse Call Equipment
1242-2006 Intermediate Metal Conduit
1449-2006 Standard for Transient Voltage Surge Suppressors
1479-2003 Fire Tests of Through-Penetration Fire Stops
1480-2003 Speaker Standards for Fire Alarm, Emergency, Commercial and
Professional use
1666-2007 Standard for Wire/Cable Vertical (Riser) Tray Flame Tests

1685-2007 Vertical Tray Fire Protection and Smoke Release Test for
Electrical and Fiber Optic Cables

1861-2012 Communication Circuit Accessories

1863-2013 Standard for Safety, communications Circuits Accessories

1865-2007 Standard for Safety for Vertical-Tray Fire Protection and
Smoke-Release Test for Electrical and Optical-Fiber Cables

2024-2011 Standard for Optical Fiber Raceways

2024-2014 Standard for Cable Routing Assemblies and Communications
Raceways

2196-2001 Standard for Test of Fire Resistive Cable

60950-1 ed. 2-2014 .. Information Technology Equipment Safety

Industry Standards:

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

American Institute of Architects (AIA): 2006 Guidelines for Design & Construction
of Health Care Facilities.

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

American Society for Testing and Materials (ASTM):

B1 (2001) Standard Specification for Hard-Drawn Copper Wire

B8 (2004) Standard Specification for Concentric-Lay-Stranded Copper
Conductors, Hard, Medium-Hard, or Soft

D1557 (2012) Standard Test Methods for Laboratory Compaction
Characteristics of Soil Using Modified Effort 56,000 ft-
lbf/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

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

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

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

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

Facility Guidelines Institute: 2010 Guidelines for Design and Construction of Health Care Facilities.

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

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

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

602-2007 IEEE Recommended Practice for Electric Systems in Health
Care Facilities

1100-2005 IEEE Recommended Practice for Powering and Grounding
Electronic Equipment

International Code Council:

AC193 (2014) Mechanical Anchors in Concrete Elements

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

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

National Fire Protection Association (NFPA):

70E-2015 Standard for Electrical Safety in the Workplace

70-2014 National Electrical Code (NEC)

72-2013 National Fire Alarm Code

75-2013 Standard for the Fire Protection of Information
Technological Equipment

76-2012 Recommended Practice for the Fire Protection of
Telecommunications Facilities

77-2014 Recommended Practice on Static Electricity

90A-2015 Standard for the Installation of Air Conditioning and
Ventilating Systems

99-2015 Health Care Facilities Code

101-2015 Life Safety Code

241 Safeguarding construction, alternation and Demolition
Operations

255-2006 Standard Method of Test of Surface Burning Characteristics
of Building Materials

262 - 2011 Standard Method of Test for Flame Travel and Smoke of Wires
and Cables for Use in Air-Handling Spaces

780-2014 Standard for the Installation of Lightning Protection Systems

1221-2013 Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems

5000-2015 Building Construction and Safety Code

Society for Protective Coatings (SSPC):

SSPC SP 6/NACE No.3 (2007) Commercial Blast Cleaning

Society of Cable Telecommunications Engineers (SCTE):

ANSI/SCTE 15 2006 .. Specification for Trunk, Feeder and Distribution Coaxial Cable

Telecommunications Industry Association (TIA):

TIA-120 Series Telecommunications Land Mobile communications (APCO/Project 25) (January 2014)

TIA TSB-140 Additional Guidelines for Field-Testing Length, Loss and Polarity of Optical Fiber Cabling Systems (2004)

TIA-155 Guidelines for the Assessment and Mitigation of Installed Category 6 Cabling to Support 10GBASE-T (2010)

TIA TSB-162-A Telecommunications Cabling Guidelines for Wireless Access Points (2013)

TIA-222-G Structural Standard for Antenna Supporting Structures and Antennas (2014)

TIA/EIA-423-B Electrical Characteristics of Unbalanced Voltage Digital Interface Circuits (2012)

TIA-455-C General Requirements for Standard Test Procedures for Optical Fibers, Cables, Transducers, Sensors, Connecting and Terminating Devices, and other Fiber Optic Components (August 2014)

TIA-455-53-A FOTP-53 Attenuation by Substitution Measurements for Multimode Graded-Index Optical Fibers in Fiber Assemblies (Long Length) (September 2001)

TIA-455-61-A FOTP-61 Measurement of Fiber of Cable Attenuation Using an OTDR (July 2003)

TIA-472D000-B Fiber Optic Communications Cable for Outside Plant Use (July 2007)

ANSI/TIA-492-B 62.5- μ Core Diameter/125- μ m Cladding Diameter Class 1a Graded-Index Multimode Optical Fibers (November 2009)

ANSI/TIA-492AAAB-A . 50- μ m Core Diameter/125- μ m 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 Intermateability Standard (August 2008)

ANSI/TIA-606-B Administration Standard for Telecommunications Infrastructure (2012)

TIA-607-B Generic Telecommunications Bonding and Grounding (Earthing) For Customer Premises (January 2013)

TIA-613 High Speed Serial Interface for Data Terminal Equipment and Data Circuit Terminal Equipment (September 2005)

ANSI/TIA-758-B Customer-owned Outside Plant Telecommunications Infrastructure Standard (April 2012)

ANSI/TIA-854 A Full Duplex Ethernet Specification for 1000 Mb/s (1000BASE-TX) Operating over Category 6 Balanced Twisted-Pair Cabling (2001)

ANSI/TIA-862-A Building Automation Systems Cabling Standard (April 2011)

TIA-942-A Telecommunications Infrastructure Standard for Data Centers (March 2014)

TIA-1152 Requirements for Field Testing Instruments and Measurements
for Balanced Twisted Pair Cabling (September 2009)
TIA-1179 Healthcare Facility Telecommunications Infrastructure
Standard (July 2010)

1.4 SINGULAR NUMBER

- A. **Where any device or part of equipment is referred in singular number (such as " rack"), reference applies to as many such devices as are required to complete installation.**

1.5 RELATED WORK

- A. **Specification Order of Precedence: FAR Clause 52.236-21, VAAR Clause 852.236-71.**

1. Field Cutting and Patching: Section 09 91 00, PAINTING.
2. Additional submittal requirements: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
3. 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. - NOT USED
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 - NOT USED.
17. Conductors and cables for electronic safety and security systems: Section 28 05 13, - NOT USED
18. Low impedance path to ground for electronic safety and security system ground fault currents: Section 28 05 26, - NOT USED
19. Conduits and partitioned telecommunications raceways for Electronic Safety and Security systems: Section 28 05 28.33, - NOT USED
20. Physical Access Control System field-installed controllers connected by data transmission network: Section 28 13 00, - NOT USED
21. Detection and screening systems: Section 28 13 53, - NOT USED
22. Intrusion sensors and detection devices, and communication links to perform monitoring, alarm, and control functions: Section 28 16 11, - NOT USED
23. Video surveillance system cameras, data transmission wiring, and control stations with associated equipment: Section 28 23 00, - NOT USED
24. Duress-panic alarms, emergency phones or call boxes, intercom systems, data transmission wiring and associated equipment: Section 28 26 00, - NOT USED
25. Alarm initiating devices, alarm notification appliances, control units, fire safety control devices, annunciators, power supplies, and wiring: Section 28 31 00, - NOT USED
26. Emergency Call telephones, intercom systems, with blue strobe light and equipment: Section 28 52 31- NOT USED

1.6 ADMINISTRATIVE REQUIREMENTS

- A. Assign a single communications project manager to serve as point of contact for Government, contractor, and design professional.
- B. Be proactive in scheduling work.
 1. Use of premises is restricted at times directed by COR.
 2. Movement of materials: Unload materials and equipment delivered to site.
 3. Coordinate installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
 4. Sequence, coordinate, and integrate installations of materials and equipment for efficient flow of Work. 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.

5. Initiate and maintain discussion regarding schedule for ceiling construction and install cables to meet that schedule.

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 descriptions 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. 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.
- I. Provide sustainable design submittals.
- J. Furnish electronic certified test reports to COR prior to final inspection and not more than 90 days after completion of tests.

1.8 CLOSEOUT SUBMITTALS

- A. Provide following closeout submittals prior to project closeout date:
 - 1. Warranty certificate.
 - 2. Evidence of compliance with requirements such as low voltage certificate of inspection.
 - 3. Project record documents.
 - 4. Instruction manuals and software that are a part of system.
- B. Maintenance and Operation Manuals: Submit in accordance with Section 01 00 00, GENERAL REQUIREMENTS.
 - 1. Prepare a manual for each system and equipment specified.
 - 2. Furnish on portable storage drive in PDF format or equivalent accepted by COR.
 - 3. Furnish complete manual as specified in specification section, fifteen days prior to performance of systems or equipment test.
 - 4. Furnish remaining manuals prior to final completion.
 - 5. Identify storage drive "MAINTENANCE AND OPERATION MANUAL" and system name.
 - 6. Include name, contact information and emergency service numbers of each subcontractor installing system or equipment and local representatives for system or equipment.
 - 7. Provide a Table of Contents and assemble files to conform to Table of Contents.
 - 8. Operation and Maintenance Data includes:
 - a. Approved shop drawing for each item of equipment.

- b. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of equipment.
- c. A control sequence describing start-up, operation, and shutdown.
- d. Description of function of each principal item of equipment.
- e. Installation and maintenance instructions.
- f. Safety precautions.
- g. Diagrams and illustrations.
- h. Test Results and testing methods.
- i. Performance data.
- j. Pictorial "exploded" parts list with part numbers. Emphasis to be placed on use of special tools and instruments. Indicate sources of supply, recommended spare parts, and name of servicing organization.
- k. Warranty documentation indicating end date and equipment protected under warranty.
- l. Appendix; list qualified permanent servicing organizations for support of equipment, including addresses and certified personnel qualifications.

C. Record Wiring Diagrams:

- 1. Red Line Drawings: Keep one E size 91.44 cm x 121.92 cm (36 inches x 48 inches) set of floor plans, on site during work hours, showing installation progress marked and backbone cable labels noted. Make these drawings available for examination during construction meetings or field inspections.
- 2. General Drawing Specifications: Detail and elevation drawings to be D size 61 cm x 91.44 cm (24 inches x 36 inches) with a minimum scale of 0.635 cm = 30.48 cm (1/4 inch = 12 inches). ER, TR and other enlarged detail floor plan drawings to be D size 61 cm x 91.44 cm (24" x 36") with a minimum scale of 0.635 cm = 30.48 cm (1/4 inch = 12 inches). Building composite floor plan drawings to be D size 61 cm x 91.44 cm (24 inches x 36 inches) with a minimum scale of 3.175 mm = 30.48 cm (1/8 inch = 1' 0 inch).
- 3. Building Composite Floor Plans: Provide building floor plans showing work area outlet locations and configuration, types of jacks, distance for each cable, and cable routing locations.
- 4. Floor plans to include:
 - a. Final room numbers and actual backbone cabling and pathway locations and labeling.
 - b. Inputs and outputs of equipment identified according to labels installed on cables and equipment
 - c. Device locations with labels.
 - d. Conduit.
 - e. Head-end equipment.
 - f. Wiring diagram.

- g. Labeling and administration documentation.
- 5. Submit Record Wiring Diagrams within five business days after final cable testing.
- 6. Deliver Record Wiring Diagrams as CAD files in .dwg formats as determined by COR.
- 7. Deliver four complete sets of electronic record wiring diagrams to COR on portable storage drive.
- D. Service Qualifications: Submit name and contact information of service organizations providing service to this installation within eight 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 0050P2H3, OEM, contractor, and local authorities.

2.2 EQUIPMENT IDENTIFICATION

- A. Provide laminated black phenolic resin with 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 - NOT USED

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 - NOT USED

2.7 AERIAL (ABOVEGROUND) ENCLOSURES - NOT USED

2.8 TEMPORARY TIP PATHS (OVERHEAD TRACKS, ROAD/PATH BRIDGES, ETC.) - NOT USED

2.9 ACCESS PANELS - NOT USED

PART 3 - EXECUTION

3.1 PREPARATION

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 will 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 pin assignments and cabling connections are in compliance with TIA standards.
 6. Visually confirm minimum 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. Measure and record signal, aural and control carrier levels of each DAS RF, voice and data channel, at each of the following minimum points in system:

- a. Utility provider entrance.
- b. Buried conduit duct locations.
- c. Maintenance Holes (Manholes) and hand holes.
- d. ENTR or DEMARC.
- e. PBX interconnections.
- f. MCR interconnections.
- g. MCOR interconnections.
- h. TER interconnections.
- i. TOR interconnections.
- j. Control room interconnections.
- k. TR interconnections.
- l. System interfaces in locations listed herein.
- m. HE interconnections.
- n. Antenna (outside and inside) interconnections.
- o. System and lightning ground interconnections.
- p. Communications circulating ground system.
- q. UPS areas.
- r. Emergency generator interconnections.
- s. Each general floor areas.
- t. Others as required by AHJ (SMCS 0050P2H3).

3. 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 0050P2H3, (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. Individual Item Test: VACO AHJ representative (SMCS 0050P2H3) may select individual items of equipment for detailed proof of performance testing until 100 percent of system has been tested and found to meet requirements of the construction documents.
2. 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 0050P2H3) 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. , 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.

SECTION 27 05 26
GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 4 - GENERAL

4.1 DESCRIPTION

- A. This section identifies common and general grounding and bonding requirements of communication installations and applies to all sections of Divisions 27.

4.2 RELATED WORK

- A. Requirements for a lightning protection system: Section 26 41 00, FACILITY LIGHTNING PROTECTION. - NOT USED
- B. Low voltage wiring: Section 27 10 00, STRUCTURED CABLING.

4.3 SUBMITTALS

- A. Submit in accordance with Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- B. Provide plan indicating location of system grounding electrode connections and routing of aboveground and underground grounding electrode conductors.
- C. Closeout Submittals: In addition to Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS provide the following:
1. Certified test reports of ground resistance.
 2. Certifications: Two weeks prior to final inspection, submit following to COR:
 - a. Certification materials and installation is in accordance with construction documents.
 - b. Certification complete installation has been installed and tested.

PART 5 - PRODUCTS

5.1 COMPONENTS

- A. Grounding and Bonding Conductors:
1. Provide UL 83 insulated stranded copper equipment grounding conductors, with the exception of solid copper conductors for sizes 6 mm² (10 AWG) and smaller. Identify all grounding conductors with continuous green insulation color, except identify wire sizes 25 mm² (4 AWG) and larger per NEC.
 2. Provide ASTM B8 bare stranded copper bonding conductors, with the exception of ASTM B1 solid bare copper for wire sizes 6 mm² (10 AWG) and smaller.
- B. Ground Rods:
1. Copper clad steel, 19 mm (3/4-inch) diameter by 3000 mm (10 feet) long, conforming to UL 467.
 2. Provide quantity of rods required to obtain specified ground resistance.
- C. Splices and Termination Components: Provide components meeting or exceeding UL 467 and clearly marked with manufacturer's name, catalog number, and permitted conductor sizes.

D. Telecommunication System Ground Busbars:

1. Telecommunications Main Grounding Busbar (TMGB):
 - a. 6.4 mm (1/4 inch) thick solid copper bar.
 - b. Minimum 100 mm (4 inches) high and length sized in accordance application requirements and future growth of minimum 510 mm (20 inches) long.
 - c. Minimum thirty predrilled attachment points (two rows of fifteen each) for attaching standard sized two-hole grounding lugs.
 - 1) 27 lugs with 15.8 mm (5/8 inch) hole centers.
 - 2) 3 lugs with 25.4 mm (1 inch) hole centers.
 - d. Wall-mount stand-off brackets, assembly screws and insulators for 100 mm (4 inches) standoff from wall.
 - e. Listed as grounding and bonding equipment.
2. Telecommunications Grounding Busbar (TGB):
 - a. 6.4 mm (1/4 inch) thick solid copper bar.
 - b. Minimum 50 mm (2 inches) high and length sized in accordance application requirements and future growth of minimum 300 mm long (12 inches) long.
 - c. Minimum nine predrilled attachment points (one row) for attaching standard sized two-hole grounding lugs.
 - 1) 6 lugs with 15.8 mm (5/8 inch) hole centers.
 - 2) 3 lugs with 25.4 mm (1 inch) hole centers.
 - d. Wall-mount stand-off brackets, assembly screws and insulators for 100 mm (4 inches) standoff from wall.
 - e. Listed as grounding and bonding equipment.

E. Equipment Rack and Cabinet Ground Bars:

1. Solid copper ground bars designed for horizontal mounting to framework of open racks or enclosed equipment cabinets:
 - a. 4.7 mm (3/16 inch) thick by 19.1 mm (3/4 inch) high hard-drawn electrolytic tough pitch 110 alloy copper bar.
 - b. 482 mm (19 inches) or 584 mm (23 inches) EIA/ECA-310-E rack mounting width (as required) for mounting on racks or cabinets.
 - c. Eight 6-32 tapped ground mounting holes on 25.4 mm (1 inch) intervals.
 - d. Four 7.1 mm (0.281 inch) holes for attachment of two-hole grounding lugs.
 - e. Copper splice bar of same material to transition between adjoining racks.
 - f. Two each 12-24 x 19.1 mm (3/4 inch) copper-plated steel screws and flat washers for attachment to rack or cabinet.
 - g. Listed as grounding and bonding equipment.
2. Solid copper ground bars designed for vertical mounting to framework of open racks or enclosed equipment cabinets:
 - a. 1.3 mm (0.05 inch) thick by 17 mm (0.68 inch) wide tinned copper strip.

- b. 1997 mm (78 inches) high for mounting vertically on full height racks.
 - c. Holes punched on 15.875 mm-15.875 mm-12.7 mm (5/8"-5/8"-1/2") alternating vertical centers to match EIA/ECA-310-E Universal Hole Pattern for a 45 RMU rack.
 - d. Three #12-24 zinc-plated thread forming hex washer head installation screws, an abrasive pad and antioxidant joint compound.
 - e. NRTL listed as grounding and bonding equipment.
- F. Ground Terminal Blocks: Provide screw lug-type terminal blocks at equipment mounting location (e.g. backboards and hinged cover enclosures) where rack-type ground bars cannot be mounted.
- 1. Electroplated tin aluminum extrusion.
 - 2. Accept conductors ranging from #14 AWG through 2/0.
 - 3. Hold conductors in place by two stainless steel set screws.
 - 4. Two 6 mm (1/4 inch) holes spaced on 15.8 mm (5/8 inch) centers to allow secure two-bolt attachment.
 - 5. Listed as a wire connector.
- G. Splice Case Ground Accessories: Provide splice case grounding and bonding accessories manufactured by splice case manufacturer when available. Otherwise, use 16 mm² (6 AWG) insulated ground wire with shield bonding connectors.
- H. Irreversible Compression Lugs:
- 1. Electroplated tinned copper.
 - 2. Two holes spaced on 15.8 mm (5/8 inch) or 25.4 mm (1 inch) centers.
 - 3. Sized to fit the specific size conductor.
 - 4. Listed as wire connectors.
- I. Antioxidant Joint Compound: Oxide inhibiting joint compound for copper-to-copper, aluminum-to-aluminum or aluminum-to-copper connections.

PART 6 - EXECUTION

6.1 EQUIPMENT INSTALLATION AND REQUIREMENTS

- A. Exterior Equipment Grounding: Bond exterior metallic components (including masts and cabinets), antennas, satellite dishes, towers, raceways, primary telecommunications protector/arresters, secondary surge protection, waveguides, cable shields, down conductors and other conductive items to directly to Intersystem Bonding Termination.
- B. Install telecommunications bonding backbone conductor throughout building via telecommunications backbone pathways effectively bonding all interior telecommunications grounding busbars in telecommunications rooms, antenna headend equipment room, telephone operators room, main computer room, digital telephone (PBX) equipment room, VoIP active equipment room and network operations room to telecommunications main grounding busbar in Demarc room after testing bond to verify bonding conductor for telecommunications from grounding electrode conductor

is installed per NEC. Size telecommunications bonding backbone conductor as specified in TIA-607-B.

C. Inaccessible Grounding Connections: Utilize exothermic welding for bonding of buried or otherwise inaccessible connections with the exception of connections requiring periodic testing.

D. Conduit Systems:

1. Bond ferrous metallic conduit to ground.
2. Bond grounding conductors installed in ferrous metallic conduit at both ends of conduit using grounding bushing with #6 AWG conductor.

E. Boxes, Cabinets, and Enclosures:

1. Bond each pull box, splice box, equipment cabinet, and other enclosures through which conductors pass (except for special grounding systems for intensive care units and other critical units shown) to ground.
2. Raised Floors: Bonding raised floor components to ground.

F. Corrosion Inhibitors: Apply corrosion inhibitor for protecting connection between metals used to contact surfaces, when making ground and ground bonding connections.

G. Telecommunications Grounding System:

1. Bond telecommunications grounding systems and equipment to facility's electrical grounding electrode at Intersystem Bonding Termination.
2. Provide hardware as required to effectively bond metallic cable shields communications pathways, cable runway, and equipment chassis to ground.
3. Install bonding conductors without splices using shortest length of conductor possible to maintain clearances required by NEC.
4. Provide paths to ground that are permanent and continuous with a resistance of 1 ohm or less from each raceway, cable tray, and equipment connection to telecommunications grounding busbar.
5. Below-Grade Connections: When making exothermic welds, wire brush or file the point of contact to a bare metal surface. Use exothermic welding cartridges and molds in accordance with manufacturer's recommendations. After welds have been made and cooled, brush slag from weld area and thoroughly clean joint areas. Notify COR prior to backfilling at ground connections.
6. Above-Grade Bolted or Screwed Grounding Connections:
 - a. Remove paint to expose entire contact surface by grinding.
 - b. Clean all connector, plate and contact surfaces.
 - c. Apply corrosion inhibitor to surfaces before joining.
7. Bonding Jumpers:
 - a. Assemble bonding jumpers using insulated ground wire of size and type shown on drawings or use a minimum of 16 mm² (6 AWG) insulated copper wire terminated with compression connectors of proper size for conductors.
 - b. Use connector manufacturer's compression tool.

8. Bonding Jumper Fasteners:

- a. Conduit: Connect bonding jumpers using lugs on grounding bushings or clamp pads on push-type conduit fasteners. Where appropriate, use zinc-plated external tooth lockwashers or Belleville Washers.
- b. Wireway and Cable Tray: Fasten bonding jumpers using zinc-plated bolts, external tooth lockwashers or Belleville washers and nuts. Install protective cover, e.g., zinc-plated acorn nuts, on bolts extending into wireway or cable tray to prevent cable damage.
- c. Grounding Busbars: Fasten bonding conductors using two-hole compression lugs. Use 300 series stainless steel bolts, Belleville Washers, and nuts.
- d. Slotted Channel Framing and Raised Floor Stringers: Fasten bonding jumpers using zinc-plated, self-drill screws and Belleville washers or external tooth lock washers.

H. Telecommunications Room Bonding:

1. Telecommunications Grounding Busbars:

- a. Install busbar hardware no less than 950 mm (18 inches) A.F.F.
- b. Where other grounding busbars are located in same room, e.g. electrical panelboard for telecommunications equipment, bond busbars together as indicated on grounding riser diagrams.
- c. Make conductor connections with two-hole compression lugs sized to fit busbar and conductors.
- d. Attach lugs with stainless steel hardware after preparing bond according to manufacturer recommendations and treating bonding surface on busbar with anti-oxidant to help prevent corrosion.

2. Telephone-Type Cable Rack Systems:

- a. Aluminum pan installed on telephone-type cable rack serves as primary ground conductor within communications room.
- b. Make ground connections by installing bonding jumpers:
 - 1) Install minimum 16 mm² (6 AWG) bonding between telecommunications ground busbars and the aluminum pan installed on cable rack.
 - 2) Install 16 mm² (6 AWG) bonding jumpers across aluminum pan junctions.

I. Self-Supporting and Cabinet-Mounted Equipment Rack Ground Bars:

1. Install rack-mount horizontal busbar or vertical busbar to provide multiple bonding points,
2. At each rack or cabinet containing active equipment or shielded cable terminations:
 - a. Bond busbar to ground as part of overall telecommunications bonding and grounding system.
 - b. Bond copper ground bars together using solid copper splice plates manufactured by same ground bar manufacturer, when ground bars are provided at rear of lineup of bolted together equipment racks.

- c. Bond non-adjacent ground bars on equipment racks and cabinets with 16 mm² (6 AWG) insulated copper wire bonding jumpers attached at each end with compression-type connectors and mounting bolts.
 - d. Provide 16 mm² (6 AWG) bonding jumpers between rack and cabinet ground busbars and overhead cable runway or raised floor stringers, as appropriate.
- J. Backboards: Provide a screw lug-type terminal block or drilled and tapped copper strip near top of backboards used for communications cross-connect systems. Connect backboard ground terminals to cable runway using an insulated 16 mm² (6 AWG) bonding jumper.
- K. Other Communication Room Ground Systems: Ground metallic conduit, wireways, and other metallic equipment located away from equipment racks or cabinets to cable tray or telecommunications ground busbar, whichever is closer, using insulated 16 mm² (6 AWG) ground wire bonding jumpers.
- L. Communications Cable Grounding:
 - 1. Bond all metallic cable sheaths in multi-pair communications cables together at each splicing or terminating location to provide 100 percent metallic sheath continuity throughout communications distribution system.
 - 2. Install a cable shield bonding connector with a screw stud connection for ground wire, at terminal points. Bond cable shield connector to ground.
 - 3. Bond all metallic cable shields together within splice closures using cable shield bonding connectors or splice case manufacturer's splice case grounding and bonding accessories. When an external ground connection is provided as part of splice closure, connect to an effective ground source and bond all other metallic components and equipment at that location.
- M. Communications Cable Tray Systems:
 - 1. Bond metallic structures of cable tray to provide 100 percent electrical continuity throughout cable tray systems.
 - 2. Where metallic cable tray systems are mechanically discontinuous:
 - a. Install splice plates provided by cable tray manufacturer between cable tray sections so resistance across a bolted connection is 0.010 ohms or less, as verified by measuring across splice plate connection.
 - b. Install 16 mm² (6 AWG) bonding jumpers across each cable tray splice or junction where splice plates cannot be used.
 - 3. Bond cable tray installed in same room as telecommunications grounding busbar to busbar.
- N. Communications Raceway Grounding:
 - 1. Conduit: Use insulated 16 mm² (6 AWG) bonding jumpers to bond metallic conduit at both ends and intermediate metallic enclosures to ground.
 - 2. Cable Tray Systems: Use insulated 16 mm² (6 AWG) grounding jumpers to bond cable tray to column-mounted building ground plates (pads) at both ends and approximately 16 meters (50 feet) on centers.

O. Ground Resistance:

1. Install telecommunications grounding system so resistance to grounding electrode system measures 5 ohms or less.
2. Measure grounding electrode system resistance using an earth test meter, clamp-on ground tester, or computer-based ground meter as defined in IEEE 81. Record ground resistance measurements before electrical distribution system is energized.
3. Backfill only after below-grade connection have been visually inspected by COR. Notify COR twenty-four hours before below-grade connections are ready for inspection.

P. Ground Rod Installation:

1. Drive each rod vertically in earth minimum 3000 mm (10 feet) in depth.
2. Make connections by exothermic process to form solid metal joints, where permanently concealed ground connections are required. Make accessible ground connections with mechanical pressure type ground connectors.
3. Install angled ground rods or grounding electrodes in horizontal trenches to achieve specified resistance, where rock prevents driving of vertical ground rods.

6.2 FIELD QUALITY CONTROL

- A. Perform tests per BICSI's Information Technology Systems Installation Methods Manual (ITSIMM), Recommended Testing Procedures and Criteria.
- B. Perform two-point bond test using trained installers qualified to use test equipment.
- C. Conduct continuity test to verify that metallic pathways in telecommunications spaces are bonded to TGB or TMGB.
- D. Conduct electrical continuity test to verify that TMGB is effectively bonded to grounding electrode conductor.
- E. Visually inspect to verify that screened and shielded cables are bonded to TGB or TMGB.
- F. Perform a resistance test to ensure patch panel, rack and cabinet bonding connection resistance measures less than 5 Ohms to TGB or TMGB.

SECTION 27 05 33
RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS

PART 7 - GENERAL

7.1 DESCRIPTION

- A. This section specifies conduit, fittings, and boxes to form complete, coordinated, raceway systems. Raceways are required for communications cabling unless shown or specified otherwise.

7.2 RELATED WORK

- A. Bedding of conduits: Section 31 20 00, EARTH MOVING. - NOT USED
- B. Mounting board for Telecommunication Rooms: Section 06 10 00, ROUGH CARPENTRY - NOT USED
- C. Sealing around penetrations to maintain integrity of fire rated construction: Section 07 84 00, FIRESTOPPING.
- D. Fabrications for deflection of water away from building envelope at penetrations: Section 07 60 00, FLASHING AND SHEET METAL. - NOT USED
- E. Sealing around conduit penetrations through building envelope to prevent moisture migration into building: Section 07 92 00, JOINT SEALANTS. - NOT USED
- F. Identification and painting of conduit and other devices: Section 09 91 00, PAINTING.
- G. 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.

7.3 SUBMITTALS

- A. In accordance with Section 27 50 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS, submit the following:
 - 1. Size and location of cabinets, splice boxes and pull boxes.
 - 2. Layout of required conduit penetrations through structural elements.
 - 3. Catalog cuts marked with specific item proposed and area of application identified.
- B. Certification: Provide letter prior to final inspection, certifying material is in accordance with construction documents and properly installed.

PART 8 - PRODUCTS

8.1 MATERIAL

- A. Minimum Conduit Size: 19 mm (3/4 inch).
- B. Conduit:
 - 1. Rigid Galvanized Steel: Conform to UL 6, ANSI C80.1.
 - 2. Rigid Aluminum: Conform to UL 6A, ANSI C80.5.
 - 3. Rigid Intermediate Steel Conduit (IMC): Conform to UL 1242, ANSI C80.6.
 - 4. Electrical Metallic Tubing (EMT):

- a. Maximum Size: 105 mm (4 inches).
 - b. Install only for cable rated 600 volts or less.
 - c. Conform to UL 797, ANSI C80.3.
- 5. Flexible Galvanized Steel Conduit: Conform to UL 1.
 - 6. Liquid-tight Flexible Metal Conduit: Conform to UL 360.
 - 7. Direct Burial Plastic Conduit: Conform to UL 651 and UL 651A, heavy wall PVC, or high-density polyethylene (HDPE).
 - 8. Surface Metal Raceway: Conform to UL 5.
 - 9. Wireway, Approved "Basket": Provide "Telecommunications Service" rated with approved length way partitions and cable straps to prevent wires and cables from changing from one partitioned pathway to another.

C. Conduit Fittings:

- 1. Rigid Galvanized Steel and Rigid Intermediate Steel Conduit Fittings:
 - a. Provide fittings meeting requirements of UL 514B and ANSI/ NEMA FB 1.
 - b. Sealing: Provide threaded cast iron type. Use continuous drain type sealing fittings to prevent passage of water and vapor. In concealed work, install sealing fittings in flush steel boxes with blank cover plates having same finishes as other electrical plates in room.
 - c. Standard Threaded Couplings, Locknuts, Bushings, and Elbows: Only steel or malleable iron materials are acceptable. Integral retractable type IMC couplings are also acceptable.
 - d. Locknuts: Bonding type with sharp edges for digging into metal wall of an enclosure.
 - e. Bushings: Metallic insulating type, consisting of an insulating insert molded or locked into metallic body of fitting. Bushings made entirely of metal or nonmetallic material are not permitted.
 - f. Erickson (union-type) and Set Screw Type Couplings:
 - 1) Couplings listed for use in concrete are permitted for use to complete a conduit run where conduit is installed in concrete.
 - 2) Use set screws of case hardened steel with hex head and cup point to seat in conduit wall for positive ground. Tightening of set screws with pliers is prohibited.
 - g. Provide OEM approved fittings.
- 2. Rigid Aluminum Conduit Fittings:
 - a. Standard Threaded Couplings, Locknuts, Bushings, and Elbows: Malleable iron, steel or aluminum alloy materials; Zinc or cadmium plate iron or steel fittings. Aluminum fittings containing more than 0.4 percent copper are not permitted.
 - b. Locknuts and Bushings: As specified for rigid steel and IMC conduit.
 - c. Set Screw Fittings: Not permitted for use with aluminum conduit.
- 3. Electrical Metallic Tubing Fittings:

- a. Conform to UL 514B and ANSI/ NEMA FB1; only steel or malleable iron materials are acceptable.
- b. Couplings and Connectors: Concrete tight and rain tight, with connectors having insulated throats.
- 1) Use gland and ring compression type couplings and connectors for conduit sizes 50 mm (2 inches) and smaller.
- 2) Use set screw type couplings with four set screws each for conduit sizes over 50 mm (2 inches).
- 3) Use set screws of case-hardened steel with hex head and cup point to seat in wall of conduit for positive grounding.
- c. Indent type connectors or couplings are not permitted.
- d. Die-cast or pressure-cast zinc-alloy fittings or fittings made of "pot metal" are not permitted.
- e. Provide OEM approved fittings.
- 4. Flexible Steel Conduit Fittings:
 - a. Conform to UL 514B; only steel or malleable iron materials are acceptable.
 - b. Provide clamp type, with insulated throat.
 - c. Provide OEM approved fittings.
- 5. Liquid-tight Flexible Metal Conduit Fittings:
 - a. Conform to UL 514B and ANSI/ NEMA FB1; only steel or malleable iron materials are acceptable.
 - b. Fittings must incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening.
 - c. Provide connectors with insulated throats to prevent damage to cable jacket.
 - d. Provide OEM approved fittings.
- 6. Direct Burial Plastic Conduit Fittings: Provide fittings meeting requirements of UL 514C and NEMA TC3, and as recommended by conduit manufacturer.
- 7. Surface Metal Raceway: Conform to UL 5 and "telecommunications service" rated with approved length-way partitions and cable straps to prevent wires and cables from changing from one partitioned pathway to another.
- 8. Surface Metal Raceway Fittings: As recommended by raceway manufacturer.
- 9. Expansion and Deflection Couplings:
 - a. Conform to UL 467 and UL 514B.
 - b. Accommodate 19 mm (3/4 inch) deflection, expansion, or contraction in any direction, and allow 30-degree angular deflections.
 - c. Include internal flexible metal braid sized to ensure conduit ground continuity and fault currents in accordance with UL 467, and NEC code tables for ground conductors.

- d. Jacket: Flexible, corrosion-resistant, watertight, moisture and heat resistant molded rubber material with stainless steel jacket clamps.
10. Rigid Aluminum Fittings:
- a. Provide malleable iron, steel or aluminum alloy materials; zinc or cadmium plate iron or steel fittings. Aluminum fittings containing more than 0.4 percent copper are prohibited.
 - b. Locknuts and Bushings: As specified for rigid steel and IMC conduit.
 - c. Set Screw Fittings: Not permitted for use with aluminum conduit.
 - d. Indent type connectors or couplings are prohibited.
 - e. Die-cast or pressure-cast zinc-alloy fittings or fittings made of "pot metal" are not permitted.
 - f. Provide OEM approved fittings.
11. Wireway Fittings: As recommended by wireway OEM.
- D. Conduit Supports:
- 1. Parts and Hardware: Provide zinc-coat or equivalent corrosion protection.
 - 2. Individual Conduit Hangers: Designed for the purpose, having a pre-assembled closure bolt and nut, and provisions for receiving a hanger rod.
 - 3. Multiple Conduit (Trapeze) Hangers: Minimum 38 mm by 38 mm (1-1/2 by 1-1/2 inch), 2.78 mm (12 gage) steel, cold formed, lipped channels; with minimum 9 mm (3/8 inch) diameter steel hanger rods.
 - 4. Solid Masonry and Concrete Anchors: Self-drilling expansion shields, or machine bolt expansion.
- E. Outlet, Splice, and Pull Boxes:
- 1. Conform to UL-50 and UL-514A.
 - 2. Cast metal where required by NEC or shown, and equipped with rustproof boxes.
 - 3. Sheet Metal Boxes: Galvanized steel, except where otherwise shown.
 - 4. Install flush mounted wall or ceiling boxes with raised covers so that front face of raised cover is flush with wall.
 - 5. Install surface mounted wall or ceiling boxes with surface style flat or raised covers.
- F. Wireways: Equip with hinged covers, except where removable covers are shown.
- G. Warning Tape: Standard, 4-Mil polyethylene 76 mm (3 inch) wide tape detectable type, red with black letters, and imprinted with "CAUTION BURIED COMMUNICATIONS CABLE BELOW".
- H. Flexible Nonmetallic Communications Raceway (Innerduct) and Fittings:
- 1. General: Provide UL 910 listed plenum, riser, and general purpose corrugated pliable communications raceway for optical fiber cables and communications cable applications; select in accordance with provisions of NEC Articles 770 and 800.
 - 2. Provide Communications Raceway with a factory installed 567 kg (1250 lb.) tensile pre-lubricated pull tape.

3. Use only metallic straps, hangers and fittings to support raceway from building structure. Cable ties are not permitted for securing raceway to building structure.
4. Provide fittings to be installed in spaces used for environmental air made of materials that do not exceed flammability, smoke generation, 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 interduct is 75 mm (3 inches) and larger.
7. Inside Plant: Listed and marked for installation in plenum airspaces and minimum 25 mm (1 inch) inside diameter.
8. Plenum: Non-metallic communications raceway.
 - a. Constructed of low smoke emission, flame retardant PVC with corrugated construction.
 - b. UL 94 V-O rating for flame spreading limitation.
9. Provide innerduct reel lengths as necessary to ensure ducts are continuous; one piece runs from ENTR to MH; MH to MH; DEMARC to MCR/TER; TR to TR. Innerduct connectors are not permitted between rooms.
10. Provide pulling accessories used for innerduct including but not limited to, inner duct lubricants, spreaders, applicators, grips, swivels, harnesses, and line missiles (blown air) compatible with materials being pulled.

I. Outlet Boxes:

1. Flush wall mounted minimum 11.9 cm (4-11/16 inches) square, 9.2 cm (3-5/8 inches) deep pressed galvanized steel.
2. Flush wall mounted 12.7 cm (5 inches) square x 7.3 cm (2-7/8 inches); deep pressed galvanized steel.
3. 2-Gang Tile Box:
 - a. Flush backbox type for installation in block walls.
 - b. Minimum 92 mm (3-5/8 inches) deep.

J. Weatherproof Outlet Boxes: Surface mount two gang, 67 mm (2-5/8 inches) deep weatherproof cast aluminum with powder coated finish internal threads on hubs 19 mm (3/4 inch) minimum.

K. Cable Tray:

1. Provide wire basket type of sizes indicated; with all required splicing and mounting hardware.
2. Materials and Finishes:
 - a. Electro-plated zinc galvanized (post plated) made from carbon steel and plated to ASTM B 633, Type III, SC-1.
 - b. Remove soot, manufacturing residue/oils, or metallic particles after fabrication.
 - c. Rounded edges and smooth surfaces.

3. Provide continuous welded top side wire to protect cable insulation and installers.
 4. High strength steel wires formed into a 50 x 100 mm (2 inches by 4 inches) wire mesh pattern with intersecting wires welded together.
 5. Wire Basket Sizes:
 - a. Wire Diameter: 5 mm (0.195 inch) minimum on all mesh sections.
 - b. Usable Loading Depth: 105 mm (4 inch) 150 mm (6 inches).
 - c. Width: 300 mm (12 inches) 450 mm (18 inches) 600 mm (24 inches).
 6. Fittings: Field-formed, from straight sections, in accordance with manufacturer's instructions.
 7. Provide accessories to protect, support and install wire basket tray system.
- L. Cable Duct: Equip with hinged covers, except where removable covers are accepted by COR.
- M. Cable Duct Fittings: As recommended by cable duct OEM.

PART 9 - EXECUTION

9.1 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
Communications Structured Cabling	27 15 00	Conduit to Cable Tray Partitioned Cable Tray

B. Penetrations:

1. Cutting or Holes:
 - a. Locate holes in advance of installation. Where they are proposed in structural sections, obtain approval of structural engineer and COR prior to drilling through structural sections.
 - b. Make holes through concrete and masonry in new and existing structures with a diamond core drill or concrete saw. Pneumatic hammer, impact electric, hand or manual hammer type drills are not permitted; COR may grant limited permission by request, in condition of limited working space.
 - c. Fire Stop: Where conduits, wireways, and other communications raceways pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING.
- 1) Fill and seal clearances between raceways and openings with fire stop material.
- 2) Install only retrofittable, non-hardening, and reusable firestop material that can be removed and reinstalled to seal around cables inside conduits.

d. Waterproofing at Floor, Exterior Wall, and Roof Conduit Penetrations:

- 1) Seal clearances around conduit and make watertight as specified in Section 07 92 00, JOINT SEALANTS or directed by waterproofing manufacturer.

C. Conduit Installation:

1. Minimum conduit size of 19 mm (3/4 inch), but not less than size required for 40 percent fill.
2. Install insulated bushings on all conduit ends.
3. Install pull boxes after every 180 degrees of bends (two 90-degree bends). Size boxes per TIA 569.
4. Extend vertical conduits/sleeves through floors minimum 75 mm (3 inches) above floor and minimum 75 mm (3 inches) below ceiling of floor below.
5. Terminate conduit runs to and from a backboard in a closet or interstitial space at top or bottom of backboard. Install conduits to enter telecommunication rooms next to wall and flush with backboard.
6. Where drilling is necessary for vertical conduits, locate holes so as not to affect structural sections.
7. Seal empty conduits located in telecommunications rooms or on backboards with a standard non-hardening putty compound to prevent entrance of moisture and gases and to meet fire resistance requirements.
8. Minimum radius of communication conduit bends:

Sizes of Conduit Trade Size	Radius of Conduit Bends mm, Inches
3/4	150 (6)
1	230 (9)
1-1/4	350 (14)
1-1/2	430 (17)
2	525 (21)
2-1/2	635 (25)
3	775 (31)
3-1/2	900 (36)
4	1125 (45)

9. Provide 19 mm (3/4 inch) thick fire-retardant plywood specified in Section 06 10 00, ROUGH CARPENTRY on wall of communication closets where shown on drawings. Mount plywood with bottom edge 300 mm (12 inches) above finished floor and top edge 2.74 m (9 feet) A.F.F.
10. Provide pull wire in all empty conduits; sleeves through floor are exceptions.
11. Complete each entire conduit run installation before pulling in cables.
12. Flattened, dented, or deformed conduit is not permitted.

13. Ensure conduit installation does not encroach into ceiling height head room, walkways, or doorways.
14. Cut conduit square with a hacksaw, ream, remove burrs, and draw tight.
15. Install conduit mechanically continuous.
16. Independently support conduit at 2.44 m (8 feet) on center; do not use other supports (i.e., suspended ceilings, suspended ceiling supporting members, luminaires, conduits, mechanical piping, or mechanical ducts).
17. Support conduit within 300 mm (1 foot) of changes of direction, and within 300 mm (1 foot) of each enclosure to which connected.
18. Close ends of empty conduit with plugs or caps to prevent entry of debris, until cables are pulled in.
19. Conduit installations under fume and vent hoods are prohibited.
20. 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.
21. Do not use aluminum conduits in wet locations.
22. Unless otherwise indicated on drawings or specified herein, conceal conduits within finished walls, floors and ceilings.
23. 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.
24. 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, 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. Surface Metal Raceways: Use only where shown on drawings.
 6. Painting:
 - a. Paint exposed conduit as specified in Section 09 91 00, PAINTING.
 - b. Refer to Section 09 91 00, PAINTING for preparation, paint type, and exact color.
 - c. Provide labels where conduits pass through walls and floors and at maximum 6000 mm (20 foot) intervals in between.
- 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: - NOT USED
- 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.
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 supports from building structure for horizontal runs at intervals not to exceed 900 mm (3 feet) and at each end.
2. Install supports from building structure for vertical runs at intervals not to exceed 1.2 m (4 feet) and at each side of joints.
3. Install only in accessible spaces not subject to physical damage or corrosive influences.
4. Make bends manually to assure internal diameter of tubing is not effectively reduced.
5. Extend each segment of innerduct minimum 300 mm (12 inches) beyond end of service conduit tie or cable tray. Restrain innerduct ends with wall mount clamps and seal when cable is installed.

9.2 TESTING

- A. Examine fittings and locknuts for secureness.
- B. Test RMC, IMC and EMT systems for electrical continuity.
- C. Perform simple continuity test after cable installation.

SECTION 27 08 00
COMMISSIONING OF COMMUNICATIONS SYSTEMS

PART 10 - GENERAL

10.1 DESCRIPTION

- A. This section includes requirements for commissioning facility communications systems, related subsystems and related equipment. This Section supplements general requirements specified in Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.
- B. Complete list of equipment and systems to be commissioned is specified in Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS and Specification 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- C. Commissioned Systems:
 - 1. Commissioning of systems specified in Division 27 is part of project's construction process including documentation and proof of performance testing of these systems, as well as training of VA's Operation and Maintenance personnel in accordance with requirements of Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS and Division 27, in cooperation with Government and Commissioning Agent.
 - 2. The facility exterior closure systems commissioning includes communications systems listed in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS and 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.

10.2 RELATED WORK

- A. System tests: Section 01 00 00, GENERAL REQUIREMENTS.
- B. Commissioning process requires review of selected submittals that pertain to systems to be commissioned: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- C. Construction phase commissioning process and procedures including roles and responsibilities of commissioning team members and user training: Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

10.3 COORDINATION

- A. Commissioning Agent will provide a list of submittals that must be reviewed by Commissioning Agent simultaneously with engineering review; do not proceed with work of sections identified without engineering and Commissioning Agent's review completed.
- B. Commissioning of communications systems require inspection of individual elements of communications system construction throughout construction period. Coordinate with Commissioning Agent in accordance with Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS and commissioning plan to schedule communications systems inspections as required to support the commissioning process.

10.4 CLOSEOUT SUBMITTALS

- A. Refer to Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for pre-functional checklists, equipment startup reports, and other commissioning documents.
- B. Pre-Functional Checklists:
 - 1. Complete pre-functional checklists provided by commissioning agent to verify systems, subsystems, and equipment installation is complete and systems are ready for Systems Functional Performance Testing.
 - 2. Submit completed checklists to COR and to Commissioning Agent.
Commissioning Agent can spot check a sample of completed checklists. If Commissioning Agent determines that information provided on the checklist is not accurate, Commissioning Agent then returns the marked-up checklist to Contractor for correction and resubmission.
 - 3. If Commissioning Agent determines that a significant number of completed checklists for similar equipment are not accurate, Commissioning Agent can select a broader sample of checklists for review.
 - 4. If Commissioning Agent determines that a significant number of broader sample of checklists is also inaccurate, all checklists for the type of equipment will be returned to Contractor for correction and resubmission.
- C. Submit training agendas and trainer resumes in accordance with requirements of Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

PART 11 - PRODUCTS - NOT USED

PART 12 - EXECUTION

12.1 FIELD QUALITY CONTROL

- A. Contractor's Tests:
 - 1. Scheduled tests required by other sections of Division 27 must be documented in accordance with Section 01 00 00, GENERAL REQUIREMENTS.
 - 2. Incorporate all testing into project schedule. Provide minimum seven calendar days' notice of testing for Commissioning Agent to witness selected Contractor tests at sole discretion of Commissioning Agent.
 - 3. Complete tests prior to scheduling Systems Functional Performance Testing.
- B. Systems Functional Performance Testing:
 - 1. 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.
 - 2. Commissioning Agent prepares detailed Systems Functional Performance Test procedures for review and acceptance by COR.
 - 3. Provide required labor, materials, and test equipment identified in test procedure to perform tests.

4. Commissioning Agent must witness and document the testing.

- a. Provide test reports to Commissioning Agent. Commissioning Agent will sign test reports to verify tests were performed.

12.2 TRAINING

- A. Training of Government's operation and maintenance personnel is required in cooperation with COR and Commissioning Agent.
- B. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning location, operation, and troubleshooting of installed systems.
- C. Schedule instruction in coordination with COR after submission and approval of formal training plans.

SECTION 27 15 00
COMMUNICATIONS STRUCTURED CABLING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies a complete and operating wireless network structured cabling distribution system and associated equipment and hardware to be installed in Huntington VA Medical Center, here-in-after referred to as the "facility".

1.2 RELATED WORK

- A. Wiring devices: Section 26 27 26, WIRING DEVICES.
- B. General electrical requirements that are common to more than one section in Division 27: Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- C. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.
- D. Conduits for cables and wiring: Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS.

1.3 SUBMITTALS

- A. In addition to requirements of Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS provide:
 - 1. Pictorial layout drawing of each network operations room showing termination cabinets, each distribution cabinet and rack, as each is expected to be installed and configured.
 - 2. List of test equipment as per 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- B. Certifications:
 - 1. Submit written certification from OEM indicating that proposed supervisor of installation and proposed provider of contract maintenance are authorized representatives of OEM. Include individual's legal name and address and OEM warranty credentials in the certification.
 - 2. Pre-acceptance Certification: Submit in accordance with test procedures.
 - 3. Test system cables and certify to COR before proof of performance testing can be conducted. Identify each cable as labeled on as-installed drawings.

4. Provide current and qualified test equipment OEM training certificates and product OEM installation certification for contractor installation, maintenance, and supervisory personnel.
- C. Closeout Submittal: Provide document from OEM certifying that each item of equipment installed conforms to OEM published specifications.

1.4 WARRANTY

- A. Work subject to terms of Article "Warranty of Construction," FAR clause 52.246-21.

PART 2 - PRODUCTS

2.1 PERFORMANCE AND DESIGN CRITERIA

- A. Provide complete wireless system including distribution sub-systems, and associated hardware including copper distribution cables, connectors, "patch" cables, and "break out" devices.
- B. Industry Standards:
 1. Cable distribution systems provided under this section are connected to systems identified as critical care performing life support functions.
 2. Conform to National and Local Life Safety Codes (whichever are more stringent), NFPA, NEC, this section, Joint Commission Life Safety Accreditation requirements, and OEM recommendations, instructions, and guidelines.
 3. Provide supplies and materials listed by a nationally recognized testing laboratory where such standards are established for supplies, materials or equipment.
 4. Refer to industry standards and minimum requirements of Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS and guidelines listed.
 5. Active and passive equipment required by system design and approved technical submittal; must conform to each UL standard in effect for equipment, when technical submittal was reviewed and approved by Government or date when COR accepted system equipment to be replaced. Where a UL standard is in existence for equipment to be used in completion of this contract, equipment must bear approved NRTL label.
- C. System Performance: Provide complete system to meet or exceed TIA Category 6 requirements.

- D. Provide continuous intra-facility wireless service.
 - 1. Provide wireless cable distribution system based on a physical "Star" topology.
 - 2. Contact SMCS 0050P2H3 (202-462-5310) for specific technical assistance and approvals.
- E. Specific Subsystem Requirements: Provide products necessary for a complete and functional wireless communications cabling system, including cross-connections, horizontal cabling systems, and patch cords.
- F. Coordinate size and type of conduit, pathways and firestopping for maximum 40 percent cable fill with subcontractors.
- G. Terminate all interconnecting twisted pair cables on patch panels. Terminate unused or spare conductors. Do not leave unused or spare twisted pair wire unterminated, unconnected, loose or unsecured.
- H. Color code distribution wiring to conform to ANSI/TIA 606-B and construction documents, whichever is more stringent. Label all equipment, conduit, and cables on record drawings, to facilitate installation and maintenance.

2.2 EQUIPMENT AND MATERIALS

- A. Cable Systems - Twisted Pair:
 - 1. General:
 - a. Provide cable (i.e. horizontal cabling) conforming to accepted industry standards with regards to size, color code, and insulation.
 - b. Some areas can be considered "plenum". Comply with all codes pertaining to plenum environments. It is contractor's responsibility to review the VA's cable requirements with COR and OI&T Service prior to installation to confirm type of environment present at each location.
 - c. Provide proper test equipment to confirm that cable pairs meet each OEM's standard transmission requirements, and ensure cable carries data transmissions at required speeds, frequencies, and fully loaded bandwidth.
 - 2. Telecommunications Rooms (TR): Provide connecting cables required to extend backbone cables (i.e. patch cords, twenty-five pair, etc.), to ensure complete and operational distribution systems.
 - 3. Horizontal Cable: Installed from wireless access point to the TR patch panel.

- a. Tested to ANSI/TIA-568-C.2 Category 6 requirements including NEXT, ELFEXT (Pair-to-Pair and Power Sum), Insertion Loss (attenuation), Return Loss, and Delay Skew.
 - b. Minimum Transmission Parameters: 250 MHz.
 - c. Provide four pair 0.205 mm² (24 AWG) cable
 - d. Terminate all four pairs on same port at patch panel in TR.
 - e. Terminate all four pairs in same connector at wireless access point.
 - 1) Connectors: Eight-pin RJ-45 ANSI/TIA-568-C.2 Category 6 Type connectors compatible with Ethernet port on wireless access point.
- B. Cross-Connect Systems (CCS):
 - 1. Copper Cables: Provide copper CCS sized to connect cables at TR and allow for a minimum of 50 percent anticipated growth.
 - 2. Maximum DC Resistance per Cable Pair: 28.6 Ohms per 305 m (1,000 feet).
- C. Telecommunication Room (TR): Terminate horizontal copper cables on appropriate cross-connection systems (CCS) containing patch panels and breakout devices provided in enclosures and tested, regardless of installation method, mounting, termination, or cross-connecting used. Provide cable management system as a part of each CCS.
- D. Main Cross-connection Subsystem (MCCS): MCCS is common point of distribution for intra-building copper and fiber optic backbone system cables, and connections to the wireless network cable systems.
- E. Data Cross-Connection Subsystems: Provide patch cords for each system pair of connection jacks with modular RJ45 connectors provided on each end to match panel's modular RJ45 female jack's.
- F. Horizontal Cabling (HC):
 - 1. Horizontal cable length to farthest system wireless access point to be maximum of 90 m (295 ft.).
 - 2. Splitting of pairs within a cable between different devices is not permitted.

2.3 DISTRIBUTION EQUIPMENT AND SYSTEMS

- A. System Connectors:
 - 1. Modular (RJ-45): Provide high speed data transmission applications type modular plugs compatible with wireless access points and other type devices requiring linking to the system compatible with UTP cables.

- a. Technical Characteristics:
 - 1) Number of Pins:
 - a) RJ-45: Eight.
 - 2) Dielectric: Surge.
 - 3) Voltage: Minimum 1,000V RMS, 60 Hz at one minute.
 - 4) Current: 2.2A RMS at 30 minutes or 7.0A RMS at 5.0 seconds.
 - 5) Leakage: Maximum 100 μ A.
 - 6) Connections:
 - a) Initial contact resistance: Maximum 20 milli-Ohms.
 - b) Insulation displacement: Maximum 10 milli-Ohms.
 - c) Interface: Must interface with modular jacks from a variety of OEMs.
 - d) Durability: Minimum 200 insertions/withdrawals.
- B. Conduit and Signal Ducts:
 - 1. Conduit:
 - a. Provide conduit or sleeves for cables penetrating walls, ceilings, floors, interstitial space, fire barriers, etc.
 - b. Minimum Conduit Size: 25 mm (1 inch).
 - c. Provide separate conduit and signal ducts for each cable type installation.
 - d. When metal (plastic covered, flexible cable protective armor, etc.) systems are authorized to be provided for use in system, follow installation guidelines and standard specified in Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS and NEC.
 - e. Maximum 40 percent conduit fill for cable installation.
 - 2. Signal Duct, Cable Duct, or Cable Tray: Use existing signal duct, cable duct, and cable tray, when identified and accepted by COR.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install for ease of operation, maintenance, and testing.
- B. Install system to comply with NFPA 70 National Electrical Code, NFPA 99 Health Care Facilities, NFPA 101 Life Safety Code, Joint Commission Manual for Health Care Facilities, and original equipment manufacturers' (OEM) installation instructions.
- C. Cable Systems Installation:
 - 1. Install system cables in cable duct, cable tray, cable runway, J-hooks, conduit or when specifically approved, flexible NEC Article 800 communications raceway. Confirm drawings show sufficient

quantity and size of cable pathways. If flexible communications raceway is used, install in same manner as conduit.

2. Bond to ground metallic cable sheaths, etc. (i.e. horizontal, etc.).

D. Labeling:

1. Industry Standard: Provide labeling in accordance with ANSI/TIA-606-B.
2. Print lettering of labels with laser printers; handwritten labels are not acceptable.
3. Label both ends of all cables in accordance with industry standard. Provide permanent Labels in contrasting colors and identify according to system "Record Wiring Diagrams".
4. Termination Hardware: Label wireless access points and patch panel connections using color coded labels with identifiers in accordance with industry standard and record on "Record Wiring Diagrams".

3.2 FIELD QUALITY CONTROL

A. Interim Inspection:

1. Verify that equipment provided adheres to installation requirements of this section. Interim inspection must be conducted by a factory-certified representative and witnessed by COR.
2. Check each item of installed equipment to ensure appropriate NRTL label.
3. Verify cabling terminations in telecommunications rooms and at workstations adhere to color code for T568B pin assignments and cabling connections comply with TIA standards.
4. Visually confirm marking of cables, patch panel connectors and patch cords.
5. Notify COR of the estimated date the contractor expects to be ready for interim inspection, at least 20 working days before requested inspection date, so interim inspection does not affect systems' completion date.
6. Provide results of interim inspection to COR. If major or multiple deficiencies are discovered, COR can require a second interim inspection before permitting contractor to continue with system installation.
7. Do not proceed with installation until COR determines if an additional inspection is required. In either case, re-inspection of deficiencies noted during interim inspections must be part of the proof of performance test.

B. Pretesting:

1. Pretest entire system upon completion of system installation.
2. Verify during system pretest, utilizing the accepted equipment, that system is fully operational and meets system performance requirements of this section.
3. Provide COR four copies of recorded system pretest measurements and the written certification that system is ready for formal acceptance test.

C. Acceptance Test:

1. After system has been pretested and the contractor has submitted pretest results and certification to COR, then schedule an acceptance test date and give COR 30 days' written notice prior to date acceptance test is expected to begin.
2. Test only in presence of a COR.
3. Test utilizing approved test equipment to certify proof of performance.
4. Verify that total system meets the requirements of this section.
5. Include expected duration of test time, with notification of the acceptance test.

D. Verification Tests: Test UTP copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors, and between conductors and shield, if cable has an overall shield. Test cables after termination and prior to cross-connection.

E. Performance Testing: Perform Category 6 tests in accordance with TIA-568-B.1 and TIA-568-B.2. Include the following tests - wire map, length, insertion loss, return loss, NEXT, PSNEXT, ELFEXT, PSELFEXT, propagation delay and delay skew.

F. Total System Acceptance Test: Perform verification tests for UTP copper cabling systems after complete wireless network distribution system is installed.

3.3 MAINTENANCE

A. Accomplish the following minimum requirements during one-year warranty period:

1. Respond and correct on-site trouble calls, during standard work week:
 - a. A routine trouble call within one working day of its report. A routine trouble is considered a trouble which causes a system device or patch cord to be inoperable.

- b. Standard work week is considered 8:00 A.M. to 5:00 P.M., Monday through Friday exclusive of Federal holidays.
- 2. Respond to an emergency trouble call within six hours of its report. An emergency trouble is considered a trouble which causes a subsystem or distribution point to be inoperable at any time.
- 3. Respond on-site to a catastrophic trouble call within four hours of its report. A catastrophic trouble call is considered total system failure.
 - a. If a system failure cannot be corrected within four hours (exclusive of standard work time limits), provide alternate equipment, or cables within four hours after four-hour trouble shooting time.
 - b. Routine or emergency trouble calls in critical emergency health care facilities (i.e., cardiac arrest, intensive care units, etc.) are also be deemed as a catastrophic trouble.
- 4. Provide COR written report itemizing each deficiency found and the corrective action performed during each official reported trouble call. Provide COR with sample copies of reports for review and approval at beginning of total system acceptance test.