CONSTRUCTION DOCUMENTS (100%)

SPECIFICATIONS

VOLUME I
DIV 00 – DIV 22

RENOVATE SPS SPACE
Project No. 534-24-102

Department of Veterans Affairs
Robert H. Johnson VA Health Care System
Charleston, SC

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December 12, 2025

PROFESSIONAL REGISTRATIONS & ACCREDITATIONS

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ENGINEER OF RECORD / MECHANICAL ENGINEERING	ELECTRICAL ENGINEERING	STRUCTURAL ENGINEERING

LICENSED PROFESSIONAL ENGINEER KEVIN FEAK FP 2304 FIRE PROTECTION STATE OF CALIFORNIA	STATE OF SOUTH CAROLINA LAWRENCE C. WITKOWSKI CHARLOTTE, NC 7559 REGISTERED ARCHITECT	STATE OF MARYLAND THOMAS C. KANE 54025 PROFESSIONAL ENGINEER 12 / 12 / 2025
LIFE SAFETY	ARCHITECTURE	FIRE SUPPRESSION / FIRE ALARM

Department of Veterans Affairs
Ralph H. Johnson VA Health Care System
Charleston, SC

VA Project No.534-24-102
Renovate SPS Spaces
Construction Documents (100%): 12/12/2025

06-01-24

DEPARTMENT OF VETERANS AFFAIRS
VHA MASTER SPECIFICATIONS

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GC131	PARTIAL ICRA PLAN - 3RD FLOOR
STRUCTURAL	
S-001	GENERAL NOTES & ABBREVIATIONS
S-141	PARTIAL ROOF FRAMING PLAN
S-501	SECTIONS & DETAILS
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LS102	LIFE SAFETY CODE DATA
LS111	CONSTRUCTION ACCESS PLAN 1ST FLOOR
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AE132	NEW WORK PLAN - PARTIAL 3RD FLOOR
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MECHANICAL

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M-002	NOTES & CONDITIONS
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M-121	NEW WORK PLAN - 2ND FLOOR MECHANICAL ROOM
M-131	NEW WORK PLAN - PARTIAL 3RD FLOOR
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ELECTRICAL

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11-01-21

SECTION 01 00 00
GENERAL REQUIREMENTS

GENERAL

1.1 SAFETY REQUIREMENTS

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

1.2 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 the Charleston VAMC Renovate SPS Project 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’s Representative (COR).

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

D. Before placement and installation of work subject to tests by testing laboratory retained by Department of Veterans Affairs, the Contractor shall notify the COR in sufficient time to enable testing laboratory personnel to be present at the site in time for proper taking and testing of specimens and field inspection. Such prior notice shall be not less than three workdays unless otherwise designated by the COR.

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

1.3 STATEMENT OF BID ITEM(S)

A. ITEM I, GENERAL CONSTRUCTION: Work includes general construction to renovate existing rooms AA304 Temp SPS, AA305, AA305A, BB320 Breakout and Receiving, BB321 Bulk Storage and adjacent corridor COR3AA-3, and COR3AA-2 to create a new Sterilization, Processing, and Distribution Space (SPS.)

1.4 SPECIFICATIONS AND DRAWINGS FOR CONTRACTOR

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

1.5 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. Before starting work the General Contractor shall give one week’s 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. Patients and staff are not to be photographed at any time.
4. VA reserves the right to close down or shut down the project site and order General Contractor’s employees off the premises in the event of a national emergency. The General Contractor may return to the site only with the written approval of the Contracting Officer.

C. Key Control:

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

2. The General Contractor shall install all permanent cores at completion of the work. See Section 08 71 00, DOOR HARDWARE and coordinate.

D. Document Control:

1. Before starting any work, the General Contractor/Sub Contractors shall submit an electronic security memorandum describing the approach to following goals and maintaining confidentiality of "sensitive information".
2. The General Contractor is responsible for safekeeping of all drawings, project manual and other project information. This information shall be shared only with those with a specific need to accomplish the project.
3. Certain documents, sketches, videos or photographs and drawings may be marked "Law Enforcement Sensitive" or "Sensitive Unclassified". Secure such information in separate containers and limit the access to only those who will need it for the project. Return the information to the Contracting Officer upon request.
4. These security documents shall not be removed or transmitted from the project site without the written approval of Contracting Officer.
5. All paper waste or electronic media such as CD's and diskettes shall be shredded and destroyed in a manner acceptable to the VA.
6. Notify Contracting Officer and Site Security Officer immediately when there is a loss or compromise of "sensitive information".
7. All electronic information shall be stored in specified location following VA standards and procedures using an Engineering Document Management Software (EDMS).
   a) Security, access and maintenance of all project drawings, both scanned and electronic shall be performed and tracked through the EDMS system.
   b) "Sensitive information" including drawings and other documents may be attached to e-mail provided all VA encryption procedures are followed.

E. 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. An unlimited number of permits shall be issued for General Contractor and its employees for parking in designated areas only. Contractor to coordinate with VA Medical Center Facility Manager.

1.6 OPERATIONS AND STORAGE AREAS (FAR 52.236-10)

A. The Contractor shall confine all operations (including storage of materials) on Government premises to areas authorized or approved by the Contracting Officer. The Contractor shall hold and save the Government, its officers and agents, free and harmless from liability of any nature occasioned by the Contractor's performance.

B. Temporary buildings (e.g., storage sheds, shops, offices) and utilities may be erected by the Contractor only with the approval of the Contracting Officer and shall be built with labor and materials furnished by the Contractor without expense to the Government. The temporary buildings and utilities shall remain the property of the Contractor and shall be removed by the Contractor at its expense upon completion of the work. With the written consent of the Contracting Officer, the buildings and utilities may be abandoned and need not be removed.

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

D. Working space and space available for storing materials shall be as shown on the drawings.

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

F. Execute work in such a manner as to interfere as little as possible with work being done by others. Keep roads clear of construction materials, debris, standing construction equipment and vehicles at all times.

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

1. Do not store materials and equipment in other than assigned areas.
2. Provide unobstructed access to the Medical Center areas required to remain in operation.
3. Where access by Medical Center personnel to vacated portions of buildings is not required, storage of Contractor's materials and equipment will be permitted subject to fire and safety requirements.

H. Phasing:

1. The Medical Center must maintain its operation 24 hours a day 7 days a week. Therefore, any interruption in service must be scheduled and coordinated with the COR to ensure that no lapses in operation occur. It is the CONTRACTOR'S responsibility to develop a work plan and schedule detailing, at a minimum, the procedures to be employed, the equipment and materials to be used, the interim life safety measure to be used during the work, and a schedule defining the duration of the work with milestone subtasks. The work to be outlined shall include, but not be limited to:
2. To ensure such executions, Contractor shall furnish the COR with a schedule of approximate phasing dates on which the Contractor intends to accomplish work in each specific area of site, building or portion thereof. In addition, Contractor shall notify the COR two weeks in advance of the proposed date of starting work in each

specific area of site, building or portion thereof. Arrange such phasing dates to ensure accomplishment of this work in successive phases mutually agreeable to the COR and Contractor.

I. The Hospital Building will be occupied during performance of work; but immediate areas of alterations will be vacated.

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

J. 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.

K. When a building and/or construction site is turned over to Contractor, Contractor shall accept entire responsibility including upkeep and maintenance therefore:

1. Contractor shall maintain a minimum temperature of 4 degrees C (40 degrees F) at all times, except as otherwise specified.
2. Contractor shall maintain in operating condition existing fire protection and alarm equipment. In connection with fire alarm

equipment, Contractor shall make arrangements for pre-inspection of site with 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.

L. Utilities Services: Maintain existing utility services for the 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 the COR. Electrical work shall be accomplished with all affected circuits or equipment de-energized. When an electrical outage cannot be accomplished, work on any energized circuits or equipment shall not commence without a detailed work plan, the Medical Center Director’s prior knowledge and written approval. Refer to specification Sections 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, 27 05 11 REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS and 28 05 00, COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY for additional requirements.
2. Contractor shall submit a request to interrupt any such services to the COR, in writing, 7 days in advance of proposed interruption. Request shall state reason, date, exact time of, and approximate duration of such interruption.
3. Contractor will be advised (in writing) of approval of request, or of which other date and/or time such interruption will cause least inconvenience to operations of the 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.

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

N. 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.
2. Method and scheduling of required cutting, altering and removal of existing roads, walks and entrances must be approved by the COR.

O. Coordinate the work for this contract with other construction operations as directed by the 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 a representative of VA Supply Service, of areas of buildings in which alterations occur and areas which are anticipated routes of access, and furnish a report, signed by both, to the Contracting Officer. This report shall list by rooms and spaces:

1. Existing condition and types of resilient flooring, doors, windows, walls and other surfaces not required to be altered throughout affected areas of building.
2. Existence and conditions of items such as plumbing fixtures and accessories, electrical fixtures, equipment, venetian blinds, shades, etc., required by drawings to be either reused or relocated, or both.
3. Shall note any discrepancies between drawings and existing conditions at site.
4. Shall designate areas for working space, materials storage and routes of access to areas within buildings where alterations occur and which have been agreed upon by Contractor and 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 the 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 will be modified accordingly, under provisions of clause entitled "DIFFERING SITE CONDITIONS" (FAR 52.236-2) and "CHANGES" (FAR 52.243-4).

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

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

D. Protection: Provide the following protective measures:

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

1.8 DISPOSAL AND RETENTION

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

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

1.9 PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES, AND IMPROVEMENTS (FAR 52.236-9)

A. The Contractor shall preserve and protect all structures, equipment, and vegetation (such as trees, shrubs, and grass) on or adjacent to the work site, which are not to be removed and which do not unreasonably

interfere with the work required under this contract. The Contractor shall only remove trees when specifically authorized to do so, and shall avoid damaging vegetation that will remain in place. If any limbs or branches of trees are broken during contract performance, or by the careless operation of equipment, or by workers, the Contractor shall trim those limbs or branches with a clean cut and paint the cut with a tree-pruning compound as directed by the Contracting Officer.

B. The Contractor shall protect from damage all existing improvements and utilities at or near the work site and on adjacent property of a third party, the locations of which are made known to or should be known by the Contractor. The Contractor shall repair any damage to those facilities, including those that are the property of a third party, resulting from failure to comply with the requirements of this contract or failure to exercise reasonable care in performing the work. If the Contractor fails or refuses to repair the damage promptly, the Contracting Officer may have the necessary work performed and charge the cost to the Contractor.

C. Refer to Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS, for additional requirements on protecting vegetation, soils and the environment. Refer to Articles, "Alterations", "Restoration", and "Operations and Storage Areas" for additional instructions concerning repair of damage to structures and site improvements.

1.10 RESTORATION

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

B. Upon completion of contract, deliver work complete and undamaged. Existing work (walls, ceilings, partitions, floors, mechanical and electrical work, lawns, paving, roads, walks, etc.) disturbed or

removed as a result of performing required new work, shall be patched, repaired, reinstalled, or replaced with new work, and refinished and left in as good condition as existed before commencing work.

C. At Contractor's own expense, Contractor shall immediately restore to service and repair any damage caused by Contractor's workers to existing piping and conduits, wires, cables, etc., of utility services or of fire protection systems and communications systems (including telephone) which are not scheduled for discontinuance or abandonment. 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 "DIFFERING SITE CONDITIONS" (FAR 52.236-2).

1.11 AS-BUILT DRAWINGS

A. The contractor shall maintain two full size sets of as-built drawings which will be kept current during construction of the project, to include all contract changes, modifications and clarifications.

B. All variations shall be shown in the same general detail as used in the contract drawings. To ensure compliance, as-built drawings shall be made available for the COR review, as often as requested.

C. Contractor shall deliver two approved completed sets of as-built drawings in the electronic version (scanned PDF) to the COR within 15 calendar days after each completed phase and after the acceptance of the project by the COR.

D. Paragraphs A, B, & C shall also apply to all shop drawings.

1.12 WARRANTY MANAGEMENT

A. Warranty Management Plan: Develop a warranty management plan which contains information relevant to FAR 52.246-21 Warranty of Construction at least 30 days before the planned pre-warranty conference, submit one set of the warranty management plan. Include within the warranty management plan all required actions and documents to assure that the Government receives all warranties to which it is entitled. The plan must be in narrative form and contain sufficient detail to render it suitable for use by future maintenance and repair personnel, whether tradesman, or of engineering background, not necessarily familiar with this contract. The term “status” as indicated below must include due

date and whether item has been submitted or was approved. Warranty information made available during the construction phase must be submitted to the Contracting Officer for approval prior to each monthly invoice for payment. Assemble approved information in a binder and turn over to the Government upon acceptance of the work. The construction warranty period will begin on the date of the project acceptance and continue for the product warranty period. A joint 4 month and 9 month warranty inspection will be conducted, measured from time of acceptance, by the Contactor and the Contracting Officer. Include in the warranty management plan, but not limited to, the following:

1. Roles and responsibilities of all personnel associated with the warranty process, including points of contact and telephone numbers within the company of the Contractor, subcontractors, manufacturers or suppliers involved.
2. Furnish with each warranty the name, address and telephone number of each of the guarantor’s representatives nearest project location.
3. Listing and status of delivery of all Certificates of Warranty for extended warranty items, to include roofs, HVAC balancing, pumps, motors, transformers and for all commissioned systems such as fire protection and alarm systems, sprinkler systems and lightning protection systems, etc.
4. A list for each warranted equipment item, feature of construction or system indicating:
   a. Name of item.
   b. Model and serial numbers.
   c. Location where installed.
   d. Name and phone numbers of manufacturers and suppliers.
   e. Name and phone numbers of manufacturers or suppliers.
   f. Names, addresses and phone numbers of sources of spare parts.
   g. Warranties and terms of warranty. Include one-year overall warranty of construction, including the starting date of warranty of construction. Items which have extended warranties must be indicated with separate warranty expiration dates.
   h. Starting point and duration of warranty period.

i. Summary of maintenance procedures required to continue the warranty in force.

j. Cross-reference to specific pertinent Operation and Maintenance manuals.

k. Organizations, names and phone numbers of persons to call for warranty service.

l. Typical response time and repair time expected for various warranted equipment.

5. The plans for attendance at the 4 and 9-month post construction warranty inspections conducted by the government.

6. Procedure and status of tagging of all equipment covered by extended warranties.

7. Copies of instructions to be posted near selected pieces of equipment where operation is critical for warranty and/or safety reasons.

B. Performance & Payment Bonds: The Performance & Payment Bonds must remain effective throughout the construction period.

1. In the event the Contractor fails to commence and diligently pursue any construction warranty work required, the Contracting Officer will have the work performed by others, and after completion of the work, will charge the remaining construction warranty funds of expenses incurred by the Government while performing the work, including, but not limited to administrative expenses.

2. In the event sufficient funds are not available to cover the construction warranty work performed by the Government at the contractor’s expenses, the Contracting Officer will have the right to recoup expenses from the bonding company.

3. Following oral or written notification of required construction warranty repair work, the Contractor shall respond in a timely manner. Written verification will follow oral instructions. Failure to respond will be cause for the Contracting Officer to proceed against the Contractor.

C. Pre-Warranty Conference: Prior to contract completion, and at a time designated by the Contracting Officer, the Contractor shall meet with the Contracting Officer to develop a mutual understanding with respect

to the requirements of this section. Communication procedures for Contractor notification of construction warranty defects, priorities with respect to the type of defect, reasonable time required for Contractor response, and other details deemed necessary by the Contracting Officer for the execution of the construction warranty will be established/ reviewed at this meeting. In connection with these requirements and at the time of the Contractor's quality control completion inspection, furnish the name, telephone number and address of a licensed and bonded company which is authorized to initiate and pursue construction warranty work action on behalf of the Contractor. This point of contract will be located within the local service area of the warranted construction, be continuously available and be responsive to Government inquiry on warranty work action and status. This requirement does not relieve the Contractor of any of its responsibilities in conjunction with other portions of this provision.

D. Contractor's Response to Construction Warranty Service Requirements:

E. Following oral or written notification by the Contracting Officer, the Contractor shall respond to construction warranty service requirements in accordance with the "Construction Warranty Service Priority List" and the three categories of priorities listed below. Submit a report on any warranty item that has been repaired during the warranty period. Include within the report the cause of the problem, date reported, corrective action taken, and when the repair was completed. If the Contractor does not perform the construction warranty within the timeframe specified, the Government will perform the work and back charge the construction warranty payment item established.

1. First Priority Code 1. Perform onsite inspection to evaluate situation, and determine course of action within 4 hours, initiate work within 6 hours and work continuously to completion or relief.
2. Second Priority Code 2. Perform onsite inspection to evaluate situation, and determine course of action within 8 hours, initiate work within 24 hours and work continuously to completion or relief.
3. Third Priority Code 3. All other work to be initiated within 3 work days and work continuously to completion or relief.
4. The "Construction Warranty Service Priority List" is as follows:

a) Code 1-Life Safety Systems
   1) Fire suppression systems.
   2) Fire alarm system(s).
b) Code 1-Air Conditioning Systems
   1) Air conditioning leak in part of the building, if causing damage.
   2) Air conditioning system not cooling properly.
c) Code 1 Doors
   1) Overhead doors not operational, causing a security, fire or safety problem.
   1) Interior, exterior personnel doors or hardware, not functioning properly, causing security, fire or safety problem.
d) Code 3-Doors
   1) Overhead doors not operational.
   2) Interior/exterior personnel doors or hardware not functioning properly.
e) Code 1-Electrical
   1) Power failure (entire area or any building operational after 1600 hours).
   2) Security lights.
   3) Smoke detectors.
f) Code 2-Electrical
   1) Power failure (no power to a room or part of building). Receptacle and lights not operational (in a room or part of building).
g) Code 3-Electrical
   1) Exterior lights not operational.
h) Code 1-Gas
   1) Leaks and pipeline breaks.
i) Code 1-Heat
   1) Power failure affecting heat.
j) Code 1-Plumbing
   1) Hot water heater failure.
   2) Leaking water supply pipes

k) Code 2-Plumbing

1) Flush valves not operating properly

2) Fixture drain, supply line or any water pipe leaking.

3) Toilet leaking at base.

l) Code 3- Plumbing

1) Leaky faucets.

m) Code 3-Interior

1) Floors damaged.

2) Paint chipping or peeling.

3) Casework damaged.

n) Code 1-Roof Leaks

1) Damage to property is occurring.

o) Code 2-Water (Exterior)

1) No water to facility.

p) Code 2-Water (Hot)

1) No hot water in portion of building listed.

q) Code 3

1) All work not listed above.

F. Warranty Tags: At the time of installation, tag each warranted item with a durable, oil and water-resistant tag approved by the Contracting Officer. Attach each tag with a copper wire and spray with a silicone waterproof coating. Also submit two record copies of the warranty tags showing the layout and design. The date of acceptance and the QC signature must remain blank until the project is accepted for beneficial occupancy. Show the following information on the tag.

Warranty Tags
Type of product/material
Model number
Serial number
Contract number
Warranty period from/to
Inspector’s signature
Construction Contractor
Address

Warranty Tags
Telephone number
Warranty Contact
Address
Telephone number
Warranty response time priority code

1.13 USE OF ROADWAYS

A. For hauling, use only established public roads and roads on Medical Center property. When necessary to cross curbing, sidewalks, or similar construction, they must be protected by well-constructed bridges.

1.14 TEMPORARY USE OF MECHANICAL AND ELECTRICAL EQUIPMENT

A. Use of new installed mechanical and electrical equipment to provide heat, ventilation, plumbing, light and power will be permitted subject to written approval and compliance with the following provisions:

1. Permission to use each unit or system must be given by COR in writing. If the equipment is not installed and maintained in accordance with the written agreement and following provisions, the COR will withdraw permission for use of the equipment.
2. Electrical installations used by the equipment shall be completed in accordance with the drawings and specifications to prevent damage to the equipment and the electrical systems, i.e. transformers, relays, circuit breakers, fuses, conductors, motor controllers and their overload elements shall be properly sized, coordinated and adjusted. Installation of temporary electrical equipment or devices shall be in accordance with NFPA 70, National Electrical Code, (2014 Edition), Article 590, *Temporary Installations.* Voltage supplied to each item of equipment shall be verified to be correct and it shall be determined that motors are not overloaded. The electrical equipment shall be thoroughly cleaned before using it and again immediately before final inspection including vacuum cleaning and wiping clean interior and exterior surfaces.
3. Units shall be properly lubricated, balanced, and aligned. Vibrations must be eliminated.

4. Automatic temperature control systems for preheat coils shall function properly and all safety controls shall function to prevent coil freeze-up damage.
5. The air filtering system utilized shall be that which is designed for the system when complete, and all filter elements shall be replaced at completion of construction and prior to testing and balancing of system.
6. All components of heat production and distribution system, metering equipment, condensate returns, and other auxiliary facilities used in temporary service shall be cleaned prior to use; maintained to prevent corrosion internally and externally during use; and cleaned, maintained and inspected prior to acceptance by the Government.

B. Prior to final inspection, the equipment or parts used which show wear and tear beyond normal, shall be replaced with identical replacements, at no additional cost to the Government.

C. This paragraph shall not reduce the requirements of the mechanical and electrical specifications sections.

D. Any damage to the equipment or excessive wear due to prolonged use will be repaired replaced by the contractor at the contractor’s expense.

1.15 TEMPORARY USE OF EXISTING ELEVATORS

A. Use of existing elevators for handling building materials and Contractor's personnel will be permitted subject to following provisions:

1. Contractor makes all arrangements with the COR for use of elevators. The COR will ascertain that elevators are in proper condition. Contractor may use elevators when permission is granted. Personnel for operating elevators will not be provided by the Department of Veterans Affairs.
2. Contractor covers and provides maximum protection of following elevator components:
   a) Entrance jambs, heads soffits and threshold plates.
   b) Entrance columns, canopy, return panels and inside surfaces of car enclosure walls.
   c) Finish flooring.

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

1.16 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, in compliance with code and as satisfactory to the Contracting Officer, shall install and maintain all necessary temporary connections and distribution lines, and all meters required to measure the amount of electricity used for the purpose of determining charges. Before final acceptance of the work by the Government, the Contractor shall remove all the temporary connections, distribution lines, meters, and associated paraphernalia and repair restore the infrastructure as required.

C. Contractor shall install meters at Contractor's expense and furnish the the Medical Center a monthly record of the Contractor's usage of electricity as hereinafter specified.

D. Heat: Furnish temporary heat necessary to prevent injury to work and materials through dampness and cold. Use of open salamanders or any temporary heating devices which may be fire hazards or may smoke and damage finished work, will not be permitted. Maintain minimum temperatures as specified for various materials:

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

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

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

1. Obtain water by connecting to the Medical Center water distribution system. Provide reduced pressure backflow preventer at each connection as per code. 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 discretion) of use of water from the Medical Center's system.

G. Fuel: Natural and LP gas and burner fuel oil required for boiler cleaning, normal initial boiler-burner setup and adjusting, and for performing the specified boiler tests will be furnished by the Government. Fuel required for prolonged boiler-burner setup, adjustments, or modifications due to improper design or operation of boiler, burner, or control devices shall be furnished and paid by the Contractor at Contractor's expense.

1.17 TESTS

A. As per specification section 23 05 93 the contractor shall provide a written testing and commissioning plan complete with component level, equipment level, sub-system level and system level breakdowns. The plan will provide a schedule and a written sequence of what will be tested, how and what the expected outcome will be. This document will

be submitted for approval prior to commencing work. The contractor shall document the results of the approved plan and submit for approval with the as built documentation.

B. 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.

C. 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.

D. Mechanical and electrical systems shall be balanced, controlled and coordinated. A system is defined as the entire system which must be coordinated to work together during normal operation to produce results for which the system is designed. For example, air conditioning supply air is only one part of entire system which provides comfort conditions for a building. Other related components are return air, exhaust air, steam, chilled water, refrigerant, hot water, controls and electricity, etc. Another example of a system which involves several components of different disciplines is a boiler installation. Efficient and acceptable boiler operation depends upon the coordination and proper operation of fuel, combustion air, controls, steam, feedwater, condensate and other related components.

E. All related components as defined above shall be functioning when any system component is tested. Tests shall be completed within a reasonable period of time during which operating and environmental conditions remain reasonably constant and are typical of the design conditions.

F. 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.

1.18 INSTRUCTIONS

A. Contractor shall furnish Maintenance and Operating manuals (hard copies and electronic) and verbal instructions when required by the various sections of the specifications and as hereinafter specified.

B. Manuals: Maintenance and operating manuals and one compact disc (four hard copies and one electronic copy each) for each separate piece of equipment shall be delivered to the COR coincidental with the delivery of the equipment to the job site. Manuals shall be complete, detailed guides for the maintenance and operation of equipment. They shall include complete information necessary for starting, adjusting, maintaining in continuous operation for long periods of time and dismantling and reassembling of the complete units and sub-assembly components. Manuals shall include an index covering all component parts clearly cross-referenced to diagrams and illustrations. Illustrations shall include "exploded" views showing and identifying each separate item. Emphasis shall be placed on the use of special tools and instruments. The function of each piece of equipment, component, accessory and control shall be clearly and thoroughly explained. All necessary precautions for the operation of the equipment and the reason for each precaution shall be clearly set forth. Manuals must reference the exact model, style and size of the piece of equipment and system being furnished. Manuals referencing equipment similar to but of a different model, style, and size than that furnished will not be accepted.

C. Instructions: Contractor shall provide qualified, factory-trained manufacturers' representatives to give detailed training to assigned Department of Veterans Affairs personnel in the operation and complete maintenance for each piece of equipment. All such training will be at the job site. These requirements are more specifically detailed in the various technical sections. Instructions for different items of equipment that are component parts of a complete system, shall be given in an integrated, progressive manner. All instructors for every piece of component equipment in a system shall be available until instructions for all items included in the system have been completed. This is to assure proper instruction in the operation of inter-related systems. All instruction periods shall be at such times as scheduled by the COR and shall be considered concluded only when the COR is satisfied in regard to complete and thorough coverage. The contractor shall submit a course outline with associated material to the COR for

review and approval prior to scheduling training to ensure the subject matter covers the expectations of the VA and the contractual requirements. The Department of Veterans Affairs reserves the right to request the removal of, and substitution for, any instructor who, in the opinion of the COR, does not demonstrate sufficient qualifications in accordance with requirements for instructors above.

1.19 GOVERNMENT-FURNISHED PROPERTY

A. The Government shall deliver to the Contractor, the Government-furnished property shown on the drawings.

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

C. Contractor shall be prepared to receive this equipment from Government and store or place such equipment not less than 90 days before Completion Date of project.

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

1. Immediately upon delivery of equipment, Contractor shall arrange for a joint inspection thereof with a representative of the Government. At such time the Contractor shall acknowledge receipt of equipment described, make notations, and immediately furnish the Government representative with a written statement as to its condition or shortages.

2. Contractor thereafter is responsible for such equipment until such time as acceptance of contract work is made by the Government.

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

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

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

1.20 RELOCATED EQUIPMENT

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

B. Perform relocation of such equipment or items at such times and in such a manner as directed by the COR.

C. Suitably cap existing service lines, such as steam, condensate return, water, drain, gas, air, vacuum and/or electrical, at the main whenever such lines are disconnected from equipment to be relocated. Remove abandoned lines in finished areas and cap as specified herein before under paragraph "Abandoned Lines".

D. Provide all mechanical and electrical service connections, fittings, fastenings and any other materials necessary for assembly and installation of relocated equipment; and leave such equipment in proper operating condition.

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

1.21 SAFETY SIGN

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

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

C. Maintain sign and remove it when directed by COR.

D. Drawing details in VA Signage Design Manual, Section 11 Specialty Signs (found on VA TIL) show required legend and other characteristics of sign and are shown on the drawings.

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

Number of photographs	
Estimated Cost	No. of Photographs
Up to $250,000	50 to 100
Up to $500,000	100 to 150
Up to $1,000,000	150 to 200
Up to $2,000,000	200 to 250
Up to $5,000,000	250 to 300
Up to $10,000,000	300 to 400
More than $10,000,000	400 to 500

1.22 PHOTOGRAPHIC DOCUMENTATION

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

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

B. Photographic documentation elements:

1. Each digital image shall be taken with a professional grade camera with minimum size of 6 megapixels (MP) capable of producing 200x250mm (8 x 10 inch) prints with a minimum of 2272 x 1704 pixels and 400x500mm (16 x 20 inch) prints with a minimum 2592 x 1944 pixels.

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

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

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

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

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

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

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

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

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

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

1.23 FINAL ELEVATION DIGITAL IMAGES

A. A minimum of four (4) images of each elevation shall be taken with a minimum 6 MP camera, by a professional photographer with different settings to allow the COR to select the image to be printed. All images are provided to the RE on a CD.

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

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

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01-01-24

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

PART 1- GENERAL

1.1 DESCRIPTION:

A. The Contractor shall develop a Critical Path Method (CPM) plan and schedule demonstrating fulfillment of the contract requirements (Project Schedule), and shall keep the Project Schedule up-to-date in accordance with the requirements of this section and shall utilize the plan for scheduling, coordinating and monitoring work under this contract (including all activities of subcontractors, equipment vendors and suppliers). Conventional Critical Path Method (CPM) technique shall be utilized to satisfy both time and cost applications.

1.2 CONTRACTOR'S REPRESENTATIVE:

A. The Contractor shall designate an authorized representative responsible for the Project Schedule including preparation, review and progress reporting with and to the Contracting Officer's Representative (COTR).

B. The Contractor's representative shall have direct project control and complete authority to act on behalf of the Contractor in fulfilling the requirements of this specification section.

C. The Contractor’s representative shall have the option of developing the project schedule within their organization or to engage the services of an outside consultant. If an outside scheduling consultant is utilized, Section 1.3 of this specification will apply.

1.3 CONTRACTOR'S CONSULTANT:

A. The Contractor shall submit a qualification proposal to the COTR, within 10 days of bid acceptance. The qualification proposal shall include:

1. The name and address of the proposed consultant.
2. Information to show that the proposed consultant has the qualifications to meet the requirements specified in the preceding paragraph.
3. A representative sample of prior construction projects, which the proposed consultant has performed complete project scheduling

services. These representative samples shall be of similar size and scope.

B. The Contracting Officer has the right to approve or disapprove the proposed consultant, and will notify the Contractor of the VA decision within seven calendar days from receipt of the qualification proposal. In case of disapproval, the Contractor shall resubmit another consultant within 10 calendar days for renewed consideration. The Contractor shall have their scheduling consultant approved prior to submitting any schedule for approval.

1.4 COMPUTER PRODUCED SCHEDULES

A. The contractor shall provide monthly, to the Department of Veterans Affairs (VA), all computer-produced time/cost schedules and reports generated from monthly project updates. This monthly computer service will include: three copies of up to five different reports (inclusive of all pages) available within the user defined reports of the scheduling software approved by the Contracting Officer; a hard copy listing of all project schedule changes, and associated data, made at the update and an electronic file of this data; and the resulting monthly updated schedule in PDM format. These must be submitted with and substantively support the contractor’s monthly payment request and the signed look ahead report. The COTR shall identify the five different report formats that the contractor shall provide.

B. The contractor shall be responsible for the correctness and timeliness of the computer-produced reports. The Contractor shall also responsible for the accurate and timely submittal of the updated project schedule and all CPM data necessary to produce the computer reports and payment request that is specified.

C. The VA will report errors in computer-produced reports to the Contractor’s representative within ten calendar days from receipt of reports. The Contractor shall reprocess the computer-produced reports and associated diskette(s), when requested by the Contracting Officer’s representative, to correct errors which affect the payment and schedule for the project.

1.5 THE COMPLETE PROJECT SCHEDULE SUBMITTAL

A. Within 45 calendar days after receipt of Notice to Proceed, the Contractor shall submit for the Contracting Officer's review; three

blue line copies of the interim schedule on sheets of paper 765 x 1070 mm (30 x 42 inches) and an electronic file in the previously approved CPM schedule program. The submittal shall also include three copies of a computer-produced activity/event ID schedule showing project duration; phase completion dates; and other data, including event cost. Each activity/event on the computer-produced schedule shall contain as a minimum, but not limited to, activity/event ID, activity/event description, duration, budget amount, early start date, early finish date, late start date, late finish date and total float. Work activity/event relationships shall be restricted to finish-to-start or start-to-start without lead or lag constraints. Activity/event date constraints, not required by the contract, will not be accepted unless submitted to and approved by the Contracting Officer. The contractor shall make a separate written detailed request to the Contracting Officer identifying these date constraints and secure the Contracting Officer’s written approval before incorporating them into the network diagram. The Contracting Officer’s separate approval of the Project Schedule shall not excuse the contractor of this requirement. Logic events (non-work) will be permitted where necessary to reflect proper logic among work events, but must have zero duration. The complete working schedule shall reflect the Contractor's approach to scheduling the complete project. **The final Project Schedule in its original form shall contain no contract changes or delays which may have been incurred during the final network diagram development period and shall reflect the entire contract duration as defined in the bid documents.** These changes/delays shall be entered at the first update after the final Project Schedule has been approved. The Contractor should provide their requests for time and supporting time extension analysis for contract time as a result of contract changes/delays, after this update, and in accordance with Article, ADJUSTMENT OF CONTRACT COMPLETION.

B. Within 30 calendar days after receipt of the complete project interim Project Schedule and the complete final Project Schedule, the Contracting Officer or his representative, will do one or both of the following:

1. Notify the Contractor concerning his actions, opinions, and objections.
2. A meeting with the Contractor at or near the job site for joint review, correction or adjustment of the proposed plan will be scheduled if required. Within 14 calendar days after the joint review, the Contractor shall revise and shall submit three blue line copies of the revised Project Schedule, three copies of the revised computer-produced activity/event ID schedule and a revised electronic file as specified by the Contracting Officer. The revised submission will be reviewed by the Contracting Officer and, if found to be as previously agreed upon, will be approved.

C. The approved baseline schedule and the computer-produced schedule(s) generated there from shall constitute the approved baseline schedule until subsequently revised in accordance with the requirements of this section.

1.6 WORK ACTIVITY/EVENT COST DATA

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

B. The Contractor shall cost load work activities/events for guarantee period services, test, balance and adjust various systems in accordance with the provisions in Article, FAR 52.232 – 5 (PAYMENT UNDER FIXED-PRICE CONSTRUCTION CONTRACTS) and VAAR 852.232 –Article 71 Including NAS-CPM for (PAYMENTS UNDER FIXED PRICE CONSTRUCTION).

C. In accordance with FAR 52.236 – 1 (PERFORMANCE OF WORK BY THE CONTRACTOR), the Contractor shall submit, simultaneously with the cost per work activity/event of the construction schedule required by this

Section, a responsibility code for all activities/events of the project for which the Contractor's forces will perform the work.

D. The Contractor shall cost load work activities/events for all BID ITEMS including ASBESTOS ABATEMENT. The sum of each BID ITEM work shall equal the value of the bid item in the Contractors' bid.

1.7 PROJECT SCHEDULE REQUIREMENTS

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

1. Show activities/events as:
   a. Contractor's time required for submittal of shop drawings, templates, fabrication, delivery and similar pre-construction work.
   b. Contracting Officer's and Architect-Engineer's review and approval of shop drawings, equipment schedules, samples, template, or similar items.
   c. Interruption of VA Facilities utilities, delivery of Government furnished equipment, and rough-in drawings, project phasing and any other specification requirements.
   d. Test, balance and adjust various systems and pieces of equipment, maintenance and operation manuals, instructions and preventive maintenance tasks.
   e. VA inspection and acceptance activity/event with a minimum duration of five work days at the end of each phase and immediately preceding any VA move activity/event required by the contract phasing for that phase.
2. Show not only the activities/events for actual construction work for each trade category of the project, but also trade relationships to indicate the movement of trades from one area, floor, or building, to another area, floor, or building, for at least five trades who are performing major work under this contract.
3. Break up the work into activities/events of a duration no longer than 20 work days each or one reporting period, except as to non-construction activities/events (i.e., procurement of materials, delivery of equipment, concrete and asphalt curing) and any other activities/events for which the COTR may approve the showing of a

longer duration. The duration for VA approval of any required submittal, shop drawing, or other submittals will not be less than 20 work days.

4. Describe work activities/events clearly, so the work is readily identifiable for assessment of completion. Activities/events labeled "start," "continue," or "completion," are not specific and will not be allowed. Lead and lag time activities will not be acceptable.
5. The schedule shall be generally numbered in such a way to reflect either discipline, phase or location of the work.

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

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

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

D. Compact Disk Requirements and CPM Activity/Event Record Specifications: Submit to the VA an electronic file(s) containing one file of the data required to produce a schedule, reflecting all the activities/events of the complete project schedule being submitted.

1.8 PAYMENT TO THE CONTRACTOR:

A. Monthly, the contractor shall submit an application and certificate for payment using VA Form 10-6001a reflecting updated schedule activities and cost data in accordance with the provisions of the following Article, PAYMENT AND PROGRESS REPORTING, as the basis upon which progress payments will be made pursuant to Article, FAR 52.232 – 5 (PAYMENT UNDER FIXED-PRICE CONSTRUCTION CONTRACTS) and VAAR 852.232 –

Article 71 Including NAS-CPM for (PAYMENTS UNDER FIXED PRICE CONSTRUCTION). The Contractor shall be entitled to a monthly progress payment upon approval of estimates as determined from the currently approved updated project schedule. Monthly payment requests shall include: a listing of all agreed upon project schedule changes and associated data; and an electronic file (s) of the resulting monthly updated schedule.

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

1.9 PAYMENT AND PROGRESS REPORTING

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

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

B. After completion of the joint review, the contractor shall generate an updated computer-produced calendar-dated schedule and supply the

Contracting Officer's representative with reports in accordance with the Article, COMPUTER PRODUCED SCHEDULES, specified.

C. After completing the monthly schedule update, the contractor's representative or scheduling consultant shall rerun all current period contract change(s) against the prior approved monthly project schedule. The analysis shall only include original workday durations and schedule logic agreed upon by the contractor and COR for the contract change(s). When there is a disagreement on logic and/or durations, the Contractor shall use the schedule logic and/or durations provided and approved by the COR. After each rerun update, the resulting electronic project schedule data file shall be appropriately identified and submitted to the VA in accordance to the requirements listed in articles 1.4 and 1.7. This electronic submission is separate from the regular monthly project schedule update requirements and shall be submitted to the COR within fourteen (14) calendar days of completing the regular schedule update. Before inserting the contract changes durations, care must be taken to ensure that only the original durations will be used for the analysis, not the reported durations after progress. In addition, once the final network diagram is approved, the contractor must recreate all manual progress payment updates on this approved network diagram and associated reruns for contract changes in each of these update periods as outlined above for regular update periods. This will require detailed record keeping for each of the manual progress payment updates.

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

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

1.10 RESPONSIBILITY FOR COMPLETION

A. If it becomes apparent from the current revised monthly progress schedule that phasing or contract completion dates will not be met, the Contractor shall execute some or all of the following remedial actions:
   1. Increase construction manpower in such quantities and crafts as necessary to eliminate the backlog of work.
   2. Increase the number of working hours per shift, shifts per working day, working days per week, the amount of construction equipment, or any combination of the foregoing to eliminate the backlog of work.
   3. Reschedule the work in conformance with the specification requirements.

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

1.11 CHANGES TO THE SCHEDULE

A. Within 30 calendar days after VA acceptance and approval of any updated project schedule, the Contractor shall submit a revised electronic file (s) and a list of any activity/event changes including predecessors and successors for any of the following reasons:
   1. Delay in completion of any activity/event or group of activities/events, which may be involved with contract changes, strikes, unusual weather, and other delays will not relieve the Contractor from the requirements specified unless the conditions are shown on the CPM as the direct cause for delaying the project beyond the acceptable limits.
   2. Delays in submittals, or deliveries, or work stoppage are encountered which make rescheduling of the work necessary.
   3. The schedule does not represent the actual prosecution and progress of the project.

4. When there is, or has been, a substantial revision to the activity/event costs regardless of the cause for these revisions.

B. CPM revisions made under this paragraph which affect the previously approved computer-produced schedules for Government furnished equipment, vacating of areas by the VA Facility, contract phase(s) and sub phase(s), utilities furnished by the Government to the Contractor, or any other previously contracted item, shall be furnished in writing to the Contracting Officer for approval.

C. Contracting Officer's approval for the revised project schedule and all relevant data is contingent upon compliance with all other paragraphs of this section and any other previous agreements by the Contracting Officer or the VA representative.

D. The cost of revisions to the project schedule resulting from contract changes will be included in the proposal for changes in work as specified in FAR 52.243 - 4 (Changes, and will be based on the complexity of the revision or contract change, man hours expended in analyzing the change, and the total cost of the change.

E. The cost of revisions to the Project Schedule not resulting from contract changes is the responsibility of the Contractor.

1.12 ADJUSTMENT OF CONTRACT COMPLETION

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

B. Actual delays in activities/events which, according to the computer- produced calendar-dated schedule, do not affect the extended

and predicted contract completion dates shown by the critical path in the network, will not be the basis for a change to the contract completion date. The Contracting Officer will within a reasonable time after receipt of such justification and supporting evidence, review the facts and advise the Contractor in writing of the Contracting Officer's decision.

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

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

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11-01-23

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 he 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 a blank submittal register in electronic format. Thereafter, the Contractor shall fill in the blank register with the required submittals as documented in the project spec. 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. Blank digital register provided for Contractor use below

ENG_FORM_4288-R.pdf

E. 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.

F. 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. Allow 5 additional review and processing days if submitting more than 5 submittals in a day, or 10 in a week.

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 without 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:

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_____________________________________________________________________
|                              CONTRACTOR                             |
|                                                                     |
|                              (Firm Name)                            |
|                                                                     |
|                                                                     |
|                                                                     |
|______Approved                                                       |
|                                                                     |
|                                                                     |
|______Approved with corrections as noted on submittal data and/or    |
| attached sheets(s)                                                  |
|                                                                     |
|                                                                     |
|                                                                     |
| SIGNATURE: ________________________________________________________|
|                                                                     |
| TITLE: _____________________________________________________________|
|                                                                     |
| DATE: ______________________________________________________________|
|                                                                     |
|_____________________________________________________________________|
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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

A. COR 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 business days for submittals.

E. VA review period is 10 business 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

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

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OWNER:	Department of Veterans Affairs
PROJECT TITLE:	Renovate SPS Spaces
LOCATION:	Charleston, SC
CONTRACT NO:	534-24-102
CONTRACTOR:	

SUBMITTAL REGISTER

Line	Specification Section	Specification Name	Description	Item Submitted	Paragraph #	Classification: GOVT or A/E Reviewer
1	01 00 00	General Requirements	Pre-Construction	Construction Security Plan	1.5	GOVT
2	01 00 00	General Requirements	Pre-Construction	Electronic Security Memorandum	1.5	GOVT
3	01 32 16.15	Project Schedules	Pre-Construction	Project Schedule	1.5	GOVT
4	01 35 26	Safety Requirements	Pre-Construction	Accident Prevention Plan	1.4	GOVT
5	01 35 26	Safety Requirements	Pre-Construction	Activity Hazard Analysis	1.5	GOVT
6	01 35 26	Safety Requirements	Pre-Construction	Training Records	1.8	GOVT
7	01 35 26	Safety Requirements	Construction	Safety Inspections	1.9	GOVT
8	01 35 26	Safety Requirements	Construction	Accident Reports, OSHA-300 Logs, Man-Hour Reports	1.10	GOVT
9	01 35 26	Safety Requirements	Pre-Construction & Construction	ICRA & Permitting	1.12	GOVT
10	01 35 26	Safety Requirements	Pre-Construction	Tuberculosis Screening	1.13	GOVT
11	01 35 26	Safety Requirements	Pre-Construction	Fire Safety Plan	1.14	GOVT
12	01 35 26	Safety Requirements	Pre-Electrical Work	Activity Hazard Analysis	1.15	GOVT
13	01 35 26	Safety Requirements	Excavation and Trenching	Trenching and Excavation Permit	1.18	GOVT
14	01 35 26	Safety Requirements	Cranes	Crane - Lift Permit	1.19	GOVT
15	01 35 26	Safety Requirements	Confined Space Entry	Confined Space Entry Plan	1.21	GOVT
16	01 35 26	Safety Requirements	Welding and Cutting	Hot Work Permit	1.22	GOVT
17	01 45 00	Quality Control	Preconstruction Submittals	Preconstruction Submittals	1.3.1	A/E + GOVT
18	01 45 00	Quality Control	Design Data	Design Data	1.3.2	A/E + GOVT
19	01 45 00	Quality Control	Test Reports	Test Reports	1.3.3	A/E + GOVT
20	01 45 29	Testing Laboratory Services	Pre-Construction	Testing Lab Certificate of Accrediation	1 & 3	GOVT
21	01 45 29	Testing Laboratory Services	Pre-Construction	Written/Verbal Reports	1 & 3	GOVT

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22	01 57 19	Temporary Environmental Controls	Pre-Construction	Environmental Protection Plan	1.4	A/E + GOVT
23	01 74 19	Construction Waste Management	Waste Management Plan	Waste Management Plan	1.5.B	A/E + GOVT
24	01 74 19	Construction Waste Management	Designated Manager	Designated Manager	1.5.C	A/E + GOVT
25	01 74 19	Construction Waste Management	Monthly Summary	Monthly Summary	1.5.D	A/E + GOVT
26	01 74 19	Construction Waste Management	Construction	Debris Disposal & Dispersion Report	3.3	GOVT
27	01 81 13	Sustainable Construction Requirements	Sustainability Action Plan	Sustainability Action Plan	1.5.B	A/E + GOVT
28	01 81 13	Sustainable Construction Requirements	Spreadsheet	Low Pollutant-Emitting Materials Tracking Spreadsheet	1.5.C	A/E + GOVT
29	01 81 13	Sustainable Construction Requirements	Management Plan	Construction Indoor Air Quality (IAQ) Management Plan	1.5.D	A/E + GOVT
30	01 81 13	Sustainable Construction Requirements	Product Submittals	Product Submittals	1.5.E	A/E + GOVT
31	01 81 13	Sustainable Construction Requirements	Progress Reports	Sustainable Construction Progress Reports	1.5.F	A/E + GOVT
32	01 81 13	Sustainable Construction Requirements	Closeout Submittals	Closeout Submittals	1.5.G	A/E + GOVT
33	01 91 00	General Commissioning Requirements	Preliminary Commissioning Plan	Preliminary Commissioning Plan Submittal	1.13.A	GOVT
34	01 91 00	General Commissioning Requirements	Final Commissioning Plan	Final Commissioning Plan Submittal	1.13.B	GOVT
35	01 91 00	General Commissioning Requirements	Test Procedure	Systems Functional Performance Test Procedure	1.13.C	GOVT
36	01 91 00	General Commissioning Requirements	Pre-Functional Checklists	Pre-Functional Checklists	1.13.D	GOVT
37	01 91 00	General Commissioning Requirements	Test and Inspection Reports	Test and Inspection Reports	1.13.E	GOVT
38	01 91 00	General Commissioning Requirements	Corrective Action Documents	Corrective Action Documents	1.13.F	GOVT
39	01 91 00	General Commissioning Requirements	Preliminary Commissioning Report	Preliminary Commissioning Report Submittal	1.13.1G	GOVT
40	01 91 00	General Commissioning Requirements	Final Commissioning Report	Final Commissioning Report Submittal	1.13.H	GOVT
41	01 91 00	General Commissioning Requirements	Data for Commissioning	Data for Commissioning	1.13.I	GOVT
42	02 41 19	Selective Demolition	Submittal	As listed in 1.6F	1.6	GOVT

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43	02 83 33.13	Lead-Based Paint Removal and Disposal	Manufacturer's Literature & Data	Each item specified	1.6	GOVT
44	02 83 33.13	Lead-Based Paint Removal and Disposal	Test Reports	Laboratory Reports	1.6	GOVT
45	02 83 33.13	Lead-Based Paint Removal and Disposal	Certifications	Lead training	1.6	GOVT
46	02 83 33.13	Lead-Based Paint Removal and Disposal	Qualifications	Paint removal, industrial hygienist, pait disposal	1.6	GOVT
47	02 83 33.13	Lead-Based Paint Removal and Disposal	Record Documents	As listed in 1.6F	1.6	GOVT
48	05 12 00	Structural Steel Framing	Drawings	Showing fabrication/installation	1.4	A/E
49	05 12 00	Structural Steel Framing	Sustainable Construction	Identify recycled content	1.4	A/E
50	05 12 00	Structural Steel Framing	Rtest Reports	Welding	1.4	A/E
51	05 12 00	Structural Steel Framing	Certificates	Steel, welding, paint compliance	1.4	A/E
52	05 12 00	Structural Steel Framing	Qualifications	Fabricator, Installer, Welding	1.4	A/E
53	05 12 00	Structural Steel Framing	Calculations	Design and Connection calcs	1.4	A/E
54	06 10 00	Rough Carpentry	Shop Drawings	Framing connection details, fasteners, connections & dimensions	1.3	A/E
55	06 10 00	Rough Carpentry	Manufacturer's Literature & Data	Data for lumber, panels, hardware & adhesives	1.3	A/E
56	06 10 00	Rough Carpentry	Manufacturer's Literature & Data	Wood preservative treatment	1.3	A/E
57	06 10 00	Rough Carpentry	Manufacturer's Literature & Data	Fire retardant treament from chemical treatment and certification	1.3	A/E
58	06 10 00	Rough Carpentry	Manufacturer's Literature & Data	Waterborne treament statement	1.3	A/E
59	06 10 00	Rough Carpentry	Certificates	Manufacturer certificate for unmarked lumber	1.3	A/E
60	07 01 50.19	Preparation for Re-Roofing	Drawings	Show size, configuration and installation details	1.5.B	A/E
61	07 01 50.19	Preparation for Re-Roofing	Manufacturer's Literature & Data	As required in 1.5.C	1.5.C	A/E
62	07 01 50.19	Preparation for Re-Roofing	Photographs	Existing conditions	1.5	A/E
63	07 01 50.19	Preparation for Re-Roofing	Reports	Field Inspection	1.5	A/E

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64	07 01 50.19	Preparation for Re-Roofing	Report	Infrared Roof Moisture	1.5	A/E
65	07 21 13	Thermal Insulation	Drawings	Show insulation type, thickness & R-value ea. Location	1.4.B	A/E
66	07 21 13	Thermal Insulation	Manufacturer's Literature & Data	Each product	1.4.C	A/E
67	07 21 13	Thermal Insulation	Manufacturer's Literature and Data	Adhesive indicating manufacturer recommendation for each application	1.4.D	A/E
68	07 21 23	Loose-Fill Insulaton	Manufacturer's Literature & Data	Types of Products to be used	1.4	A/E
69	07 21 23	Loose-Fill Insulaton	Samples	Loose-fill insulation	1.4	A/E
70	07 21 23	Loose-Fill Insulaton	Sustainable Construction Submittals	Recycled content	1.4	A/E
71	07 51 00	Built-up Bituminous Roofing	Data	Product Data	1.6.B	A/E
72	07 51 00	Built-up Bituminous Roofing	Certificates	As required in 1.6.B	1.6.B	A/E
73	07 51 00	Built-up Bituminous Roofing	Warranty	Contract Provisions	1.6.D	A/E
74	07 51 00	Built-up Bituminous Roofing	Closeout Submittals	Maintenance manuals / Installer/Mfg warranty	1.6.E	A/E
75	07 84 00	Firestopping	Qualifications	Installer Qualifications	1.3	A/E
76	07 84 00	Firestopping	Qualifications	Inspector Qualifications	1.3	A/E
77	07 84 00	Firestopping	Manufacturer's Literature and Data	For Firestopping and Smoke Stopping Types	1.3.B	A/E
78	07 84 00	Firestopping	Manufacturer's Literature and Data	Product data and application/patching instructions	1.3.C	A/E
79	07 84 00	Firestopping	List	FM, UL, or WH Classification Numbers of systems installed	1.3.D	A/E
80	07 84 00	Firestopping	Certified Laboratory Test Reports	For systems proposed for use that are not listed by FM, UL, or WH	1.3.E	A/E
81	07 84 00	Firestopping	Firestopping Material Certificates	Compliance with Specified Requirements	1.3.F	A/E
82	07 92 00	Joint Sealants	Qualifications	Certification joints are proper size & design	1.3	A/E
83	07 92 00	Joint Sealants	Certifications	Contractor & Inataller Certification & Spec compliance	1.3	A/E
84	07 92 00	Joint Sealants	Product Information	Installation Instructions	1.5.C	A/E

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85	07 92 00	Joint Sealants	Samples	Cured Samples of Each Sealant	1.5.D	A/E
86	07 92 00	Joint Sealants	Manufacturer's Literature and Data	Primers	1.5.E	A/E
87	07 92 00	Joint Sealants	Manufacturer's Literature and Data	Sealing Compound, Each Type	1.5	A/E
88	07 92 00	Joint Sealants	Closeout Submittal	Manufacturer Warranty	1.5.F	A/E
89	07 92 00	Joint Sealants	Warranty	Construction; manufacturer's	1.9	A/E
90	07 95 13	Expansion Joint Cover Assemblies	Drawings	Submittal Drawings	1.4	A/E
91	08 11 13	Hollow Metal Doors and Frames	Submittal Drawings	Size, Configuration, Fabrication, Installation Details	1.4	A/E
92	08 11 13	Hollow Metal Doors and Frames	Manufacturer's Literature & Data	Each product	1.4	A/E
93	08 11 13	Hollow Metal Doors and Frames	Manufacturer's Literature & Data	Schedule	1.4	A/E
94	08 11 13	Hollow Metal Doors and Frames	Manufacturer's Literature & Data	Installation Instructions	1.4	A/E
95	08 11 13	Hollow Metal Doors and Frames	Sustainable Construction	Recycled content	1.4	A/E
96	08 11 13	Hollow Metal Doors and Frames	Test Reports	Sound rated doors	1.4	A/E
97	08 11 13	Hollow Metal Doors and Frames	Qualifications	Manufacturer	1.4	A/E
98	08 11 13	Hollow Metal Doors and Frames	Warranty	Construction	1.8	A/E
99	08 14 00	Interior Wood Doors	Submittal Drawings	Size, Configuration, Fabrication, Installation Details	1.4	A/E
100	08 14 00	Interior Wood Doors	Submittal Drawings	Details of glazing	1.4	A/E
101	08 14 00	Interior Wood Doors	Submittal Drawings	Project specific requirements	1.4	A/E
102	08 31 13	Access Doors and Frames	Drawings	Size, Configuration, Fabrication, Installation Details	1.4	A/E
103	08 31 13	Access Doors and Frames	Manufacturer's Literature and Data	Product Descriptions and Installation Instructions	1.4	A/E
104	08 31 13	Access Doors and Frames	Sustainable Construction	Recycled content	1.4.	A/E
105	08 32 13	ICU Sliding Glass Doors	Submittal	Submittal Procedures	1.6	A/E

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106	08 32 13	ICU Sliding Glass Doors	Submittal	Submittal Drawings	1.6	A/E
107	08 32 13	ICU Sliding Glass Doors	Manufacturer's Literature and Data	Product Descriptions and Installation Instructions	1.6	A/E
108	08 32 13	ICU Sliding Glass Doors	Samples	As specificed in 1.6 D	1.6	A/E
109	08 32 13	ICU Sliding Glass Doors	Reports	Test Reports	1.6	A/E
110	08 32 13	ICU Sliding Glass Doors	Certificates	Product Certifications	1.6	A/E
111	08 32 13	ICU Sliding Glass Doors	Qualifications	Manufacturer and Installation and Welder Procedures	1.6	A/E
112	08 32 13	ICU Sliding Glass Doors	Design Drawings and Calculations	Location and magnitude | Identify Deviations	1.6	A/E
113	08 32 13	ICU Sliding Glass Doors	Instructions	Operation & Maintenance Data		
114	08 71 00	Door Hardware	Hardware Schedule	As specified in table	1.6	GOVT
115	08 71 00	Door Hardware	Samples and Manufacturer's Literature	Items not previously approved	1.6	A/E
116	08 71 00	Door Hardware	Certificate of Compliance; Test Reports	As described	1.6	A/E
117	08 71 13	Automatic Door Operators	Drawings	Size, configuration, fabrication, installation details	1.4.B	A/E
118	08 71 13	Automatic Door Operators	Manufacturer's Literature & Data	Product description, Installation instructions, Warranty	1.4.C	A/E
119	08 71 13	Automatic Door Operators	Reports	Test reports	1.4.D	A/E
120	08 71 13	Automatic Door Operators	Qualifications	Manufacturer, Installer	1.4.E	A/E
121	08 71 13	Automatic Door Operators	Operation & Maintenance Data	Instructions: Care, Maint, Emerg Shut down	1.4.F	A/E
122	08 80 00	Glazing	Certificates	As required in 1.4.B	1.4	A/E
123	08 80 00	Glazing	Warranty	Manufactures Warranty	1.4	A/E
124	08 80 00	Glazing	Manufacturer's Literature & Data	As required in 1.4.D	1.4	A/E
125	08 80 00	Glazing	Pre-Construction Report	Adhesion and Compatibility Test Report	1.4	A/E
126	09 05 16	Subsurface Preparation for Floor Finishes	Written approval	Product Compatibility	1.3	A/E

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127	09 05 16	Subsurface Preparation for Floor Finishes	Product Data	As required in 1.3.C	1.3	A/E
128	09 05 16	Subsurface Preparation for Floor Finishes	Test Data	Moisture / Ph	1.3	A/E
129	09 06 00	Schedule for Finishes	Samples	Materials and Finishes	1.3	GOVT
130	09 22 16	Non-Structural Metal Framing	Manufacturer's Literature & Data	Studs, runners and accessories	1.4	A/E
131	09 22 16	Non-Structural Metal Framing	Manufacturer's Literature & Data	Channels (rolled steel)	1.4	A/E
132	09 22 16	Non-Structural Metal Framing	Manufacturer's Literature & Data	Test reports	1.4	A/E
133	09 22 16	Non-Structural Metal Framing	Shop Drawings	Typical ceiling suspension system	1.4	A/E
134	09 22 16	Non-Structural Metal Framing	Shop Drawings	Typical metal stud construction system including details around openings and corner details	1.4	A/E
135	09 22 16	Non-Structural Metal Framing	Test Reports	Fire rating test designation each required assembly	1.4	A/E
136	09 29 00	Gypsum Board	Manufacturer's Literature and Data	Cornerbead and Edge Trim; Finishing materials; Laminating adhesive; Gypsum board, each type	1.4.	A/E
137	09 29 00	Gypsum Board	Samples	Cornerbead, Edge Trim, Control Joints	1.4	A/E
138	09 29 00	Gypsum Board	Test Results	Fire rating tests; sound rating test	1.4.	A/E
139	09 29 00	Gypsum Board	Certificates	Certification that products Do Not Contain Asbestos	1.4	A/E
140	09 30 13	Ceramic/Porcelain Tiling	Samples	Porcelain tile, each type, color, patterns and size.	1.3	A/E
141	09 30 13	Ceramic/Porcelain Tiling	Samples	Trim shapes, bullnose cap and cove including bullnose cap and base pieces at internal and external corners of vertical surfaces, each type, color and size	1.3	A/E
142	09 30 13	Ceramic/Porcelain Tiling	Product Data	Porcelain tile, marked to show each type, size, and shape required	1.3	A/E
143	09 30 13	Ceramic/Porcelain Tiling	Product Data	Leveling compound	1.3	A/E
144	09 30 13	Ceramic/Porcelain Tiling	Product Data	Latex-portland cement mortar and grout	1.3	A/E
145	09 30 13	Ceramic/Porcelain Tiling	Product Data	Fasteners	1.3	A/E
146	09 30 13	Ceramic/Porcelain Tiling	Product Data	Elastomeric waterproofing membrane	1.3	A/E

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147	09 30 13	Ceramic/Porcelain Tiling	Certifications	Master grade certificate, ANSI A137.1	1.3	A/E
148	09 30 13	Ceramic/Porcelain Tiling	Certifications	Manufacturer's certificates	1.4	A/E
149	09 30 13	Ceramic/Porcelain Tiling	Installer qualifications	Installer experience	1.4	A/E
150	09 51 00	Acoustical Ceilings	Submittal Drawings	Drawings	1.5	A/E
151	09 51 00	Acoustical Ceilings	Manufacturer's Literature and Data	Descriptions of each product	1.5	A/E
152	09 51 00	Acoustical Ceilings	Manufacturer's Literature and Data	Ceiling Suspension System	1.5	A/E
153	09 51 00	Acoustical Ceilings	Manufacturer's Literature and Data	Installation instructions	1.5	A/E
154	09 51 00	Acoustical Ceilings	Manufacturer's Literature and Data	Warranty	1.5	A/E
155	09 51 00	Acoustical Ceilings	Samples	Acoustical Units, Each Type	1.5	A/E
156	09 51 00	Acoustical Ceilings	Samples	Suspension system, trim, molding	1.5	A/E
157	09 51 00	Acoustical Ceilings	Samples	Colored markers	1.5	A/E
158	09 51 00	Acoustical Ceilings	Sustainable Construction	Recycled content; biobased content	1.5	A/E
159	09 51 00	Acoustical Ceilings	Certificates	Acoustical Units, Each Type	1.5	A/E
160	09 51 00	Acoustical Ceilings	Qualifications	Manufacturer	1.5	A/E
161	09 51 00	Acoustical Ceilings	Closeout Submittals	O&M Data	1.5	A/E
162	09 65 13	Resilient Base and Accessories	Manufacturer's Literature & Data	As required in 1.4.B	1.4	A/E
163	09 65 13	Resilient Base and Accessories	Samples	As required in 1.4.C	1.4	A/E
164	09 65 13	Resilient Base and Accessories	Sustainable Construction	Recycled content; biobased content	1.4	A/E
165	09 65 13	Resilient Base and Accessories	Operation & Maintenance Data	Care instructions	1.4	A/E
166	09 65 16	Resilient Sheet Flooring	Manufacturer's Literature & Data	Description. Instructions, Warranty	1.4	A/E
167	09 65 16	Resilient Sheet Flooring	Samples	As required in 1.4.C	1.4	A/E

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168	09 65 16	Resilient Sheet Flooring	Sustainable Construction	Low Pollutant-Emitting Materials	1.4	A/E
169	09 65 16	Resilient Sheet Flooring	Certificates	Heat Welded seaming	1.4	A/E
170	09 65 16	Resilient Sheet Flooring	Qualifications	Manufacturer, Installer	1.4	A/E
171	09 67 23.60	Resinous (Epoxy Base) With Vinyl Chip Broadcast (RES-2)	Manufacturer's Literature & Data	Description, application, maintenance	1.3.B	A/E
172	09 67 23.60	Resinous (Epoxy Base) With Vinyl Chip Broadcast (RES-2)	Qualifications	Installer	1.3.C	A/E
173	09 67 23.60	Resinous (Epoxy Base) With Vinyl Chip Broadcast (RES-2)	Sustainable Design Submittals	As required in 1.3.D	1.3.D	A/E
174	09 67 23.60	Resinous (Epoxy Base) With Vinyl Chip Broadcast (RES-2)	Samples	As required in 1.3.E	1.3.E	A/E
175	09 67 23.60	Resinous (Epoxy Base) With Vinyl Chip Broadcast (RES-2)	Drawings	Shop Drawings	1.3.F	A/E
176	09 67 23.60	Resinous (Epoxy Base) With Vinyl Chip Broadcast (RES-2)	Certifications/Approvals	As required in 1.3.G	1.3.G	A/E
177	09 67 23.60	Resinous (Epoxy Base) With Vinyl Chip Broadcast (RES-2)	Warranty	As required in 1.3.H	1.3.H	A/E
178	09 91 00	Painting	Qualifications	For Painter	1.3	A/E
179	09 91 00	Painting	Manufacturer's Literature & Data	For each type of coating	1.3	A/E
180	09 91 00	Painting	Manufacturer's Literature & Data	Current MPI "Approved Product List" for each type of coating	1.3	A/E
181	09 91 00	Painting	Samples	Identity Markers (if used)	1.3	A/E
182	09 91 00	Painting	Manufacturer's Certificates	Various requirements	1.3	A/E
183	09 96 59	High-Build Glazed Coatings	Data	Product Data	1.3	A/E
184	09 96 59	High-Build Glazed Coatings	Manufacturer's Literature & Data	Description each product, Application/ Install instructions, Maintenance Instructions	1.3	A/E
185	09 96 59	High-Build Glazed Coatings	Qualifications	Installer	1.3	A/E
186	09 96 59	High-Build Glazed Coatings	Sustainable submittals	Prodcut Data	1.3	A/E
187	09 96 59	High-Build Glazed Coatings	Samples	As listed in 1.3.E	1.3	A/E
188	09 96 59	High-Build Glazed Coatings	Shop Drawings	Shop Drawings	1.3	A/E

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189	09 96 59	High-Build Glazed Coatings	Certifications	Manufacturer's / Installers / Contractors certifcates & approval	1.3	A/E
190	09 96 59	High-Build Glazed Coatings	Warranty	As specified	1.3	A/E
191	10 14 00	Exterior Signage	Qualifications	Manufacturer's qualifications	1.3	A/E
192	10 14 00	Exterior Signage	Samples	Sign panels and frames, with letters and symbols, each ty	1.4	A/E
193	10 14 00	Exterior Signage	Samples	Sign panels , with letters	1.4	A/E
194	10 14 00	Exterior Signage	Samples	Color Samples ea. Type	1.4	A/E
195	10 14 00	Exterior Signage	Samples	Sample typeface	1.4	A/E
196	10 14 00	Exterior Signage	Manufacturer's Literature	Showing the methods and procedures	1.4	A/E
197	10 14 00	Exterior Signage	Manufacturer's Literature	Signs	1.4	A/E
198	10 14 00	Exterior Signage	Manufacturer's Certificates	For Coating Installer	1.4	A/E
199	10 26 00	Wall and Door Protection	Sustainable Design Submittals	Volatile organic compounds	1.4	A/E
200	10 26 00	Wall and Door Protection	Shop Drawings	Shop Drawings	1.4	A/E
201	10 26 00	Wall and Door Protection	Manufacturer's Literature & Data	Corner Guards, Handrail, Wall Guard	1.4	A/E
202	10 26 00	Wall and Door Protection	Test Report	Tackboard / Frame	1.4	A/E
203	10 26 00	Wall and Door Protection	Qualifications	Manufacturer's	1.4	A/E
204	10 26 00	Wall and Door Protection	Qualifications	Installers	1.4	A/E
205	10 26 00	Wall and Door Protection	Warranty	Manufacturer's	1.4	A/E
206	10 28 00	Toilet, Bath, and Laundry Accessories	Drawings	Submittal Drawings	1.3	A/E
207	10 28 00	Toilet, Bath, and Laundry Accessories	Manufacturer's Literature & Data	Each product	1.3	A/E
208	10 28 00	Toilet, Bath, and Laundry Accessories	Samples	Each product	1.3	A/E
209	10 28 00	Toilet, Bath, and Laundry Accessories	Certificates	Product compliance	1.3	A/E

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210	10 28 00	Toilet, Bath, and Laundry Accessories	Qualifications	Manufacturer	1.3	A/E
211	10 28 00	Toilet, Bath, and Laundry Accessories	Operation & Maintenance Data	Care instructions	1.3	A/E
212	10 44 13	Fire Extinguisher Cabinets	Manufacturer's Literature & Data	Fire extinguisher cabinet including installation instructions and rough opening required	1.2	A/E
213	11 17 36	Package Transfer Units	Drawings	Shop Drawings	1.3	A/E
214	11 17 36	Package Transfer Units	Manufacturer's Literature & Data	Product description	1.3	A/E
215	11 17 36	Package Transfer Units	Certificates	Certify product compliance	1.3	A/E
216	12 31 00	Manufactured Metal Casework	Product Data	Manufacturer’s literature and other data showing compliance	1.4	A/E
217	12 31 00	Manufactured Metal Casework	Certification	Manufacturer’s qualifications specified	1.4	A/E
218	12 31 00	Manufactured Metal Casework	Manufacturer's Literature & Data	As specified in 1.4	1.4	A/E
219	12 31 00	Manufactured Metal Casework	Shop Drawings	As specified in 1.3	1.3	A/E
220	12 31 00	Manufactured Metal Casework	Samples	As specified in 1.3	1.3	A/E
221	12 31 00	Manufactured Metal Casework	Warranty	Manufacturer's Warranty	1.3	A/E
222	12 36 00	Countertops	Shop Drawings	Show dimensions of section and method of assembly	1.3	GOVT
223	12 36 00	Countertops	Drawings	Show details of construction at a scale of 1/2 inch to a foot	1.3	A/E
224	12 36 00	Countertops	Samples	samples each top	1.3	A/E
225	12 36 00	Countertops	Samples	Front edge, back splash, end splash and core with surface material and backing	1.3	A/E
226	13 05 41	Seismic Restraint Requirements for Non Structural Components	Drawings	Equipment Anchorage Drawings	1.3	A/E
227	13 05 41	Seismic Restraint Requirements for Non Structural Components	Drawings	Bracing Drawings	1.3	A/E
228	13 05 41	Seismic Restraint Requirements for Non Structural Components	Calculations	Signed/sealed design calculations	1.3	A/E
229	13 05 41	Seismic Restraint Requirements for Non Structural Components	Certification/Approval	Compliance verification for concrete anchors	1.3	A/E
230	21 13 13	Wet-Pipe Sprinkler System	Certificates	Contractor Qualifications and License	1.4	A/E

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231	21 13 13	Wet-Pipe Sprinkler System	Shop Drawings	Detail Drawings	1.4	A/E
232	21 13 13	Wet-Pipe Sprinkler System	Product Data	Manufacturer's Literature and Data	1.4	A/E
233	21 13 13	Wet-Pipe Sprinkler System	Shop Drawings	Hydraulic Calculations	1.4	A/E
234	21 13 13	Wet-Pipe Sprinkler System	Closeout Submittals	As Built Drawings	1.4	A/E
235	21 13 13	Wet-Pipe Sprinkler System	Closeout Submittals	Operation and Maintenance Manuals	1.4	A/E
236	21 13 13	Wet-Pipe Sprinkler System	Closeout Submittals	Maintenance Schedule	1.4	A/E
237	21 13 13	Wet-Pipe Sprinkler System	Certificates	Certified Test Data	1.4	A/E
238	22 05 11	Common Work Results for Plumbing	Certification	Contractor certification of coordination w/Mfg(s) of major equipment/items	1.4	A/E
239	22 05 11	Common Work Results for Plumbing	List	Installing contractor - List of previous installations/contacts	1.4	A/E
240	22 05 11	Common Work Results for Plumbing	Manufacturer's Literature & Data	Various requirements	1.4	A/E
241	22 05 11	Common Work Results for Plumbing	Submittals/Shop Drawings	Interdependent items	1.4	A/E
242	22 05 11	Common Work Results for Plumbing	Coordination Drawings	Drawings	1.4	A/E
243	22 05 11	Common Work Results for Plumbing	Maintenance & Operating Manuals	Manuals	1.4	A/E
244	22 05 11	Common Work Results for Plumbing	Maintenance & Operating Manuals	Manuals	1.4; 3.1	A/E
245	22 05 11	Common Work Results for Plumbing	Drawings	Arrangement and Installation of equipment and piping	3.1	A/E
246	22 05 12	General Requirements for Plumbing Equipment	Drawings	As required in 1.3.C	1.3	A/E
247	22 05 12	General Requirements for Plumbing Equipment	Maintenance & Operating Manuals	Manuals, as specified	1.3	A/E
248	22 05 19	Meters and Gages for Plumbing Piping	Manufacturer's Literature & Data	As specified in 1.4.C	1.4	A/E
249	22 05 19	Meters and Gages for Plumbing Piping	Maintenance & Operating Manual	Manuals, as specified	1.4	A/E
250	22 05 19	Meters and Gages for Plumbing Piping	Drawings	Shop Drawings as specified in 1.4.E	1.4	A/E
251	22 05 23	General-Duty Valves for Plumbing	Manufacturer's Literature and Data	Valves and backflow preventers	1.4	A/E

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252	22 05 23	General Duty Valves for Plumbing Piping	Maintenance & Operating Manuals	Manuals	1.4	A/E
253	22 07 11	Plumbing Insulation	Manufacturer's Literature and Data	Full description	1.4	A/E
254	22 07 11	Plumbing Insulation	Drawings	Shop Drawings	1.4	A/E
255	22 08 00	Commissioning of Plumbing Systems	Submittals	as required in 1.4	1.4	A/E
256	22 11 00	Facility Water Distribution	Manufacturer's Literature and Data	Full description	1.4	A/E
257	22 11 23	Domestic Water Pumps	Manufacturer's Literature & Data	As specified in 1.4	1.4	A/E
258	22 11 23	Domestic Water Pumps	Certified Data	All factory & Construction Site test data and reports	1.4	A/E
259	22 11 23	Domestic Water Pumps	Maintenance & Operating Manuals	Manuals, as specified in 1.4.E	1.4	A/E
260	22 11 23	Domestic Water Pumps	Signed Checklist	Completed System Readiness Checklist	1.4	A/E
261	22 11 23	Domestic Water Pumps	Plans & Qualifications	Training Plans; Instructor Qualifications	1.4	A/E
262	22 13 00	Facility Sanitary and Vent Piping	Manufacturer's Literature and Data	Full description	1.4	A/E
263	22 13 00	Facility Sanitary and Vent Piping	Drawings	Shop Drawings	1.4	A/E
264	22 40 00	Plumbing Fixtures	Manufacturer's Literature and Data	As specified in 1.4	1.4	A/E
265	22 40 00	Plumbing Fixtures	Instructions	Opersting Instructions	1.4	A/E
266	22 40 00	Plumbing Fixtures	Signed Checklist	Completed System Readiness Checklist	1.4	A/E
267	22 40 00	Plumbing Fixtures	Plans & Qualifications	Training Plans; Instructor Qualifications	1.4	A/E
268	22 63 00	Gas Systems for Laboratory and Healthcare Facilities	Manufacturer's Literature and Data	As specified in 1.4.C	1.4	A/E
269	22 63 00	Gas Systems for Laboratory and Healthcare Facilities	Manufacturer Letter	Station Inlets	1.4	A/E
270	22 63 00	Gas Systems for Laboratory and Healthcare Facilities	Certification	Gas Systems	1.4	A/E
271	22 63 00	Gas Systems for Laboratory and Healthcare Facilities	Checklist	System Readiness Checklist	1.4	A/E
272	22 63 00	Gas Systems for Laboratory and Healthcare Facilities	Plans & Qualifications	Training Plans; Instructor Qualifications	1.4	A/E

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273	22 66 00	Chemical-Waste Systems Piping for Facilities	Manufacturer's Literature and Data	As specified in 1.4.C	1.4.C	A/E
274	22 67 19.16	Reverse-Osmosis Water Equipment	Manufacturer's Literature and Data	As specified in 1.4.C	1.4.C	A/E
275	22 67 19.16	Reverse-Osmosis Water Equipment	Drawing	Complete detailed layout	1.4.D	A/E
276	22 67 19.16	Reverse-Osmosis Water Equipment	Checklist	System Readiness Checklist	1.4.E	A/E
277	22 67 19.16	Reverse-Osmosis Water Equipment	Plans & Qualifications	Training Plans; Instructor Qualifications	1.4.F	A/E
278	23 05 11	Common Work Results for HVAC	Certificates	Certification of Manufacturer's Coordination	1.4	A/E
279	23 05 11	Common Work Results for HVAC	Shop Drawings	Interdependent items	1.4	A/E
280	23 05 11	Common Work Results for HVAC	Shop Drawings	Coordinated Layout Drawings	1.4	A/E
281	23 05 11	Common Work Results for HVAC	Manufacturer's Literature & Data	Various requirements	1.4	A/E
282	23 05 11	Common Work Results for HVAC	Rigging Plan	Rigging Plan	1.4	A/E
283	23 05 11	Common Work Results for HVAC	HVAC Maintenance Data	Various requirements	1.4	A/E
284	23 05 11	Common Work Results for HVAC	Approved submittals	HVAC Equipment submittals	1.4	A/E
285	23 05 11	Common Work Results for HVAC	Checklist	Completed Readiness Checklist	1.4	A/E
286	23 05 11	Common Work Results for HVAC	Traing Plans/Qualifications	Instructor Traing Plans/Qualifications	1.4	A/E
287	23 05 11	Common Work Results for HVAC	Tests	Operating & Performance Tests	1.4	A/E
288	23 05 11	Common Work Results for HVAC	Training	Demonstration & Training	1.4	A/E
289	23 05 12	General Motor Requirements for HVAC	Shop Drawings	Shop Drawings	1.4	A/E
290	23 05 12	General Motor Requirements for HVAC	Manuals	IOM Manuals	1.4	A/E
291	23 05 12	General Motor Requirements for HVAC	Certificates	Certification	1.4	A/E
292	23 05 12	General Motor Requirements for HVAC	Test Reports	System Readiness Checklist	1.4	A/E
293	23 05 41	Noise and Vibration Control for HVAC and Piping Equipment	Manufacturer's Literature and Data	As required in 1.4.B	1.4.B	A/E

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294	23 05 41	Noise and Vibration Control for HVAC and Piping Equipment	Data	Load Calculations	1.4.C	A/E
295	23 05 41	Noise and Vibration Control for HVAC and Piping Equipment	Submittals	Seismic requirements	1.4.D	A/E
296	23 05 93	Testing, Adjusting, and Balancing for HVAC	Certificates	Names and Qualifications	1.3, 1.4	A/E
297	23 05 93	Testing, Adjusting, and Balancing for HVAC	Test Equipment Criteria	Calibration History	1.3	A/E
298	23 05 93	Testing, Adjusting, and Balancing for HVAC	Product Data	AABC or NEBB Publications	1.4	A/E
299	23 05 93	Testing, Adjusting, and Balancing for HVAC	Report	Various Reports	1.4	A/E
300	23 05 93	Testing, Adjusting, and Balancing for HVAC	Report	Test and Balance Reports	1.4	A/E
301	23 07 11	HVAC Insulation	Shop Drawings	Shop Drawings	1.4	A/E
302	23 07 11	HVAC Insulation	Samples	Samples	1.4	A/E
303	23 08 00	Commissioning of HVAC Systems	Closeout Submittals	List of Submittals	1.6	A/E
304	23 08 00	Commissioning of HVAC Systems	Pre-Functional Checklists	Pre-Functional Checklists	3.2	GOVT
305	23 08 00	Commissioning of HVAC Systems	Contractors Tests	As required by other sections	3.3	GOVT
306	23 08 00	Commissioning of HVAC Systems	Functional Tests	Signing of CxA produced and witnessed test	3.4	GOVT
307	23 08 00	Commissioning of HVAC Systems	Training	Training Plans	3.5	GOVT
308	23 09 23	Direct Digital Control System for HVAC	Contractor Qualifications	Letters	1.4	A/E
309	23 09 23	Direct Digital Control System for HVAC	Warranty	Warranty	1.6	A/E
310	23 09 23	Direct Digital Control System for HVAC	Product Data	Manufacturer's Literature and Data	1.7	A/E
311	23 09 23	Direct Digital Control System for HVAC	Certificates	Product Certificates	1.7	A/E
312	23 09 23	Direct Digital Control System for HVAC	Certificates	Product Licenses	1.7	A/E
313	23 09 23	Direct Digital Control System for HVAC	Closeout Submittals	As Built Control Drawings	1.7	A/E
314	23 09 23	Direct Digital Control System for HVAC	Closeout Submittals	Operation and Maintenance Manuals	1.7	A/E

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315	23 09 23	Direct Digital Control System for HVAC	Closeout Submittals	Performance Report	1.7	GOVT
316	23 21 13	Hydronic Piping	Product Data	Manufacturer's Literature and Data	1.4	A/E
317	23 21 13	Hydronic Piping	Product Data	Manufacturer's Certified Data Report for Pressure Vessels	1.4	A/E
318	23 21 13	Hydronic Piping	Certificates	Welder's Qualifications	1.4	A/E
319	23 21 13	Hydronic Piping	Shop Drawings	Coordination Drawings	1.4	A/E
320	23 21 13	Hydronic Piping	Closeout Submittals	As Built Piping Diagrams	1.4	A/E
321	23 21 23	Hydronic Pumps	Manufacturer's Literature and Data	As specified in 1.4.C	1.4	A/E
322	23 21 23	Hydronic Pumps	Chascteristic Curves	As specified in 1.4.D	1.4	A/E
323	23 21 23	Hydronic Pumps	Maintenance & Operating Manuals	Manuals, as required in 1.4.E	1.4	A/E
324	23 21 23	Hydronic Pumps	Checklist	Completed Readiness Checklist	1.4	A/E
325	23 21 23	Hydronic Pumps	Traing Plans/Qualifications	Instructor Traing Plans/Qualifications	1.4	A/E
326	23 22 13	Steam and Condensate Heating Piping	Product Data	Manufacturer's Literature and Data	1.4	A/E
327	23 22 13	Steam and Condensate Heating Piping	Manufacturer's Certified Data Report	ASME Papers	1.4	A/E
328	23 22 13	Steam and Condensate Heating Piping	Coordination Drawings	Coordination Drawings	1.4	A/E
329	23 22 13	Steam and Condensate Heating Piping	As-Built Drawings	As-Built Drawings	1.4	A/E
330	23 25 00	HVAC Water Treatment	Product Data	Manufacturer's Literature and Data	1.4	A/E
331	23 25 00	HVAC Water Treatment	Water Analysis Verification	Report	1.4	A/E
332	23 25 00	HVAC Water Treatment	MSDS	w/Product Data Submittal	1.4	A/E
333	23 25 00	HVAC Water Treatment	Closeout Submittals	IO&M information	1.4	A/E
334	23 31 00	HVAC Ducts and Casings	Product Data	Manufacturer's Literature and Data	1.4	A/E
335	23 31 00	HVAC Ducts and Casings	Shop Drawings	Coordination Drawings	1.4	A/E

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336	23 31 00	HVAC Ducts and Casings	Duct Leakage Tests	Leak and Repair reports	3.2	GOVT
337	23 34 00	HVAC Fans	Product Data	Submittal	1.4	A/E
338	23 34 00	HVAC Fans	Sound Data	Submittal	1.4	A/E
339	23 34 00	HVAC Fans	Motor Data	Submittal	1.4	A/E
340	23 34 00	HVAC Fans	Roof Curbs	Submittal	1.4	A/E
341	23 34 00	HVAC Fans	Belt Guards	Submittal	1.4	A/E
342	23 34 00	HVAC Fans	Closeout Submittals	IO&M information	1.4	A/E
343	23 34 00	HVAC Fans	Certified curves	Submittal	1.4	A/E
344	23 36 00	Air Terminal Units	Product Data	Submittal	1.4	A/E
345	23 36 00	Air Terminal Units	Samples	Sample	1.4	GOVT
346	23 36 00	Air Terminal Units	Certificates	Product Qualifications	1.4	A/E
347	23 36 00	Air Terminal Units	Closeout Submittals	O&M information	1.4	A/E
348	23 37 00	Air Outlets and Inlets	Product Data	Manufacturer's Literature and Data	1.4	A/E
349	23 37 00	Air Outlets and Inlets	Shop Drawings	Coordination Drawings	1.4	A/E
350	23 40 00	HVAC Air Cleaning Devices	Product Data	Submittal	1.4	A/E
351	23 40 00	HVAC Air Cleaning Devices	Performance Reports	Submittal	1.4; 1.3	A/E
352	23 40 00	HVAC Air Cleaning Devices	Certificates	Warranty	1.4; 1.3	A/E
353	23 40 00	HVAC Air Cleaning Devices	HEPA FilterTest Reports	Field Test Reports	1.4	A/E
354	23 82 16	Air Coils	Product Data	Manufacturer's Literature and Data	1.4	A/E
355	23 82 16	Air Coils	Instructions	Installation, Operation and Maintenance Manuals	1.4	A/E
356	23 82 16	Air Coils	Certificates	Certification Compliance	1.4	A/E

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357	23 82 16	Air Coils	Commissioning	System Readiness Checklist	1.4.F	GOVT
358	26 05 11	Requirements for Electrical Installations	Qualifications	Manufacturer, Products, and Services	1.4	A/E
359	26 05 11	Requirements for Electrical Installations	Submittals	Procedures	1.12	A/E
360	26 05 11	Requirements for Electrical Installations	O&M Manuals	O&M Manuals	1.12	A/E
361	26 05 11	Requirements for Electrical Installations	Acceptance Checks	Test Data and Report of Results,	1.14	A/E
362	26 05 11	Requirements for Electrical Installations	Warranty	Letter	1.15	A/E
363	26 05 11	Requirements for Electrical Installations	Instruction	Qualifications, Agendas, Schedules	1.16	A/E
364	26 05 19	Low Voltage Electrical Power Conductors and Cables	Product Data	Manufacturer's Literature and Data	1.5	A/E
365	26 05 19	Low Voltage Electrical Power Conductors and Cables	Certificates	Certifications	1.5	A/E
366	26 05 19	Low Voltage Electrical Power Conductors and Cables	Tests	Acceptance Checks and Tests	3.5	A/E
367	26 05 26	Grounding and Bonding for Electrical Systems	Product Data - Shop Drawings	Manufacturer's Literature and Data	1.4	A/E
368	26 05 26	Grounding and Bonding for Electrical Systems	Test Reports	Ground Resistance Test	1.4	A/E
369	26 05 26	Grounding and Bonding for Electrical Systems	Certificates	Certification of Installation	1.4	A/E
370	26 05 33	Raceway and Boxes for Electrical Systems	Product Data	Manufacturer's Literature and Data	1.4	A/E
371	26 05 33	Raceway and Boxes for Electrical Systems	Shop Drawings	Shop Drawings	1.4	A/E
372	26 05 33	Raceway and Boxes for Electrical Systems	Certificates	Certifications of Materials and Installation	1.4	A/E
373	26 08 00	Commissioning of Electrical Systems	Pre-Functional Checklists	Pre-Functional Checklists	3.2	A/E
374	26 08 00	Commissioning of Electrical Systems	Contractors Tests	As required by other sections	3.3	A/E
375	26 08 00	Commissioning of Electrical Systems	Functional Tests	Signing of CA produced and witnessed test	3.4	A/E
376	26 08 00	Commissioning of Electrical Systems	Training	Training Plans	3.5	A/E
377	26 09 23	Lighting Controls	Shop Drawings	Shop Drawings	1.4	A/E

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378	26 09 23	Lighting Controls	O&M Data	Manuals	1.4	A/E
379	26 09 23	Lighting Controls	Certifications	Lighting Control Systems	1.4	A/E
380	26 09 23	Lighting Controls	Instructions	Instructions	3.4	A/E
381	26 27 26	Wiring Devices	Shop Drawings	Shop Drawings	1.4	A/E
382	26 27 26	Wiring Devices	Closeout Submittals	Operation and Maintenance Manuals	1.4	A/E
383	26 27 26	Wiring Devices	Certificates	Certifications of Materials and Installation	1.4	A/E
384	26 27 26	Wiring Devices	Tests	Acceptance Checks and Tests	3.2	A/E
385	26 29 21	Enclosed Switches and Circuit Breakers	Shop Drawings	Shop Drawings	1.4	A/E
386	26 29 21	Enclosed Switches and Circuit Breakers	Closeout Submittals	Operation and Maintenance Manuals	1.4	A/E
387	26 29 21	Enclosed Switches and Circuit Breakers	Certificates	Certifications of Materials and Installation	1.4	A/E
388	26 29 21	Enclosed Switches and Circuit Breakers	Tests	Acceptance Checks and Tests	3.2	A/E
389	26 41 00	Facility Lightning Protection	Shop Drawings	Shop Drawings	1.4	A/E
390	26 41 00	Facility Lightning Protection	Certifications	Lightening Protection System	1.4	A/E
391	26 41 00	Facility Lightning Protection	Tests	Acceptance Checks and Tests	3.2	A/E
392	26 51 00	Interior Lighting	Shop Drawings	Shop Drawings	1.3	A/E
393	26 51 00	Interior Lighting	Closeout Submittals	Operation and Maintenance Manuals	1.3	A/E
394	26 51 00	Interior Lighting	Certificates	Certifications of Materials and Installation	1.3	A/E
395	26 51 00	Interior Lighting	Tests	Acceptance Checks and Tests	3.2	A/E
396	27 05 11	Requirements for Communications Installations	List	List of Parts	1.7	A/E
397	27 05 11	Requirements for Communications Installations	Information	Product Information	1.7	A/E
398	27 05 11	Requirements for Communications Installations	Source Quality Control Submittal	As required in 1.7.D	1.7	A/E

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399	27 05 11	Requirements for Communications Installations	Qualifications	Installer	1.7	A/E
400	27 05 11	Requirements for Communications Installations	Submittals	Delagated Design submittals - seismic	1.7	A/E
401	27 05 11	Requirements for Communications Installations	Submittals	Anchors and supports	1.7	A/E
402	27 05 11	Requirements for Communications Installations	Test Equipment List	As required in 1.7.H	1.7	A/E
403	27 05 11	Requirements for Communications Installations	Drawings	As required in 1.7.I	1.7	A/E
404	27 05 11	Requirements for Communications Installations	Submittals	Sustainable Design	1.7	A/E
405	27 05 11	Requirements for Communications Installations	Test Reports	Certified Test Reports	1.7	A/E
406	27 05 26	Grounding and Bonding for Communications Systems	Plans & Qualifications	Location /Routing	1.3	A/E
407	27 05 26	Grounding and Bonding for Communications Systems	Submittals	Closeout Submittals	1.3	A/E
408	27 05 33	Raceways and Boxes for Communications Systems	Submittals	As required in 1.3.A	1.3	A/E
409	27 05 33	Raceways and Boxes for Communications Systems	Certification	Material certification	1.3	A/E
410	27 08 00	Commissioning of Communications Systems	Pre-Functional Checklists	Pre-Functional Checklists	1.4	A/E
411	27 08 00	Commissioning of Communications Systems	Traing Agendas and Resumes	Traing Agendas and Resumes	1.4	A/E
412	27 10 00	Control, Communication and Signal Wiring	Certification	As required in 1.3.B	1.3	A/E
413	27 10 00	Control, Communication and Signal Wiring	Installation Requirements	As required in 1.3.C	1.3	A/E
414	27 10 00	Control, Communication and Signal Wiring	Data	Power Data	1.3	A/E
415	27 10 00	Control, Communication and Signal Wiring	Data	Conduit Sizes	1.3	A/E
416	27 10 00	Control, Communication and Signal Wiring	Submittals	Closeout Submittals	1.3	A/E
417	27 51 23	Intercommunications and Program Systems	Data	As required in 1.3.A	1.3.A	A/E
418	27 51 23	Intercommunications and Program Systems	Certifications	As required in 1.3.B	1.3.B	A/E
419	27 51 23	Intercommunications and Program Systems	Warranty	OEM Warranty	1.3.C	A/E

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420	27 51 23	Intercommunications and Program Systems	Report	Needs Assessment	1.3.D	A/E
421	27 51 23	Intercommunications and Program Systems	Material	Maintenance Materials	1.3.E	A/E
422	27 52 23	Nurse Call and Code Blue Systems	Various submittals	As specified in 1.8	1.8	A/E
423	28 05 00	Common Work Results for Electronic Safety and Security	Submittals	as required in 1.6.D	1.6	A/E
424	28 05 13	Conductors and Cables for Electronic Safety and Security	Product Data	Manufacturer's Literature and Data	1.4	A/E
425	28 05 13	Conductors and Cables for Electronic Safety and Security	Certificates	Certifications	1.4	A/E
426	28 05 13	Conductors and Cables for Electronic Safety and Security	Wiring Diagrams	Wiring Diagrams	1.4	A/E
427	28 05 13	Conductors and Cables for Electronic Safety and Security	Cable Administration Drawings	Cable Administration Drawings	1.4	A/E
428	28 05 13	Conductors and Cables for Electronic Safety and Security	Project Planning Documents	Project Planning Documents	1.4	A/E
429	28 05 13	Conductors and Cables for Electronic Safety and Security	Maintenance Data	Maintenance Data	1.4	A/E
430	28 05 26	Grounding and Bonding for Electronic Safety & Security	Mfg Data, Certificates, Shop Drawings	As requested in 1.3	1.3	A/E
431	28 05 28.33	Conduits and Backboxes for Electronic Safety and Security	Shop Drawings	Shop Drawings	1.5	A/E
432	28 05 28.33	Conduits and Backboxes for Electronic Safety and Security	Certificates	Certifications	1.5	A/E
433	28 05 28.33	Conduits and Backboxes for Electronic Safety and Security	Product Data	Manufacturer's Literature and Data	1.5	A/E
434	28 05 28.33	Conduits and Backboxes for Electronic Safety and Security	Coordination Drawings	Coordination Drawings	1.5	A/E
435	28 05 28.33	Conduits and Backboxes for Electronic Safety and Security	Closeout Submittals	Quality Control Test Reports	1.5	A/E
436	28 08 00	Commissioning of Electronic Safety and Security Systems	Submittals	as required in 1.6.D	1.6	A/E
437	28 13 00	Physical Access Control System	Certificates	Quality Assurance compliance	1.4	A/E
438	28 13 00	Physical Access Control System	Drawings	Pre-Installation and AsBuilts	1.4	A/E
439	28 13 00	Physical Access Control System	Shop Drawings	As Required in 1.4.E	1.4	A/E
440	28 13 00	Physical Access Control System	Pre-Installation Design Package	As Required in 1.4.F	1.4	A/E

OWNER:	Department of Veterans Affairs
PROJECT TITLE:	Renovate SPS Spaces
LOCATION:	Charleston, SC
CONTRACT NO:	534-24-102
CONTRACTOR:	

SUBMITTAL REGISTER

Line	Specification Section	Specification Name	Description	Item Submitted	Paragraph #	Classification: GOVT or A/E Reviewer
441	28 13 00	Physical Access Control System	Data	Secutity System Cut sheets	1.4	A/E
442	28 13 00	Physical Access Control System	Data / Certification	Mfg Certification of UL Listing	1.4	A/E
443	28 13 00	Physical Access Control System	Submittals	As Required in 1.4.J	1.4	A/E
444	28 13 00	Physical Access Control System	Submittals	As Required in 1.4.K	1.4	A/E
445	28 13 00	Physical Access Control System	Group II Technical Data Package	As Required in 1.4.L	1.4	A/E
446	28 13 00	Physical Access Control System	Group III Technical Data Package	As Required in 1.4.M	1.4	A/E
447	28 13 00	Physical Access Control System	Group IV Technical Data Package	As Required in 1.4.N	1.4	A/E
448	28 13 00	Physical Access Control System	Group V Technical Data Package	As Required in 1.4.O	1.4	A/E
449	28 13 00	Physical Access Control System	Certificates	FIPS 201 Compliance Certificates	1.4	A/E
450	28 13 00	Physical Access Control System	Checklist	System Readiness Checklist	1.4	A/E
451	28 23 00	Video Surveillance	Certificates	Quality Assurance Compliance	1.5	A/E
452	28 23 00	Video Surveillance	Pre-Installation	As-Built Package	1.5	A/E
453	28 23 00	Video Surveillance	Pre-Installation	Design Package	1.5	A/E
454	28 23 00	Video Surveillance	Data	Security System Cut sheets	1.5	A/E
455	28 23 00	Video Surveillance	Data / Certification	Mfg Certification of UL Listing	1.5	A/E
456	28 23 00	Video Surveillance	Checklist	System Readiness Checklist	1.5	A/E
457	28 31 00	Fire Detection and Alarm	Drawings	Drawings	1.4	A/E
458	28 31 00	Fire Detection and Alarm	Manuals	Operation and Maintenance Manuals	1.4	A/E
459	28 31 00	Fire Detection and Alarm	Certificates	Certifications	1.4	A/E
460	28 31 00	Fire Detection and Alarm	Shop Drawings	Shop Drawings	1.2	A/E
461	28 31 00	Fire Detection and Alarm	Closeout Submittals	Operation and Maintenance Manuals	1.2	A/E

OWNER:	Department of Veterans Affairs
PROJECT TITLE:	Renovate SPS Spaces
LOCATION:	Charleston, SC
CONTRACT NO:	534-24-102
CONTRACTOR:	

SUBMITTAL REGISTER

Line	Specification Section	Specification Name	Description	Item Submitted	Paragraph #	Classification: GOVT or A/E Reviewer
462	28 31 00	Fire Detection and Alarm	Certificates	Certifications of Materials and Installation	1.2	A/E
463	28 31 00	Fire Detection and Alarm	Warranty	Warranty	1.2	A/E
464	28 31 00	Fire Detection and Alarm	Data	Instructions	3.5	A/E

05-01-24

SECTION 01 35 26

SAFETY REQUIREMENTS

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SAFETY REQUIREMENTS

1.1 APPLICABLE PUBLICATIONS

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

B. American Society of Safety Professionals (ASSP):

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

Z359.0-2012.....Definitions and Nomenclature Used for Fall Protection and Fall Arrest

Z359.1-2016.....The Fall Protection Code

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

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

D. The Facilities Guidelines Institute (FGI):

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

E. National Fire Protection Association (NFPA):

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

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

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

70-2020.....National Electrical Code

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

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

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

703-2024.....Standard for Fire Retardant-Treated Wood and Fire-Retardant Coatings for Building Materials

F. The Joint Commission (TJC)

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

G. U.S. Nuclear Regulatory Commission

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

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

29 CFR 1904 .....Reporting and Recording Injuries & Illnesses

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

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

CPL 2-0.124.....Multi-Employer Citation Policy

I. US Army Corps of Engineers Safety and Occupational Health (SOH) Requirements Publication No. EM 385-1-1, 2024 edition

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. Competent Person, Confined Space

The CP, Confined Space, is a person meeting the competent person requirements as defined EM 385-1-1 Appendix Q, with thorough knowledge of OSHA's Confined Space Standard, 29 CFR 1910.146, and designated in writing to be responsible for the immediate supervision, implementation

and monitoring of the confined space program, who through training, knowledge and experience in confined space entry is capable of identifying, evaluating and addressing existing and potential confined space hazards and, who has the authority to take prompt corrective measures with regard to such hazards.

D. Competent Person, Cranes and Rigging.

The CP, Cranes and Rigging, as defined in EM 385-1-1 Appendix Q, is a person meeting the competent person, who has been designated in writing to be responsible for the immediate supervision, implementation and monitoring of the Crane and Rigging Program, who through training, knowledge and experience in crane and rigging is capable of identifying, evaluating and addressing existing and potential hazards and, who has the authority to take prompt corrective measures regarding such hazards.

E. Competent Person, Excavation/Trenching.

A CP, Excavation/Trenching, is a person meeting the competent person requirements as defined in EM 385-1-1 Appendix Q and 29 CFR 1926, who has been designated in writing to be responsible for the immediate supervision, implementation and monitoring of the excavation/trenching program, who through training, knowledge and experience in excavation/trenching is capable of identifying, evaluating and addressing existing and potential hazards and, who has the authority to take prompt corrective measures with regard to such hazards.

F. Competent Person, Fall Protection

The CP, Fall Protection, is a person meeting the competent person requirements as defined in EM 385-1-1 Appendix Q and in accordance with ASSE/SAFE Z359.0, who has been designated in writing by the employer to be responsible for immediate supervising, implementing and monitoring of the fall protection program, who through training, knowledge and experience in fall protection and rescue systems and equipment, is capable of identifying, evaluating and addressing existing and potential fall hazards and, who has the authority to take prompt corrective measures with regard to such hazards.

G. Competent Person, Scaffolding

The CP, Scaffolding is a person meeting the competent person requirements in EM 385-1-1 Appendix Q and designated in writing by the

employer to be responsible for immediate supervising, implementing and monitoring of the scaffolding program. The CP for Scaffolding has enough training, knowledge and experience in scaffolding to correctly identify, evaluate and address existing and potential hazards and has the authority to take prompt corrective measures with regard to these hazards. CP qualifications must be documented and include experience on the specific scaffolding systems/types being used, assessment of the base material that the scaffold will be erected upon, load calculations for materials and personnel, and erection and dismantling. The CP for scaffolding must have a documented, minimum of 8-hours of scaffold training to include training on the specific type of scaffold being used (e.g. mast-climbing, adjustable, tubular frame), in accordance with EM 385-1-1 Section 22.B.02.

H. Competent Person (CP) Trainer

A competent person trainer as defined in EM 385-1-1 Appendix Q, who is qualified in the material presented, and who possesses a working knowledge of applicable technical regulations, standards, equipment and systems related to the subject matter on which they are training Competent Persons. A competent person trainer must be familiar with the typical hazards and the equipment used in the industry they are instructing. The training provided by the competent person trainer must be appropriate to that specific industry. The competent person trainer must evaluate the knowledge and skills of the competent persons as part of the training process.

I. High Risk Activities

High Risk Activities are activities that involve work at heights, crane and rigging, excavations and trenching, scaffolding, electrical work, and confined space entry.

J. "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.

K. Qualified Person, Fall Protection (QP for FP)

A QP for FP is a person meeting the requirements of EM 385-1-1 Appendix Q, and ASSE/SAFE Z359.0, with a recognized degree or professional

certificate and with extensive knowledge, training and experience in the fall protection and rescue field who is capable of designing, analyzing, and evaluating and specifying fall protection and rescue systems.

L. USACE Property and Equipment
Interpret "USACE" property and equipment specified in USACE EM 385-1-1 as Government property and equipment.

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

N. Mishap: Mishap in this specification is defined according to the EM 385-1-1. A mishap is any unplanned, undesired event that occurs during the course of work being performed. This includes accidents, incidents, and near misses.

O. Mishap Criticality Categories
1. No impact/Near-Miss – near miss incidents that shall be investigated and reported to the VA within 24 hours.
2. Minor incident/impact – incidents that require first aid or result in minor equipment damage (less than $5000). These incidents must be investigated and reported to the VA within 24 hours.
3. Moderate incident/impact – Any work-related injury or illness that results in any of the following. These incidents must be investigated and are required to be reported to the VA within 2 hours.
   a. Days away from work (any time lost after day of injury/illness onset);
   b. Restricted work;
   c. Transfer to another job;
   d. Medical treatment beyond first aid;
   e. Loss of consciousness;
   f. 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,
   g. any incident that leads to major equipment damage (greater than $5000).
4. 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.

P. Load Handling Equipment (LHE)
LHE is a term used to describe cranes, hoists and all other hoisting equipment (hoisting equipment means equipment, including crane, derricks, hoists and power operated equipment used with rigging to raise, lower or horizontally move a load).

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

1.3 SUBMITTAL REQUIRMENTS

A. Government approval or concurrence is required for submittals with a "G" designation; submittals not having a "G" designation are submitted for information only.

B. Preconstruction Submittals
1. Accident Prevention Plan (APP); G

C. Reports
1. Monthly Contractor Health Safety and Environmental (HS&E) Performance Report; G
2. Notifications and Reports;
3. Mishap Reports;
4. Near-Miss Reports;
5. LHE Inspection Reports
6. Monthly Exposure Hour Reports;

D. Work Plans
1. Standard Lift Plan; G
2. Critical Lift Plan; G
3. Activity Hazard Analysis (AHA); G
4. Confined Space Entry Permit
5. Hot Work Permit
6. Radiography Operation Planning Work Sheet; G
7. Portable Gauge Operations Planning Worksheet; G

E. Certificates

1. Contractor Safety Self-Evaluation Checklist
2. Crane Operators/Riggers Certifications; G
3. Certificate of Compliance
4. Mobile Cranes Inspection Certificate
5. License Certificates
6. Machinery & Mechanized Equipment Certification Form

1.4 REGULATORY REQUIREMENTS

A. In addition to the detailed requirements included in the provisions of this contract, comply with the most recent edition of USACE EM 385-1-1, comply with 29 CFR 1926, comply with 29 CFR 1910 as incorporated by reference within 29 CFR 1926, comply with ASSP 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 COR, Contracting Officer Representative or Government Designated Authority.

1.5 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 Mishap 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. Specifically articulating the safety

requirements found within these VA contract safety specifications and the latest version of the United States Army Corps of Engineers – Safety and Occupational Health (SOH) Requirements - EM 385-1-1 Manual. Model language and format can be found in Appendix A of the EM 385-1-1 Manual

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. The Statement of Safety and Health Policy must be signed by a company executive.

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 or EM 385-1-1 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 Construction Outreach training within the past five years is required for all workers on site and the OSHA 30-hour Construction Outreach training within the past five years 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. **MISHAP INVESTIGATION & REPORTING.**

1) The APP shall include identify person(s) responsible to provide the following to the Contracting Officer Representative:

1. Monthly HS&E Performance Report (Exposure Hours Data);
2. Mishap investigation reports;
3. Project site injury and illness logs;
4. Near-Miss reports;

i. **PLANS (PROGRAMS, PROCEDURES) REQUIRED.** Based on a risk assessment of contracted activities and on mandatory OSHA and/or EM 385-1-1 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 limited to procedures for addressing the risks associated 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 (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) Pre-Cast Concrete;
28) Public (Mandatory compliance with ANSI/ASSP A10.34-2012);
29) Sub-contractor or cross-trade coordination;

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

D. Once accepted by the Contracting Officer Representative, the APP and attachments will be enforced as part of the contract. Disregarding the provisions of this contract or the accepted APP will be cause for stopping of work, at the discretion of the Contracting Officer 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 COR, Contracting Officer Representative or Government Designated Authority. Should any severe hazard exposure, i.e. imminent danger, become evident, stop work in the

area, secure the area, and develop a plan to remove the exposure and control the hazard. Notify the COR and Contracting Officer within 2 hours of discovery. Eliminate/remove the hazard. In the interim, take all necessary action to restore and maintain safe working conditions to safeguard onsite personnel, visitors, the public and the environment.

1.6 ACTIVITY HAZARD ANALYSES (AHAS)

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

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

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

1. The names of the Competent/Qualified Person(s) required for a particular activity (for example, excavations, scaffolding, fall protection, other activities as specified by OSHA, EM 385-1-1, or other State and Local agencies) shall be identified and included in the AHA. Certification of their competency/qualification shall be submitted to the Government Designated Authority (GDA) for acceptance prior to the start of that work activity.

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

a. If more than one Competent/Qualified Person is used on the AHA activity, a list of names shall be submitted as an attachment to the AHA. Those listed must be Competent/Qualified for the type of

work involved in the AHA and familiar with current site safety issues.

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

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

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

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

1.7 PRECONSTRUCTION SAFETY 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 pre-construction safety 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.

1.8 SAFETY MEETINGS

A. Conduct safety meetings to review past activities, plan for new or changed operations, review pertinent aspects of appropriate AHA (by trade), establish safe working procedures for anticipated hazards, and provide pertinent Safety and Occupational Health (SOH) training and motivation. Conduct meetings at least once a month for all supervisors on the project location. The SSHO, supervisors, foremen, or CDSOs must conduct meetings at least once a week for the trade workers. Document meeting minutes to include the date, persons in attendance, subjects discussed, and names of individual(s) who conducted the meeting. Maintain documentation on-site and furnish copies to the Contracting Officer on request. Notify the Contracting Officer of all scheduled meetings 7 calendar days in advance.

1.9 “SITE SAFETY AND HEALTH OFFICER” (SSHO) AND “COMPETENT PERSON” (CP)

A. The Prime Contractor shall provide a Safety oversight team that includes a minimum of one (1) person at each project site, for each shift, to function as the Site Safety and Health Officer (SSHO). The Prime Contractor shall provide a minimum of one “Full-Time” SSHO at each project site, for each shift that holds as current, a professional safety certification with at least 3 years of dedicated construction safety related experience. The SSHO shall ensure that the requirements of the VA and of 29 CFR 1926.16 are met for the project. The SSHO must be at the work site at all times, during construction activities, to implement and administer the Contractor's safety program and government-accepted Accident Prevention Plan. If the SSHO is off-site for a period longer than 8 hours, or one shift, and not exceeding 40 hours, or 5 shifts, a pre-approved Alternate Safety Officer shall be provided and shall fulfill the same roles and responsibilities as the primary SSHO. The Alternate Safety Officer shall have the required training, experience, and qualifications in accordance with EM 385-1-1 Section 01.A.17, and all associated sub-paragraphs. When the SSHO is temporarily (not to exceed 8 hours) off-site, a Designated

Representative (DR) from the Prime Contractors' staff, as identified in the AHA may be used in lieu of an Alternate Safety Officer and shall be on the project site, at all times, when work is being performed. Note that the DR is a collateral duty safety position, with safety duties in addition to their full-time occupation. 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). However, the SSHO has be a separate qualified individual from the Prime Contractor's Superintendent and/or Quality Control Manager with duties only as the SSHO

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

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

1.10 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.

B. As a minimum the SSHO must have completed the OSHA 30-hour Construction Safety Outreach class within the past five (5) years and:

1. Seven (7) years of construction industry safety related experience.
2. OR have a safety and health degree from an accredited university or college and five (5) years of construction industry safety related experience
3. OR hold as current, a Certified Safety Professional (CSP) or a Construction Health and Safety Technician (CHST) certification and five (3) years of construction industry safety related experience.

C. The Alternate Safety Officer shall meet, at a minimum, the requirements of EM 385-1-1 Section 1 and have five (5) years of construction industry safety experience If the SSHO does not have a current certification, certification must be obtained within 90 days, maximum, of contract award.

D. All designated CPs shall have completed the OSHA 30-hour Construction Safety course and/or EM 385-1-1 40-hour training within the past 5 years. In addition, 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 and control associated with those high hazard work operations. Documented “repeat” deficiencies in the execution of safety requirements will require retaking the requisite formal course.

E. All other construction workers shall have the OSHA 10-hour Construction Safety Outreach course within the past 5 years and any necessary safety training to be able to identify hazards within their work environment.

F. Submit training records associated with the above training requirements to Contracting Officer Representative for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP

DRAWINGS, PRODUCT DATA AND SAMPLES 15 calendar days prior to the date of the preconstruction safety conference for acceptance.

G. 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.

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

1.11 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 with a written report of the entire construction areas with the subcontractors’ “Trade Safety and Health CPs” present in their work areas. Coordinate with, and report findings and corrective actions weekly to Contracting Officer Representative.

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 shall be one that is not a part of the immediate site project team. The individual can be a corporate safety professional or independently contracted who is not an immediate member of the construction project site team. 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 will be notified immediately prior to start of the inspection and invited to accompany the inspection.
3. Identified hazard and controls will be discussed to come to a mutual understanding to ensure abatement and prevent future reoccurrence.

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

1.12 MISHAPS, OSHA 300 LOGS, AND EXPOSURE-HOURS

A. The prime contractor shall establish and maintain a Near-Miss and Mishap 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 and provide an initial report to the Contracting Officer Representative as soon as practical, but no more than two hours after any Moderate or Major Mishap, High Visibility Incidents, or any weight handling and hoisting equipment mishap. No Impact/Near-Miss and Minor Mishaps shall be reported within 24 hours or as soon as practical. Within the notification the sender shall include contractor name; contract title; type of contract; name of activity, installation or location where mishap 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 mishap (to include type of construction equipment used, PPE used, etc.). Preserve the conditions and evidence on the Mishap site until the Contracting Officer Representative determines whether a government investigation will be conducted.

B. Conduct a mishap investigation for all Mishaps including mishaps resulting in at least $20,000 in damages without injury, to establish the root cause(s) of the mishap. The Mishap investigation shall include images, 5 whys, the injured person’s firsthand account, any witness accounts, methods of procedures, related AHA to the task, and corrective action plan signed by the president, vice president, or appropriate corporate-level leadership identified in the company’s org chart for the project. Additionally, complete the VA Form 2162 (or equivalent) and provide the report to the Contracting Officer Representative within 7 calendar days of the accident. The Contracting Officer Representative will provide copies of any required or special forms.

C. A summation of all exposure-hours worked by the contractor and associated sub-contractors for each month will be reported to

Contracting Officer Representative no later than the 10th day of the following month.

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

1.13 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. Any PPE above and beyond the Mandatory PPE identified below and determined by the Contracting Officer or their Representative to be necessary in the performance of the Governments duties relative to this contract, shall be provided to the Government upon written notification by the Contracting Officer and at no additional expense to the Government. All PPE provided to the Government shall also be accompanied by any relevant or required training necessary to ensure its proper use.

C. Mandatory Minimum PPE includes:

1. Hard Hats – unless written authorization is given by the Contracting Officer Representative in circumstances of work operations that have limited potential for falling object hazards such as during finishing work or minor remodeling. With authorization to relax the requirement of hard hats, if a worker becomes exposed to an overhead falling object hazard, then hard hats would be required in accordance with the OSHA and/or EM 385-1-1 regulations.
2. Safety glasses - unless written authorization is given by the Contracting Officer Representative 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

Contracting Officer Representative 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.
5. High-visibility Safety Apparel – appropriate brightly colored clothing that feature some type of reflective material on them, such as safety vests, shall be worn by personnel or visitors on construction sites.

1.14 PRE-CONSTRUCTION RISK ASSESSMENT

A. Control of all construction-associated hazards that affect VA medical facilities, their occupants, services and mission-essential functions and capabilities is critical in all medical center facilities. VHA Pre-Construction Risk Assessments (PCRAs) for construction, renovation and maintenance projects are included with this contract solicitation with required mitigations of identified hazards. VHA-PCRAs will be re-validated and updated as needed based on but not limited to changes from original designs, affected individuals, areas/locations, scope, contractor means and methods, safety requirements, phasing, contractor competencies and capabilities.

B. Infection Prevention and 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. A detailed analysis of potential risks for infectious disease transmission affecting the care, treatment or services of patients or residents has been conducted. VHA Infection Control Risk Assessments (ICRAs) are included with this contract solicitation with required mitigation actions/activities. VHA-ICRAs will be re-validated and updated as needed based on changes in original designs, affected individuals, area(s) or location(s), scope, contractor means and methods, infection prevention and control requirements, differing site conditions, phasing, contractor competencies and capabilities, and infectious disease outbreaks. The Contractor shall adhere to the latest VHA-ICRA requirements, which at the date on this Specification is Version 1.3.

C. For work occurring at a VA medical facility, coordinate with the facility Safety Manager/Officer, as several aspects of this section directly relate to infection control risk assessments required in or adjacent to construction affecting occupied buildings accredited by The Joint Commission.

D. Products and Materials:

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

1.15 DUST CONTROL

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

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

C. 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.

1.16 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.

1.17 FIRE SAFETY

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

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

C. For work occurring at a VA medical facility, coordinate with the facility Safety Manager/Officer, as several aspects of this section directly relate to interim life safety measures required in or adjacent to construction affecting occupied buildings accredited by The Joint Commission.

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

E. Temporary Construction Partitions:

1. Install and maintain temporary construction partitions to provide smoke-tight separations between construction areas and adjoining areas. Construct partitions of gypsum board or fire-retardant treated plywood (fire-retardant treated in accordance with NFPA 703) on both sides of fire-retardant treated wood framing or metal steel studs. Extend the partitions through suspended ceilings to floor slab deck or roof. Seal joints and penetrations. At door openings, install Class C, ¾ hour fire/smoke rated doors with self-closing devices.
2. Install one-hour fire-rated temporary construction partitions as shown on drawings to maintain integrity of existing exit stair enclosures, exit passageways, fire-rated enclosures of hazardous areas, horizontal exits, smoke barriers, vertical shafts and openings enclosures.
3. Close openings in smoke barriers and fire-rated construction to maintain fire ratings. Seal penetrations with listed through-penetration firestop materials in accordance with Section 07 84 00, FIRESTOPPING.

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

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

H. Egress Routes for Construction Workers: Maintain free and unobstructed egress. Inspect daily. Report findings and corrective actions weekly to Contracting Officer Representative.

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

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

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

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

M. Smoke Detectors: Prevent accidental operation. Remove temporary covers at end of work operations each day. Coordinate with Contracting Officer Representative.

N. Hot Work: Perform and safeguard hot work operations in accordance with NFPA 241 and NFPA 51B. Coordinate with Facility Safety Office. Obtain permits from facility Safety Officer at least 24 hours in advance.

O. Fire Hazard Prevention and Safety Inspections: Inspect entire construction areas weekly. Coordinate with, and report findings and corrective actions weekly to Contracting Officer Representative.

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.

1.18 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 when 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 Facility Safety Officer or Contracting Officer Representative with approval of the Medical Center Director will make the determination if the circumstances would meet the exception outlined above. An AHA and permit specific to energized work activities will be developed, reviewed, and accepted by the VA prior to the start of that activity.

1. Development of a Hazardous Electrical Energy Control Procedure is required prior to de-energization. A single Simple Lockout/Tagout Procedure for multiple work operations can only be used for work involving qualified person(s) de-energizing one set of conductors or circuit part source. Task specific Complex Lockout/Tagout Procedures are required at all other times.
2. Verification of the absence of voltage after de-energization and lockout/tagout is considered “energized electrical work” (live work) under NFPA 70E, and shall only be performed by qualified persons wearing appropriate shock protective (voltage rated) gloves and arc rate personal protective clothing and equipment, using Underwriters Laboratories (UL) tested and appropriately rated contact electrical testing instruments or equipment appropriate for the environment in which they will be used.

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

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

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

1.19 FALL PROTECTION

A. The fall protection (FP) threshold height requirement is 4ft for ALL WORK in government occupied sites, unless the OSHA 29 CFR 1926 or EM 385-1-1 requirements are more stringent, to include steel erection activities, systems-engineered activities (prefabricated) metal buildings, residential (wood) construction and scaffolding work. For work occurring at new “greenfield” sites or sites with 24/7 Contractor controlled 100% restricted access, the fall protection (FP) threshold height may be increased to 6ft unless the OSHA 29 CFR 1926 or EM 385-1-1 requirements are more stringent.

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 more stringent of OSHA and EM 385-1-1 requirements.

1.20 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 4 ft as stated in Section 1.16.

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

1. Scaffolds, platforms, or temporary floors shall be provided for all work except that can be performed safely from the ground or similar footing.
2. Ladders less than 20 feet may be used as work platforms only when use of small hand tools or handling of light material is involved.
3. Ladder jacks, lean-to, and prop-scaffolds are prohibited.
4. Emergency descent devices shall not be used as working platforms.

D. Contractors shall use a scaffold tagging system in which all scaffolds are tagged by the Competent Person. Tags shall be color-coded: green indicates the scaffold has been inspected and is safe to use; red indicates the scaffold is unsafe to use. Tags shall be readily visible, made of materials that will withstand the environment in which they are used, be legible and shall include:

1. The Competent Person’s name and signature;
2. Dates of initial and last inspections.

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

1.21 EXCAVATION AND TRENCHES

A. All excavation and trenching work shall comply with 29 CFR 1926 Subpart P. Excavations less than 5 feet in depth require evaluation by the contractor’s “Competent Person” (CP) for determination of the necessity

of an excavation protective system where kneeing, laying in, or stooping within the excavation is required.

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

1. Estimated start time & stop time
2. Specific location and nature of the work.
3. Indication of the contractor's "Competent Person" (CP) in excavation safety with qualifications and signature. Formal course in excavation safety is required by the contractor's CP.
4. Indication of whether soil or concrete removal to an offsite location is necessary.
5. Indication of whether soil samples are required to determined soil contamination.
6. Indication of coordination with local authority (i.e. "One Call") or contractor's effort to determine utility location with search and survey equipment.
7. Indication of review of site drawings for proximity of utilities to digging/drilling.

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

1. Determination of OSHA classification of soil. Soil samples will be from freshly dug soil with samples taken from different soil type layers as necessary and placed at a safe distance from the excavation by the excavating equipment. A pocket penetrometer will

be utilized in determination of the unconfined compression strength of the soil for comparison against OSHA table (Less than 0.5 Tons/FT2 – Type C, 0.5 Tons/FT2 to 1.5 Tons/FT2 – Type B, greater than 1.5 Tons/FT2 – Type A without condition to reduce to Type B).

2. Indication of selected protective system (sloping/benching, shoring, shielding). When soil classification is identified as "Type A" or "Solid Rock", only shoring or shielding or Professional Engineer designed systems can be used for protection. A Sloping/Benching system may only be used when classifying the soil as Type B or Type C. Refer to Appendix B of 29 CFR 1926, Subpart P for further information on protective systems designs.
3. Indication of the spoil pile being stored at least 2 feet from the edge of the excavation and safe access being provided within 25 feet of the workers.
4. Indication of assessment for a potential toxic, explosive, or oxygen deficient atmosphere where oxygen deficiency (atmospheres containing less than 19.5 percent oxygen) or a hazardous atmosphere exists or could reasonably be expected to exist. Internal combustion engine equipment is not allowed in an excavation without providing force air ventilation to lower the concentration to below OSHA PELs, providing sufficient oxygen levels, and atmospheric testing as necessary to ensure safe levels are maintained.

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

1. The planned dig site will be outlined/marked in white prior to locating the utilities.
2. Used of the American Public Works Association Uniform Color Code is required for the marking of the proposed excavation and located utilities.
3. 811 will be called two business days before digging on all local or State lands and public Right-of Ways.
4. Digging will not commence until all known utilities are marked.
5. Utility markings will be maintained

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

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

1.22 CRANES

A. All crane work shall comply with 29 CFR 1926 Subpart CC and EM 385-1-1.

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

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

D. Crane operators shall not carry loads

1. over the general public or VAMC personnel
2. over any occupied building unless
   a. The top two or more floors are vacated under the lift affected area AND a Contractor provided engineering analysis, performed by a Professional Engineer, demonstrates that overhead protection provided by the roof and vacated floors is sufficient to protect against the potential loss of a load being lifted or a minimum of 300 psf of protection is provided, whichever is greater
   b. OR Overhead protection is designed by a Professional Engineer and installed over the roof by the Contractor to protect the occupants below. The installed system shall be sufficient to protect against the potential loss of a load being lifted or a

minimum of 300 psf of protection is provided, whichever is greater.

c. OR A formal request may be submitted to the Contracting Officer for documentation, if available, indicating the roof of the building has been previously designed and constructed using a reinforced concrete roof slab or other means to provide overhead protection from construction activities specifically associated with the vertical or horizontal expansion of the same building AND a Contractor provided engineering analysis, performed by a Professional Engineer, demonstrates that overhead protection provided by the roof is sufficient to protect against the potential loss of a load being lifted or a minimum of 300 psf of protection is provided, whichever is greater.

1.23 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.

1.24 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 Facility Safety Officer.

1.25 WELDING AND CUTTING

A. 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 Officer. Obtain permits from Facility Safety Officer at least 24 hours in advance.

1.26 LADDERS

A. All Ladder use shall comply with 29 CFR 1926 Subpart X and EM 385-1-1.

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

C. Manufacturer safety labels shall be in place on ladders

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

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

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

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

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

G. Ladders shall be inspected for visible defects on a daily basis and after any occurrence that could affect their safe use. Broken or damaged ladders shall be immediately tagged "DO NOT USE," or with similar wording, and withdrawn from service until restored to a condition meeting their original design.

1.27 FLOOR & WALL OPENINGS

A. All floor and wall openings shall comply with 29 CFR 1926 Subpart M and EM 385-1-1.

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

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

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

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

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11-01-20

SECTION 01 42 19
REFERENCE STANDARDS

PART 1 - GENERAL

1.1 DESCRIPTION

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

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

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

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

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

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

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

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

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

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

AABC Associated Air Balance Council
https://www.aabc.com

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

AH American Hort
https://www.americanhort.org

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

AIA American Institute of Architects

http://www.aia.org

AISC American Institute of Steel Construction
http://www.aisc.org

AISI American Iron and Steel Institute
http://www.steel.org

AITC American Institute of Timber Construction
https://aitc-glulam.org

AMCA Air Movement and Control Association, Inc.
http://www.amca.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

ARPM Association for Rubber Product Manufacturers
https://arpm.com

ASABE American Society of Agricultural and Biological Engineers
https://www.asabe.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 International
http://www.asse-plumbing.org

ASTM American Society for Testing and Materials International
http://www.astm.org

AWI Architectural Woodwork Institute
https://www.awinet.org

AWS American Welding Society
https://www.aws.org

AWWA American Water Works Association
https://www.awwa.org

BHMA	Builders Hardware Manufacturers Association https://www.buildershardware.com
BIA	The Brick Industry Association http://www.gobrick.com
CAGI	Compressed Air and Gas Institute https://www.cagi.org
CGA	Compressed Gas Association, Inc. https://www.cganet.com
CI	The Chlorine Institute, Inc. https://www.chlorineinstitute.org
CISCA	Ceilings and Interior Systems Construction Association https://www.cisca.org
CISPI	Cast Iron Soil Pipe Institute https://www.cispi.org
CLFMI	Chain Link Fence Manufacturers Institute https://www.chainlinkinfo.org
CPA	Composite Panel Association https://www.compositepanel.org
CPMB	Concrete Plant Manufacturers Bureau https://www.cpmb.org
CRA	California Redwood Association http://www.calredwood.org
CRSI	Concrete Reinforcing Steel Institute https://www.crsi.org
CTI	Cooling Technology Institute https://www.cti.org
DHA	Decorative Hardwoods Association https://www.decorativehardwoods.org
DHI	Door and Hardware Institute https://www.dhi.org
EGSA	Electrical Generating Systems Association http://www.egsa.org
EEI	Edison Electric Institute https://www.eei.org
EPA	United States Environmental Protection Agency https://www.epa.gov

ETL	ETL Testing Services http://www.intertek.com
FAA	Federal Aviation Administration https://www.faa.gov
FCC	Federal Communications Commission https://www.fcc.gov
FPS	Forest Products Society http://www.forestprod.org
GANA	Glass Association of North America http://www.glasswebsite.com
FM	Factory Mutual Global Insurance https://www.fmglobal.com
GA	Gypsum Association https://gypsum.org
GSA	General Services Administration https://www.gsa.gov
HI	Hydraulic Institute http://www.pumps.org
ICC	International Code Council https://shop.iccsafe.org
ICEA	Insulated Cable Engineers Association https://www.icea.net
ICAC	Institute of Clean Air Companies http://www.icac.com
IEEE	Institute of Electrical and Electronics Engineers https://www.ieee.org\
IGMA	Insulating Glass Manufacturers Alliance https://www.igmaonline.org
IMSA	International Municipal Signal Association http://www.imsasafety.org
MBMA	Metal Building Manufacturers Association https://www.mbma.com
MSS	Manufacturers Standardization Society of the Valve and Fittings Industry http://msshq.org

NAAMM	National Association of Architectural Metal Manufacturers https://www.naamm.org
PHCC	Plumbing-Heating-Cooling Contractors Association https://www.phccweb.org
NBS	National Bureau of Standards See - NIST
NBBI	The National Board of Boiler and Pressure Vessel Inspectors https://www.nationalboard.org
NEC	National Electric Code See - NFPA National Fire Protection Association
NEMA	National Electrical Manufacturers Association https://www.nema.org
NFPA	National Fire Protection Association https://www.nfpa.org
NHLA	National Hardwood Lumber Association https://www.nhla.com
NIH	National Institute of Health https://www.nih.gov
NIST	National Institute of Standards and Technology https://www.nist.gov
NELMA	Northeastern Lumber Manufacturers Association, Inc. http://www.nelma.org
NPA	National Particleboard Association (See CPA, Composite Panel Association)
NSF	National Sanitation Foundation http://www.nsf.org
OSHA	Occupational Safety and Health Administration Department of Labor https://www.osha.gov
PCA	Portland Cement Association https://www.cement.org
PCI	Precast Prestressed Concrete Institute https://www.pci.org
PPI	Plastics Pipe Institute https://www.plasticpipe.org

PEI	Porcelain Enamel Institute http://www.porcelainenamel.com
PTI	Post-Tensioning Institute http://www.post-tensioning.org
RFCI	Resilient Floor Covering Institute https://www.rfci.com
RIS	Redwood Inspection Service (See Western Wood Products Association) https://www.wwpa.org
SCMA	Southern Cypress Manufacturers Association http://www.cypressinfo.org
SDI	Steel Door Institute http://www.steeldoor.org
SJI	Steel Joist Institute https://www.steeljoist.org
SMACNA	Sheet Metal & Air-Conditioning Contractors' National Association https://www.smacna.org
SSPC	The Society for Protective Coatings https://www.sspc.org
STI	Steel Tank Institute https://www.steeltank.com
SWI	Steel Window Institute https://www.steelwindows.com
TCNA	Tile Council of North America https://www.tcnatile.com
TEMA	Tubular Exchanger Manufacturers Association http://www.tema.org
TPI	Truss Plate Institute https://www.tpinst.org
UBC	The Uniform Building Code (See ICC)
UL	Underwriters' Laboratories Incorporated https://www.ul.com
ULC	Underwriters' Laboratories of Canada https://www.ulc.ca

WCLB	West Coast Lumber Inspection Bureau http://www.wclib.org
WDMA	Window and Door Manufacturers Association https://www.wdma.com
WRCLA	Western Red Cedar Lumber Association https://www.realcedar.com
WWPA	Western Wood Products Association http://www.wwpa.org

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02-01-21

SECTION 01 45 00

QUALITY CONTROL

PART 1 - GENERAL

1.1 DESCRIPTION

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

1.2 APPLICABLE PUBLICATIONS

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

B. ASTM International (ASTM)

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

1.3 SUBMITTALS

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

1. Preconstruction Submittals
   a. Interim CQC Plan
   b. CQC Plan
   c. Additional Requirements for Design Quality Control (DQC) Plan
2. Design Data
   a. Discipline-Specific Checklists
   b. Design Quality Control
3. Test Reports
   a. Verification Statement

PART 2 PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

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

3.2 CQC PLAN

A. Submit the CQC Plan no later than 30 days after receipt of Notice to Proceed (NTP) proposed to implement the requirements of the FAR Clause 52.246.12 titled "Inspection of Construction". The Government will consider an Interim CQC Plan for the first 30 days of operation, which must be accepted within 10 business days of NTP. Design and/or construction will be permitted to begin only after acceptance of the CQC Plan or acceptance of an Interim plan applicable to the particular feature of work to be started. Work outside of the accepted Interim CQC Plan will not be permitted to begin until acceptance of a CQC Plan or another Interim CQC Plan containing the additional work scope is accepted.

B. Content of the CQC Plan: Include, as a minimum, the following to cover all design and construction operations, both onsite and offsite, including work by subcontractors, designers of record consultants, architects/engineers (A/E), fabricators, suppliers, and purchasing agents:

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

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

C. Additional Requirements for Design Quality Control (DQC) Plan: The following additional requirements apply to the DQC Plan for DB projects only and not DBB projects:
1. Submit and maintain a DQC Plan as an effective QC program which assures that all services required by this contract are performed and provided in a manner that meets professional architectural and engineering quality standards. As a minimum, all documents must be technically reviewed by competent, independent reviewers identified in the DQC Plan. The same element that produced the product may not perform the independent technical review (ITR). Correct errors and deficiencies in the design documents prior to submitting them to the Government.
2. Include the design schedule in the master project schedule, showing the sequence of events involved in carrying out the project design tasks within the specific Contract period. This should be at a detailed level of scheduling sufficient to identify all major design tasks, including those that control the flow of work. Include review and correction periods associated with each item. This should be a forward planning as well as a project monitoring tool. The schedule

reflects calendar days and not dates for each activity. If the schedule is changed, submit a revised schedule reflecting the change within 7 calendar days. Include in the DQC Plan the discipline-specific checklists to be used during the design and quality control of each submittal. Submit at each design phase as part of the project documentation these completed discipline-specific checklists.

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

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

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

3.3 COORDINATION MEETING

A. After the Preconstruction Conference Post-award Conference before start of design or construction, and prior to acceptance by the Government of the CQC Plan, meet with the Contracting Officer or Authorized designee to discuss the Contractor’s quality control system. Submit the CQC Plan a minimum of 5 business days prior to the Coordination Meeting. During the meeting, a mutual understanding of the system details must be developed, including the forms for recording the CC operations, design activities (if applicable), control activities, testing, administration of the system for both onsite and offsite work, and the

interrelationship of Contractor's Management and control with the Government's Quality Assurance. Minutes of the meeting will be prepared by the Government, signed by both the Contractor and Contracting Officer or Authorized designee and will become a part of the contract file. There can be occasions when subsequent conferences will be called by either party to reconfirm mutual understandings or address deficiencies in the CQC system or procedures which can require corrective action by the Contractor.

3.4 QUALITY CONTROL ORGANIZATION:

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

B. CQC System Manager: Identify as CQC System Manager an individual within the onsite work organization that is responsible for overall management of CQC and has the authority to act in all CQC matters for the Contractor. The CQC system Manager is required to be a graduate

engineer, graduate architect, or a graduate of construction management, with a minimum of 5 years construction experience on construction similar to the scope of this Contract. The CQC System Manger is assigned as CQC System Manager but has duties as project superintendent in addition to quality control. Identify in the plan an alternate to serve in the event of the CDQC System Manager's absence. The requirements for the alternate are the same as the CQC System Manager.

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

EXPERIENCE MATRIX

Area	Qualifications
Civil	Graduate Civil Engineer or Construction Manager with 2 years experience in the type of work being performed on this project or technician with 5 years related experience.
Mechanical	Graduate Mechanical Engineer with 2 years experience or construction professional with 5 years of experience supervising mechanical features of work in the field with a construction company.

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

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

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

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

3.6 CONTROL

A. CQC is the means by which the Contractor ensures that the construction, to include that of subcontractors and suppliers, complies with the requirements of the contract. At least three phases of control are required to be conducted by the CQC System Manager for each definable feature of the construction work as follows:

1. Preparatory Phase: This phase is performed prior to beginning work on each definable feature of work after all required plans/documents/materials are approved/accepted, and after copies are at the work site. This phase includes:

   a. A review of each paragraph of applicable specifications, references codes, and standards. Make available during the preparatory inspection a copy of those sections of referenced codes and standards applicable to that portion of the work to be accomplished in the field. Maintain and make available in the field for use by Government personnel until final acceptance of the work.

   b. Review of the Contract drawings.

   c. Check to assure that all materials and equipment have been tested, submitted, and approved.

   d. Review of provisions that have been made to provide required control inspection and testing.

e. Review Special Inspections required by Section 01 45 35 Special Inspections, that Statement of Special Inspections and the Schedule of Specials Inspections.

f. Examination of the work area to assure that all required preliminary work has been completed and is in compliance with the Contract.

g. Examination of required materials, equipment, and sample work to assure that they are on hand conform to approved shop drawings or submitted data, and are properly stored.

h. Review of the appropriate Activity Hazard Analysis (AHA) to assure safety requirements are met.

i. Discussion of procedures for controlling quality of the work including repetitive deficiencies. Document construction tolerances and workmanship standards – contract defined or industry standard if not contract defined - for that feature of work.

i. Check to ensure that the portion of the plan for the work to be performed has been accepted by the Contracting Officer.

j. Discussion of the initial control phase.

k. The Government needs to be notified at least 48 hours or 2 business days in advance of beginning the Preparatory control phase. Include a meeting conducted by the CQC System Manager and attended by the superintendent, other CQC personnel (as applicable), and the foreman responsible for the definable feature. Document the results of the Preparatory phase actions by separate minutes prepared by the CQC System Manager and attach to the daily CQC report. Instruct applicable workers as to the acceptable level of workmanship required in order to meet contract specifications.

B. Initial Phase: This phase is accomplished at the beginning of a definable feature of work. Accomplish the following:

1. Check work to ensure that it is in full compliance with contract requirements. Review minutes of the Preparatory meeting.

2. Verify adequacy of controls to ensure full contract compliance. Verify the required control inspection and testing is in compliance with the contract.

3. Establish level of workmanship and verify that it meets minimum acceptable workmanship standards. Compare with required sample panels as appropriate.
4. Resolve all differences.
5. Check safety to include compliance with an upgrading of the safety plan and activity hazard analysis. Review the activity analysis with each worker.
6. The Government needs to be notified at least 48 hours or 2 business days in advance of beginning the initial phase for definable features of work. Prepare separate minutes of this phase by the CQC System Manager and attach to the daily CQC report. Indicate the exact location of initial phase for definable feature of work for future reference and comparison with Follow-Up phases.
7. The initial phase for each definable feature of work is repeated for each new crew to work onsite, or any time acceptable specified quality standards are not being met.
8. Coordinate scheduled work with Special Inspections required by Section 01 45 35 Special Inspections, the Statement of Special Inspections, and the Schedule of Special Inspections.

C. Follow-Up Phase: Perform daily checks to assure control activities, including control testing, are providing continued compliance with contract requirements until the completion of the particular feature of work. Record the checks in the CQC documentation. Conduct final Follow-Up checks and correct all deficiencies prior to the start of additional features of work which may be affected by the deficient work. Do not build upon nor conceal non-conforming work. Coordinate scheduled work with Special Inspections required by Section 01 45 35 Special Inspections, the Statement of Special Inspections, and the Schedule of Special Inspections

D. Additional Preparatory and Initial Phases on the same definable features of work if: the quality ongoing work is unacceptable; if there are changes in the applicable CQC staff, onsite production supervision or work crew; if work on a definable feature is resumed after a substantial period of inactivity, or if other problems develop.

3.7 TESTS

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

1. Verify that testing procedures comply with contract requirements.
2. Verify that facilities and testing equipment are available and comply with testing standards.
3. Check test instrument calibration data against certified standards.
4. Verify that recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.
5. Record results of all tests taken, both passing and failing on the CQC report for the date taken. Specification paragraph reference, location where tests were taken, and the unique sequential control number identifying the test. If approved by the Contracting Officer or Authorized designee, actual test reports are submitted later with a reference to the test number and date taken. Provide an information copy of tests performed by an offsite or commercial test facility directly to the Contracting Officer or Authorized designee. Failure to submit timely test reports as stated results in nonpayment for related work performed and disapproval of the test facility for this Contract.

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

1. Capability Check: The Government reserves the right to check laboratory equipment in the proposed laboratory for compliance with the standards set forth in the contract specifications and to check the laboratory technician’s testing procedures and techniques.

Laboratories utilized for testing soils, concrete, asphalt and steel are required to meet criteria detailed in ASTM D3740 and ASTM E329.

2. Capability Recheck: If the selected laboratory fails the capability check, the Contractor will be assessed a charge equal to value of recheck to reimburse the Government for each succeeding recheck of the laboratory or the checking of a subsequently selected laboratory. Such costs will be deducted from the Contract amount due the Contractor.

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

3.8 COMPLETION INSPECTION

A. Punch-Out Inspection: Conduct an inspection of the work by the CQC system Manager near the end of the work, or any increment of the work established by the specifications. Prepare and include in the CQC documentation a punch list of items which do not conform to the approved drawings and specifications. Include within the list of deficiencies the estimated date by which the deficiencies will be corrected. Make a second inspection the CQC System Manager or staff to ascertain that all deficiencies have been corrected. Once this is accomplished, notify the Government that the facility is ready for the Government Pre-Final Inspection.

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

C. Final Acceptance Inspection: The Contractor’s QC Inspection personnel, plus the superintendent or other primary management person, and the

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

3.9 DOCUMENTATION

A. Quality Control Activities: Maintain current records providing factual evidence that required QC activities and tests have been performed. Include in these records the work of subcontractors and suppliers on an acceptable form that includes, as a minimum, the following information:
   1. The name and area of responsibility of the Contractor/Subcontractor
   2. Operating plant/equipment with hours worked, idle, or down for repair.
   3. Work performed each day, giving location, description, and by whom. When Network Analysis (NAS) is used, identify each phase of work performed each day by NAS activity number.
   4. Test and control activities performed with results and references to specification/drawing requirements. Identify the Control Phase (Preparatory, Initial, and/or Follow-Up). List deficiencies noted, along with corrective action.
   5. Quantity of materials received at the site with statement as to acceptability, storage, and reference to specification/drawing requirements.
   6. Submittals and deliverables reviewed, with Contract reference, by whom, and action taken.
   7. Offsite surveillance activities, including actions taken.

8. Job safety evaluations stating what was checked, results, and instructions or corrective actions.
9. Instructions given/received and conflicts in plans and specifications.
10. Provide documentation of design quality control activities. For independent design reviews, provide, as a minimum, identification of the Independent Technical Reviewer (ITR) team, the ITR review comments, responses, and the record of resolution of the comments.

B. Verification Statement: Indicate a description of trades working on the project; the number of personnel working; weather conditions encountered; and any delays encountered. Cover both conforming and deficient features and include a statement that equipment and materials incorporated in the work and workmanship comply with the Contract. Furnish the original and one copy of these records in report form to the Government daily with 1 week after the date covered by the report, except that reports need not be submitted for days on which no work is performed. As a minimum, prepare and submit on report for every 7 days of no work and on the last day of a no work period. All calendar days need to be accounted for throughout the life of the contract. The first report following a day of no work will be for that day only. Reports need to be signed and dated by the CQC System Manager. Include copies of test reports and copies of reports prepared by all subordinate QC personnel within the CQC System Manager Report.

3.10 SAMPLE FORMS

A. Templates of various quality control reports can be found on the Whole Building Design Guide website at https://www.wbdg.org/FFC/NAVGRAPH/01%2045%2000.00%2020_quality_control_reports.pdf

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

the subject of claim for extension of time or for excess costs or damages by the Contractor.

--- End of Section ---

11-01-18

SECTION 01 45 29

TESTING LABORATORY SERVICES

PART 1 - GENERAL

1.1 DESCRIPTION

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

1.2 APPLICABLE PUBLICATIONS

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

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

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

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

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

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

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

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

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

C. American Concrete Institute (ACI):

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

of Soil and Rock as used in Engineering Design and Construction

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

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

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

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

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

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

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

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

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

E. American Welding Society (AWS):

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

1.3 REQUIREMENTS

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

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

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

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

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

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 CONCRETE

A. Batch Plant Inspection and Materials Testing:

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

B. Field Inspection and Materials Testing:

1. Provide a technician at site of placement at all times to perform concrete sampling and testing.
2. Review the delivery tickets of the ready-mix concrete trucks arriving on-site. Notify the Contractor if the concrete cannot be placed within the specified time limits or if the type of concrete delivered is incorrect. Reject any loads that do not comply with the Specification requirements. Rejected loads are to be removed from the site at the Contractor’s expense. Any rejected concrete that is placed will be subject to removal.
3. Take concrete samples at point of placement in accordance with ASTM C172. Mold and cure compression test cylinders in accordance with ASTM C31. Make at least three cylinders for each 40 m^3 (50 cubic yards) or less of each concrete type, and at least three cylinders for any one day's pour for each concrete type. After good concrete quality control has been established and maintained as determined by COR make three cylinders for each 80 m^3 (100 cubic yards) or less of each concrete type, and at least three cylinders from any one day's pour for each concrete type. Label each cylinder with an identification number. COR may require additional cylinders to be molded and cured under job conditions.
4. Perform slump tests in accordance with ASTM C143. Test the first truck each day, and every time test cylinders are made. Test pumped concrete at the hopper and at the discharge end of the hose at the beginning of each day’s pumping operations to determine change in slump.
5. Determine the air content of concrete per ASTM C173. For concrete required to be air-entrained, test the first truck and every 20 m^3 (25 cubic yards) thereafter each day. For concrete not required to be air-entrained, test every 80 m^3 (100 cubic yards) at random. For pumped concrete, initially test concrete at both the hopper and the discharge end of the hose to determine change in air content.
6. If slump or air content fall outside specified limits, make another test immediately from another portion of same batch.

7. Perform unit weight tests in compliance with ASTM C138 for normal weight concrete and ASTM C567 for lightweight concrete. Test the first truck and each time cylinders are made.
8. Notify laboratory technician at batch plant of mix irregularities and request materials and proportioning check.
9. Verify that specified mixing has been accomplished.
10. Environmental Conditions: Determine the temperature per ASTM C1064 for each truckload of concrete during hot weather and cold weather concreting operations:
    a. When ambient air temperature falls below 4.4 degrees C (40 degrees F), record maximum and minimum air temperatures in each 24-hour period; record air temperature inside protective enclosure; record minimum temperature of surface of hardened concrete.
    b. When ambient air temperature rises above 29.4 degrees C (85 degrees F), record maximum and minimum air temperature in each 24-hour period; record minimum relative humidity; record maximum wind velocity; record maximum temperature of surface of hardened concrete.
11. Inspect the reinforcing steel placement, including bar size, bar spacing, top and bottom concrete cover, proper tie into the chairs, and grade of steel prior to concrete placement. Submit detailed report of observations.
12. Observe conveying, placement, and consolidation of concrete for conformance to specifications.
13. Observe condition of formed surfaces upon removal of formwork prior to repair of surface defects and observe repair of surface defects.
14. Observe curing procedures for conformance with specifications, record dates of concrete placement, start of preliminary curing, start of final curing, end of curing period.
15. Observe preparations for placement of concrete:
    a. Inspect handling, conveying, and placing equipment, inspect vibrating and compaction equipment.
    b. Inspect preparation of construction, expansion, and isolation joints.

16. Observe preparations for protection from hot weather, cold weather, sun, and rain, and preparations for curing.
17. Observe concrete mixing:
    a. Monitor and record amount of water added at project site.
    b. Observe minimum and maximum mixing times.
18. Measure concrete flatwork for levelness and flatness as follows:
    a. Perform Floor Tolerance Measurements F_F and F_L in accordance with ASTM E1155. Calculate the actual overall F- numbers using the inferior/superior area method.
    b. Perform all floor tolerance measurements within 48 hours after slab installation and prior to removal of shoring and formwork.
    c. Provide the Contractor and the COR with the results of all profile tests, including a running tabulation of the overall F_F and F_L values for all slabs installed to date, within 72 hours after each slab installation.
19. Other inspections:
    a. Grouting under base plates.
    b. Grouting anchor bolts and reinforcing steel in hardened concrete.

C. Laboratory Tests of Field Samples:
1. Test compression test cylinders for strength in accordance with ASTM C39. For each test series, test one cylinder at 7 days and one cylinder at 28 days. Use remaining cylinder as a spare tested as directed by COR. Compile laboratory test reports as follows: Compressive strength test shall be result of one cylinder, except when one cylinder shows evidence of improper sampling, molding or testing, in which case it shall be discarded and strength of spare cylinder shall be used.
2. Make weight tests of hardened lightweight structural concrete in accordance with ASTM C567.
3. Furnish certified compression test reports (duplicate) to COR. In test report, indicate the following information:
    a. Cylinder identification number and date cast.
    b. Specific location at which test samples were taken.
    c. Type of concrete, slump, and percent air.
    d. Compressive strength of concrete in MPa (psi).

e. Weight of lightweight structural concrete in kg/m^3 (pounds per cubic feet).

f. Weather conditions during placing.

g. Temperature of concrete in each test cylinder when test cylinder was molded.

h. Maximum and minimum ambient temperature during placing.

i. Ambient temperature when concrete sample in test cylinder was taken.

j. Date delivered to laboratory and date tested.

3.2 STRUCTURAL STEEL

A. General: Provide shop and field inspection and testing services to certify structural steel work is done in accordance with contract documents. Welding shall conform to AWS D1.1 Structural Welding Code.

B. Prefabrication Inspection:

1. Review design and shop detail drawings for size, length, type and location of all welds to be made.
2. Approve welding procedure qualifications either by pre-qualification or by witnessing qualifications tests.
3. Approve welder qualifications by certification or retesting.
4. Approve procedure for control of distortion and shrinkage stresses.
5. Approve procedures for welding in accordance with applicable sections of AWS D1.1.

C. Fabrication and Erection:

1. Weld Inspection:

a. Inspect welding equipment for capacity, maintenance and working condition.

b. Verify specified electrodes and handling and storage of electrodes in accordance with AWS D1.1.

c. Inspect preparation and assembly of materials to be welded for conformance with AWS D1.1.

d. Inspect preheating and interpass temperatures for conformance with AWS D1.1.

e. Measure 25 percent of fillet welds.

f. Welding Magnetic Particle Testing: Test in accordance with ASTM E709 for a minimum of:
   1) 20 percent of all shear plate fillet welds at random, final pass only.
   2) 20 percent of all continuity plate and bracing gusset plate fillet welds, at random, final pass only.
   3) 100 percent of tension member fillet welds (i.e., hanger connection plates and other similar connections) for root and final passes.
   4) 20 percent of length of built-up column member partial penetration and fillet welds at random for root and final passes.
   5) 100 percent of length of built-up girder member partial penetration and fillet welds for root and final passes.

g. Welding Ultrasonic Testing: Test in accordance with ASTM E164 and AWS D1.1 for 100 percent of all full penetration welds, braced and moment frame column splices, and a minimum of 20 percent of all other partial penetration column splices, at random.

h. Welding Radiographic Testing: Test in accordance with ASTM E94, and AWS D1.1 for 5 percent of all full penetration welds at random.

i. Verify that correction of rejected welds are made in accordance with AWS D1.1.

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

2. Bolt Inspection:
   a. Inspect high-strength bolted connections in accordance AISC Specifications for Structural Joints Using ASTM F3125 Bolts.
   b. Slip-Critical Connections: Inspect 10 percent of bolts, but not less than 2 bolts, selected at random in each connection in accordance with AISC Specifications for Structural Joints Using ASTM F3125 Bolts. Inspect all bolts in connection when one or more are rejected.
   c. Fully Pre-tensioned Connections: Inspect 10 percent of bolts, but not less than 2 bolts, selected at random in 25 percent of

connections in accordance with AISC Specification for Structural Joints Using ASTM F3125 Bolts. Inspect all bolts in connection when one or more are rejected.

d. Bolts installed by turn-of-nut tightening may be inspected with calibrated wrench when visual inspection was not performed during tightening.

e. Snug Tight Connections: Inspect 10 percent of connections verifying that plies of connected elements have been brought into snug contact.

f. Inspect field erected assemblies; verify locations of structural steel for plumbness, level, and alignment.

D. Submit inspection reports, record of welders and their certification, and identification, and instances of noncompliance to COR.

3.3 STEEL DECKING

A. Provide field inspection of welds of metal deck to the supporting steel, and testing services to ensure steel decking has been installed in accordance with contract documents and manufacturer’s requirements.

B. Qualification of Field Welding: Qualify welding processes and welding operators in accordance with “Welder Qualification” procedures of AWS D1.1. Refer to the “Plug Weld Qualification Procedure” in Part 3 “Field Quality Control.”

C. Submit inspection reports, certification, and instances of noncompliance to COR.

3.8 SPRAYED-ON FIREPROOFING

A. Provide field inspection and testing services to certify sprayed-on fireproofing has been applied in accordance with contract documents.

B. Obtain a copy of approved submittals from COR.

C. Use approved installation in test areas as criteria for inspection of work.

D. Test sprayed-on fireproofing for thickness and density in accordance with ASTM E605.

1. Thickness gauge specified in ASTM E605 may be modified for pole extension so that overhead sprayed material can be reached from floor.

E. Location of test areas for field tests as follows:

1. Thickness: Select one bay per floor, or one bay for each 930 m^2 (10,000 square feet) of floor area, whichever provides for greater number of tests. Take thickness determinations from each of following locations: Metal deck, beam, and column.
2. Density: Take density determinations from each floor, or one test from each 930 m^2 (10,000 square feet) of floor area, whichever provides for greater number of tests, from each of the following areas: Underside of metal deck, beam flanges, and beam web.

F. Submit inspection reports, certification, and instances of noncompliance to COR.

- - - E N D - - -

SECTION 01 57 19
TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the control of environmental pollution and damage that the Contractor must consider for air, water, and land resources. It includes management of visual aesthetics, noise, solid waste, radiant energy, and radioactive materials, as well as other pollutants and resources encountered or generated by the Contractor. The Contractor is obligated to consider specified control measures with the costs included within the various contract items of work.

B. Environmental pollution and damage is defined as the presence of chemical, physical, or biological elements or agents which:
   1. Adversely effect human health or welfare,
   2. Unfavorably alter ecological balances of importance to human life,
   3. Effect other species of importance to humankind, or;
   4. Degrade the utility of the environment for aesthetic, cultural, and historical purposes.

C. Definitions of Pollutants:
   1. Chemical Waste: Petroleum products, bituminous materials, salts, acids, alkalis, herbicides, pesticides, organic chemicals, and inorganic wastes.
   2. Debris: Combustible and noncombustible wastes, such as leaves, tree trimmings, ashes, and waste materials resulting from construction or maintenance and repair work.
   3. Sediment: Soil and other debris that has been eroded and transported by runoff water.
   4. Solid Waste: Rubbish, debris, garbage, and other discarded solid materials resulting from industrial, commercial, and agricultural operations and from community activities.
   5. Surface Discharge: The term "Surface Discharge" implies that the water is discharged with possible sheeting action and subsequent soil erosion may occur. Waters that are surface discharged may terminate in drainage ditches, storm sewers, creeks, and/or "water

of the United States" and would require a permit to discharge water from the governing agency.

6. Rubbish: Combustible and noncombustible wastes such as paper, boxes, glass and crockery, metal and lumber scrap, tin cans, and bones.
7. Sanitary Wastes:
   a. Sewage: Domestic sanitary sewage and human and animal waste.
   b. Garbage: Refuse and scraps resulting from preparation, cooking, dispensing, and consumption of food.

1.2 QUALITY CONTROL

A. Establish and maintain quality control for the environmental protection of all items set forth herein.

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

1.3 REFERENCES

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

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

1.4 SUBMITTALS

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

1. Environmental Protection Plan: After the contract is awarded and prior to the commencement of the work, the Contractor shall meet with the Contracting Officer’s Representative (COR) to discuss the proposed Environmental Protection Plan and to develop mutual understanding relative to details of environmental protection. Not more than 20 days after the meeting, the Contractor shall prepare and submit to the Contracting Officer for approval, a written and/or graphic Environmental Protection Plan including, but not limited to, the following:
   a. Name(s) of person(s) within the Contractor's organization who is (are) responsible for ensuring adherence to the Environmental Protection Plan.
   b. Name(s) and qualifications of person(s) responsible for manifesting hazardous waste to be removed from the site.

c. Name(s) and qualifications of person(s) responsible for training the Contractor's environmental protection personnel.
d. Description of the Contractor's environmental protection personnel training program.
e. A list of Federal, State, and local laws, regulations, and permits concerning environmental protection, pollution control, noise control and abatement that are applicable to the Contractor's proposed operations and the requirements imposed by those laws, regulations, and permits.
f. Methods for protection of features to be preserved within authorized work areas including trees, shrubs, vines, grasses, ground cover, landscape features, air and water quality, fish and wildlife, soil, historical, and archeological and cultural resources.
g. Procedures to provide the environmental protection that comply with the applicable laws and regulations. Describe the procedures to correct pollution of the environment due to accident, natural causes, or failure to follow the procedures as described in the Environmental Protection Plan.
h. Permits, licenses, and the location of the solid waste disposal area.
i. Drawings showing locations of any proposed material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials. Include as part of an Erosion Control Plan approved by the District Office of the U.S. Soil Conservation Service and the Department of Veterans Affairs.
j. Environmental Monitoring Plans for the job site including land, water, air, and noise.
k. Work Area Plan showing the proposed activity in each portion of the area and identifying the areas of limited use or nonuse. Plan should include measures for marking the limits of use areas. This plan may be incorporated within the Erosion Control Plan.
l. Inclusion of “best management practices” and methodologies.

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

1.5 PROTECTION OF ENVIRONMENTAL RESOURCES

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

B. Protection of Land Resources: Prior to construction, identify all land resources to be preserved within the work area. Do not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, topsoil, and landforms without permission from the COR. Do not fasten or attach ropes, cables, or guys to trees for anchorage unless specifically authorized, or where special emergency use is permitted. Provide erosion control plans, in phases where required.

1. Work Area Limits: Prior to any construction, mark the areas that require work to be performed under this contract. Mark or fence isolated areas within the general work area that are to be saved and protected. Protect monuments, works of art, and markers before construction operations begin. Convey to all personnel the purpose of marking and protecting all necessary objects.
2. Protection of Landscape: Protect trees, shrubs, vines, grasses, land forms, and other landscape features shown on the drawings to be preserved by marking, fencing, or using any other approved techniques.
   a. Box and protect from damage existing trees and shrubs to remain on the construction site.
   b. Immediately repair all damage to existing trees and shrubs by trimming, cleaning, and painting with antiseptic tree paint.
   c. Do not store building materials or perform construction activities closer to existing trees or shrubs than the farthest extension of their limbs.
3. Handle and dispose of solid wastes in such a manner that will prevent contamination of the environment. Place solid wastes (excluding clearing debris) in containers that are emptied on a regular schedule. Transport all solid waste off Government property and dispose of waste in compliance with Federal, State, and local requirements.

4. Store chemical waste away from the work areas in corrosion resistant containers and dispose of waste in accordance with Federal, State, and local regulations.
5. Handle discarded materials other than those included in the solid waste category as directed by the COR.

C. Protection of Water Resources: Keep construction activities under surveillance, management, and control to avoid pollution of surface and ground waters and sewer systems. Implement management techniques to control water pollution by the listed construction activities that are included in this contract.
   1. Washing and Curing Water: Do not allow wastewater directly derived from construction activities to enter water areas. Collect and place wastewater in retention ponds allowing the suspended material to settle, the pollutants to separate, or the water to evaporate.

D. Protection of Fish and Wildlife Resources: Keep construction activities under surveillance, management, and control to minimize interference with, disturbance of, or damage to fish and wildlife. Prior to beginning construction operations, list species that require specific attention along with measures for their protection.

E. Protection of Air Resources: Keep construction activities under surveillance, management, and control to minimize pollution of air resources. Burning is not permitted on the job site. Maintain ambient air quality standards set by the Environmental Protection Agency, for those construction operations and activities specified.
   1. Particulates: Control dust particles, aerosols, and gaseous by-products from all construction activities, processing, and preparation of materials (such as from asphaltic batch plants) at all times, including weekends, holidays, and hours when work is not in progress.
   2. Particulates Control: Maintain all excavations, stockpiles, haul roads, permanent and temporary access roads, plant sites, spoil areas, borrow areas, and all other work areas within or outside the project boundaries free from particulates which would cause a hazard or a nuisance. Sprinklering, chemical treatment of an approved type, light bituminous treatment, baghouse, scrubbers, electrostatic

precipitators, or other methods are permitted to control particulates in the work area.

3. Hydrocarbons and Carbon Monoxide: Control monoxide emissions from equipment to Federal and State allowable limits.
4. Odors: Control odors of construction activities and prevent obnoxious odors from occurring.

F. Reduction of Noise: Minimize noise using every action possible. Perform noise-producing work in less sensitive hours of the day or week as directed by the COR. Maintain noise-produced work at or below the decibel levels and within the time periods specified.

1. Perform construction activities involving repetitive, high-level impact noise only between 6 p.m. and 5am, Monday through Friday, and all day Saturday and Sunday, unless otherwise permitted by the COR. Repetitive impact noise on the property shall not exceed the following dB limitations:

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

2. The SPS operations are only permitted to be taken offline Monday through Friday between the hours of 6pm and 5am, or any time on Saturdays and Sundays. All work that will affect SPS operations must be approved by the COR 48 hours prior to affecting SPS operations.
3. Provide sound-deadening devices on equipment and take noise abatement measures that are necessary to comply with the requirements of this contract, consisting of, but not limited to, the following:
   a. Maintain maximum permissible construction equipment noise levels at 15 meter (50 feet) (dBA):

EARTHMOVING		MATERIALS HANDLING	
FRONT LOADERS	75	CONCRETE MIXERS	75
BACKHOES	75	CONCRETE PUMPS	75
DOZERS	75	CRANES	75
TRACTORS	75	DERRICKS IMPACT	75

SCAPERS	80	PILE DRIVERS	95
GRADERS	75	JACK HAMMERS	75
TRUCKS	75	ROCK DRILLS	80
PAVERS, STATIONARY	80	PNEUMATIC TOOLS	80
PUMPS	75	SAWS	75
GENERATORS	75	VIBRATORS	75
COMPRESSORS	75		

b. Use shields or other physical barriers to restrict noise transmission.

c. Provide soundproof housings or enclosures for noise-producing machinery.

d. Use efficient silencers on equipment air intakes.

e. Use efficient intake and exhaust mufflers on internal combustion engines that are maintained so equipment performs below noise levels specified.

f. Line hoppers and storage bins with sound deadening material.

g. Conduct truck loading, unloading, and hauling operations so that noise is kept to a minimum.

4. Measure sound level for noise exposure due to the construction at least once every five successive working days while work is being performed above 55 dB(A) noise level. Measure noise exposure at the property line or 15 m (50 feet) from the noise source, whichever is greater. Measure the sound levels on the A weighing network of a General Purpose sound level meter at slow response. To minimize the effect of reflective sound waves at buildings, take measurements at 900 to 1800 mm (three to six feet) in front of any building face. Submit the recorded information to the COR noting any problems and the alternatives for mitigating actions.

G. Restoration of Damaged Property: If any direct or indirect damage is done to public or private property resulting from any act, omission, neglect, or misconduct, the Contractor shall restore the damaged property to a condition equal to that existing before the damage at no additional cost to the Government. Repair, rebuild, or restore property as directed or make good such damage in an acceptable manner.

H. Final Clean-up: On completion of project and after removal of all debris, rubbish, and temporary construction, Contractor shall leave the construction area in a clean condition satisfactory to the COR. Cleaning shall include off the station disposal of all items and materials not required to be salvaged, as well as all debris and rubbish resulting from demolition and new work operations.

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SECTION 01 58 16
TEMPORARY INTERIOR SIGNAGE

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies temporary interior signs.

PART 2 - PRODUCTS

2.1 TEMPORARY SIGNS

A. Fabricate from 110-pound mat finish white paper.

B. Cut to 4-inch wide by 12 inch long size tag.

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

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

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

PART 3 - EXECUTION

3.1 INSTALLATION

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

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

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

3.2 LOCATION

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

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

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

C. Replace missing, damaged, or illegible signs.

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SECTION 01 74 19
CONSTRUCTION WASTE MANAGEMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the requirements for the management of non-hazardous building construction and demolition waste.

B. Waste disposal in landfills shall be minimized to the greatest extent possible. Of the inevitable waste that is generated, 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:

D. Waste Management Plan development and implementation.

E. Techniques to minimize waste generation.

F. Sorting and separating of waste materials.

G. Salvage of existing materials and items for reuse or resale.

H. Recycling of materials that cannot be reused or sold.

I. At a minimum the following waste categories shall be diverted from landfills:

1. Soil.
2. Inerts (eg, concrete, masonry and asphalt).
3. Clean dimensional wood and palette wood.
4. Green waste (biodegradable landscaping materials).
5. Engineered wood products (plywood, particle board and I-joists, etc).
6. Metal products (eg, steel, wire, beverage containers, copper, etc).
7. Sheathings
8. Cardboard, paper and packaging.
9. Bitumen roofing materials.
10. Plastics (eg, ABS, PVC).
11. Carpet and/or pad.
12. Gypsum board.
13. Insulation.
14. Paint.
15. Fluorescent lamps.

1.2 RELATED WORK

A. Section 02 41 19, SELECTIVE DEMOLITION.

B. Section 01 00 00, GENERAL REQUIREMENTS.

1. C. Lead Paint: Section 02 83 33.13, LEAD BASED PAINT REMOVAL AND DISPOSAL.

1.3 QUALITY ASSURANCE

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

1. Excess or unusable construction materials.
2. Packaging used for construction products.
3. Poor planning and/or layout.
4. Construction error.
5. Over ordering.
6. Weather damage.
7. Contamination.
8. Mishandling.
9. Breakage.

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

C. Contractor shall develop and implement procedures to recycle construction and demolition waste to a minimum of 50 percent.

D. Contractor shall be responsible for implementation of any special programs involving rebates or similar incentives related to recycling. Any revenues or savings obtained from salvage or recycling shall accrue to the contractor.

E. Contractor shall provide all demolition, removal and legal disposal of materials. Contractor shall ensure that facilities used for recycling, reuse and disposal shall be permitted for the intended use to the extent required by local, state, federal regulations.

F. Contractor shall assign a specific area to facilitate separation of materials for reuse, salvage, recycling, and return. Such areas are to

be kept neat and clean and clearly marked in order to avoid contamination or mixing of materials.

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

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

1.4 TERMINOLOGY

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

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

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

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

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

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

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

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

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

J. Mixed Debris Recycling Facility: A solid resource processing facility that accepts loads of mixed construction and demolition debris for the

purpose of recovering re-usable and recyclable materials and disposing non-recyclable materials.

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

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

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

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

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

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

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

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

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

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

1.5 SUBMITTALS

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

B. Prepare and submit to the COR a written demolition debris management plan. The plan shall include, but not be limited to, the following information:

1. Procedures to be used for debris management.
2. Techniques to be used to minimize waste generation.
3. Analysis of the estimated job site waste to be generated:
   a. List of each material and quantity to be salvaged, reused, recycled.
   b. List of each material and quantity proposed to be taken to a landfill.
4. Detailed description of the Means/Methods to be used for material handling.
   a. On site: Material separation, storage, protection where applicable.
   b. Off site: Transportation means and destination. Include list of materials.
      1) Description of materials to be site-separated and self-hauled to designated facilities.
      2) Description of mixed materials to be collected by designated waste haulers and removed from the site.
         a) The names and locations of mixed debris reuse and recycling facilities or sites.
         b) The names and locations of trash disposal landfill facilities or sites.
         c) Documentation that the facilities or sites are approved to receive the materials.

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

D. Monthly summary of construction and demolition debris diversion and disposal, quantifying all materials generated at the work site and disposed of or diverted from disposal through recycling.

E. Target waste diversion rate by material and an overall diversion rate.

F. Final report documenting the results of implementation of the preconstruction waste management plan.

1.6 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced by the basic designation only. In the event that criteria requirements conflict, the most stringent requirements shall be met.

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

1. Green Building Initiative (GBI): Green Globes for New Construction 2019

1.7 RECORDS

A. Maintain records to document the quantity of waste generated; the quantity of waste diverted through sale, reuse, or recycling; and the quantity of waste disposed by landfill or incineration. Records shall be kept in accordance with the Green Globes for New Construction 2019 Technical Reference Manual.

PART 2 - PRODUCTS

2.1 MATERIALS

A. List of each material and quantity to be salvaged, recycled, reused.

B. List of each material and quantity proposed to be taken to a landfill.

C. Material tracking data: Receiving parties, dates removed, transportation costs, weight tickets, tipping fees, manifests, invoices, net total costs or savings.

PART 3 - EXECUTION

3.1 COLLECTION

A. Provide all necessary containers, bins and storage areas to facilitate effective waste management.

B. Clearly identify containers, bins and storage areas so that recyclable materials are separated from trash and can be transported to respective recycling facility for processing.

C. Hazardous wastes shall be separated, stored, disposed of according to local, state, federal regulations.

3.2 DISPOSAL

A. Contractor shall be responsible for transporting and disposing of materials that cannot be delivered to a source-separated or mixed

materials recycling facility to a transfer station or disposal facility that can accept the materials in accordance with state and federal regulations.

B. Construction or demolition materials with no practical reuse or that cannot be salvaged or recycled shall be disposed of at a landfill or incinerator.

3.3 REPORT

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

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

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

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SECTION 01 81 13

SUSTAINABLE CONSTRUCTION REQUIREMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section describes general requirements and procedures to comply with federal mandates and U.S. Department of Veterans Affairs (VA) policies for sustainable construction.

B. The Design Professional has selected materials and utilized integrated design processes that achieve the Government's objectives. Contractor is responsible to maintain and support these objectives in developing means and methods for performing work and in proposing product substitutions or changes to specified processes. Obtain approval from Contracting Officer for all changes and substitutions to materials or processes. Proposed changes must meet, or exceed, materials or processes specified.

1.2 RELATED WORK

A. Section 01 57 19 TEMPORARY ENVIRONMENTAL CONTROLS.

B. Section 01 74 19 CONSTRUCTION WASTE MANANGEMENT.

C. Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

1.3 DEFINITIONS

A. Recycled Content: Recycled content of materials is defined according to Federal Trade Commission Guides for the Use of Environmental Marketing Claims (16 CFR Part 260). Recycled content value of a material assembly is determined by weight. Recycled fraction of assembly is multiplied by cost of assembly to determine recycled content value.

1. "Post-Consumer" material is defined as waste material generated by households or by commercial, industrial, and institutional facilities in their role as end users of the product, which can no longer be used for its intended purpose.

2. "Pre-Consumer" material is defined as material diverted from waste stream during the manufacturing process. Excluded is reutilization of materials such as rework, regrind, or scrap generated in a process and capable of being reclaimed within the same process that generated it.

B. Biobased Products: Biobased products are derived from plants and other renewable agricultural, marine, and forestry materials and provide an

alternative to conventional petroleum derived products. Biobased products include diverse categories such as lubricants, cleaning products, inks, fertilizers, and bioplastics.

C. Low Pollutant-Emitting Materials: Materials and products which are minimally odorous, irritating, or harmful to comfort and well-being of installers and occupants.

D. Volatile Organic Compounds (VOC): Chemicals that are emitted as gases from certain solids or liquids. VOCs include a variety of chemicals, some of which may have short- and long-term adverse health effects.

1.4 REFERENCE STANDARDS

A. Carpet and Rug Institute Green Label Plus program.

B. U.S. Department of Agriculture BioPreferred program (USDA BioPreferred).

C. U.S. Environmental Protection Agency Comprehensive Procurement Guidelines (CPG).

D. U.S. Environmental Protection Agency WaterSense Program (WaterSense).

E. U.S. Environmental Protection Agency ENERGY STAR Program (ENERGY STAR).

F. U. S. Department of Energy Federal Energy Management Program (FEMP).

G. Green Electronic Council EPEAT Program (EPEAT).

1.5 SUBMITTALS

A. All submittals to be provided by contractor to COR.

B. Sustainability Action Plan:

1. Submit documentation as required by this section; provide additional copies of typical submittals required under technical sections when sustainable construction requires copies of record submittals.
2. Within 30 days after Preconstruction Meeting provide a narrative plan for complying with requirements stipulated within this section.
3. Sustainability Action Plan must:
   a. Make reference to sustainable construction submittals defined by this section.
   b. Address all items listed under PERFORMANCE CRITERIA.
   c. Indicate individual(s) responsible for implementing the plan.

C. Low Pollutant-Emitting Materials Tracking Spreadsheet: Within 30 days after Preconstruction Meeting provide a preliminary Low Pollutant-Emitting Materials Tracking Spreadsheet. The Low Pollutant-Emitting Materials Tracking Spreadsheet must be an electronic file and include

all materials on Project in categories described under Low Pollutant-Emitting Materials in 01 81 13.

D. Construction Indoor Air Quality (IAQ) Management Plan:

1. Not more than 30 days after Preconstruction Meeting provide a Construction IAQ Management Plan as an electronic file including descriptions of the following:
   a. Instruction procedures for meeting or exceeding minimum requirements of ANSI/SMACNA 008-2008, Chapter 3, including procedures for HVAC Protection, Source Control, Pathway Interruption, Housekeeping, and Scheduling.
   b. Instruction procedures for protecting absorptive materials stored on-site or installed from moisture damage.
   c. Schedule of submission of photographs of on-site construction IAQ management measures such as protection of ducts and on-site stored oil installed absorptive materials.
   d. Instruction procedures if air handlers must be used during construction, including a description of filtration media to be used at each return air grille.
   e. Instruction procedure for replacing all air-filtration media immediately prior to occupancy after completion of construction, including a description of filtration media to be used at each air handling or air supply unit.
   f. Instruction procedures and schedule for implementing building flush-out.

E. Product Submittals:

1. Recycled Content: Submit product data from manufacturer indicating percentages by weight of post-consumer and pre-consumer recycled content for products having recycled content (excluding MEP systems equipment and components).
2. Biobased Content: Submit product data for products to be installed or used which are included in any of the USDA BioPreferred program’s product categories. Data to include percentage of biobased content and source of biobased material.
3. Low Pollutant-Emitting Materials: Submit product data confirming compliance with relevant requirements for all materials on Project

in categories described under Low Pollutant-Emitting Materials in 01 81 13.

4. For applicable products and equipment, submit product documentation confirming ENERGY STAR label, FEMP certification, WaterSense, and/or EPEAT certification.

F. Sustainable Construction Progress Reports: Concurrent with each Application for Payment, submit a Sustainable Construction Progress Report to confirm adherence with Sustainability Action Plan.

1. Include narratives of revised strategies for bringing work progress into compliance with plan and product submittal data.
2. Include updated and current Low Pollutant-Emitting Materials Tracking Spreadsheet.
3. Include construction waste tracking, in tons or cubic yards, including waste description, whether diverted or landfilled, hauler, and percent diverted for comingled quantities; and excluding land-clearing debris and soil. Provide haul receipts and documentation of diverted percentages for comingled wastes.

G. Closeout Submittals: Within 14 days after Substantial Completion provide the following:

1. Final version of Low Pollutant-Emitting Materials Tracking Spreadsheet.
2. Manufacturer’s cut sheets and product data highlighting the Minimum Efficiency Reporting Value (MERV) for filtration media installed at return air grilles during construction if permanently installed air handling units are used during construction.
3. Manufacturer’s cut sheets and product data highlighting the Minimum Efficiency Reporting Value (MERV) for final filtration media in air handling units.
4. Minimum 18 construction photographs including six photographs taken on three different occasions during construction of ANSI/SMACNA 008-2008, Chapter 3 approaches employed, along with a brief description of each approach, documenting implementation of IAQ management measures, such as protection of ducts and on-site stored or installed absorptive materials.
5. Flush-out Documentation:
   a. Product data for filtration media used during flush-out.

b. Product data for filtration media installed immediately prior to occupancy.

c. Signed statement describing building air flush-out procedures including dates when flush-out was begun and completed and statement that filtration media was replaced after flush-out.

1.6 QUALITY ASSURANCE

A. Preconstruction Meeting: After award of Contract and prior to commencement of Work, schedule and conduct meeting with COR and Architect to discuss the Project Sustainable Action Plan content as it applies to submittals, project delivery, required Construction Indoor Air Quality (IAQ) Management Plan, and other Sustainable Construction Requirements. The purpose of this meeting is to develop a mutual understanding of the Sustainable Construction Requirements and coordination of contractor’s management of these requirements with the Contracting Officer and the Construction Quality Manager.

B. Construction Job Conferences: Status of compliance with Sustainable Construction Requirements of these specifications will be an agenda item at regular job meetings conducted during the course of work at the site.

1.7 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

B. Green Seal Standard GS-11, Paints, 1st Edition, May 20, 1993.

C. Green Seal Standard GC-03, Anti-Corrosive Paints, 2nd Edition, January 7, 1997.

D. Green Seal Standard GC-36, Commercial Adhesives, October 19, 2000.

E. South Coast Air Quality Management District (SCAQMD) Rule 1113, Architectural Coatings, rules in effect on January 1, 2004.

F. South Coast Air Quality Management District (SCAQMD) Rule 1168, July 1, 2005 and rule amendment date of January 7, 2005.

G. Sheet Metal and Air Conditioning National Contractors’ Association (SMACNA) IAQ Guidelines for Occupied Buildings under Construction, 2nd Edition (ANSI/SMACNA 008-2008), Chapter 3.

H. California Department of Public Health Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers, Version 1.1, Emission Testing method for California Specification 01350 (CDPH Standard Method V1.1-2010).

I. Federal Trade Commission Guides for the Use of Environmental Marketing Claims (16 CFR Part 260).

J. ASHRAE Standard 52.2-2007.

PART 2 – PRODUCTS

2.1 PERFORMANCE CRITERIA

A. Construction waste diversion from landfill disposal must comprise at least 50 percent of total construction waste, excluding land clearing debris and soil. Alternative daily cover (ADC) does not qualify as material diverted from disposal.

B. Low Pollutant-Emitting Materials:

1. Adhesives, sealants and sealant primers applied on site within the weatherproofing membrane must comply with VOC limits of SCAQMD Rule 1168:

a. Flooring Adhesives and Sealants:

1) Indoor carpet adhesives: 50 g/L.
2) Wood Flooring Adhesive: 100 g/L.
3) Rubber Floor Adhesives: 60 g/L.
4) Subfloor Adhesives: 50 g/L.
5) Ceramic Tile Adhesives and Grout: 65 g/L.
6) Cove Base Adhesives: 50 g/L.
7) Multipurpose Construction Adhesives: 70 g/L.
8) Porous Material (Except Wood) Substrate: 50 g/L.
9) Wood Substrate: 30 g/L.
10) Architectural Non-Porous Sealant Primer: 250 g/L.
11) Architectural Porous Sealant Primer: 775 g/L.
12) Other Sealant Primer: 750 g/L.
13) Structural Wood Member Adhesive: 140 g/L.
14) Sheet-Applied Rubber Lining Operations: 850 g/L.
15) Top and Trim Adhesive: 250 g/L.
16) Architectural Sealant: 250 g/L.
17) Other Sealant: 420 g/L.

b. Non-Flooring Adhesives and Sealants:
   1) Drywall and Panel Adhesives: 50 g/L.
   2) Multipurpose Construction Adhesives: 70 g/L.
   3) Structural Glazing Adhesives: 100 g/L.
   4) Metal-to-Metal Substrate Adhesives: 30 g/L.
   5) Plastic Foam Substrate Adhesive: 50 g/L.
   6) Porous Material (Except Wood) Substrate Adhesive: 50 g/L.
   7) Wood Substrate Adhesive: 30 g/L.
   8) Fiberglass Substrate Adhesive: 80 g/L.
   9) Architectural Non-Porous Sealant Primer: 250 g/L.
   10) Architectural Porous Sealant Primer: 775 g/L.
   11) Other Sealant Primer: 750 g/L.
   12) PVC Welding Adhesives: 510 g/L.
   13) CPVC Welding Adhesives: 490 g/L.
   14) ABS Welding Adhesives: 325 g/L.
   15) Plastic Cement Welding Adhesives: 250 g/L.
   16) Adhesive Primer for Plastic: 550 g/L.
   17) Contact Adhesive: 80 g/L.
   18) Special Purpose Contact Adhesive: 250 g/L.
   19) Structural Wood Member Adhesive: 140 g/L.
   20) Sheet Applied Rubber Lining Operations: 850 g/L.
   21) Top and Trim Adhesive: 250 g/L.
   22) Architectural Sealants: 250 g/L.
   23) Other Sealants: 420 g/L.

2. Aerosol adhesives applied on site within the weatherproofing membrane must comply with the following Green Seal GS-36.
   a. Aerosol Adhesive, General-Purpose Mist Spray: 65 percent VOCs by weight.
   b. Aerosol Adhesive, General-Purpose Web Spray: 55 percent VOCs by weight.
   c. Special-Purpose Aerosol Adhesive (All Types): 70 percent VOCs by weight.
3. Paints and coatings applied on site within the weatherproofing membrane must comply with the following criteria:
   a. VOC content limits for paints and coatings established in Green Seal Standard GS-11.

b. VOC content limit for anti-corrosive and anti-rust paints applied to interior ferrous metal substrates of 250 g/L established in Green Seal GC-03.

c. Clear wood finishes, floor coatings, stains, primers, sealers, and shellacs applied to interior elements must not exceed VOC content limits established in SCAQMD Rule 1113.

d. Comply with the following VOC content limits:

1) Anti-Corrosive/Antirust Paints: 250 g/L.
2) Clear Wood Finish, Lacquer: 550 g/L.
3) Clear Wood Finish, Sanding Sealer: 350 g/L.
4) Clear Wood Finish, Varnish: 350 g/L.
5) Floor Coating: 100 g/L.
6) Interior Flat Paint, Coating or Primer: 50 g/L.
7) Interior Non-Flat Paint, Coating or Primer: 150 g/L.
8) Sealers and Undercoaters: 200 g/L.
9) Shellac, Clear: 730 g/L.
10) Shellac, Pigmented: 550 g/L.
11) Stain: 250 g/L.
12) Clear Brushing Lacquer: 680 g/L.
13) Concrete Curing Compounds: 350 g/L.
14) Japans/Faux Finishing Coatings: 350 g/L.
15) Magnesite Cement Coatings: 450 g/L.
16) Pigmented Lacquer: 550 g/L.
17) Waterproofing Sealers: 250 g/L.
18) Wood Preservatives: 350 g/L.
19) Low-Solids Coatings: 120 g/L.

4. Carpet installed in building interior must comply with one of the following:

a. Meet testing and product requirements of the Carpet and Rug Institute Green Label Plus program.

b. Maximum VOC concentrations specified in CDPH Standard Method V1.1-2010, using office scenario at the 14 day time point.

5. Each non-carpet flooring element installed in building interior which is not inherently non-emitting (stone, ceramic, powder-coated metals, plated or anodized metal, glass, concrete, clay brick, and

unfinished or untreated solid wood flooring) must comply with one of the following:

a. Meet requirements of the FloorScore standard as shown with testing by an independent third-party.

b. Maximum VOC concentrations specified in CDPH Standard Method V1.1-2010, using office scenario at 14 day time point.

6. Composite wood and agrifiber products used within the weatherproofing membrane must contain no added urea-formaldehyde resins.

7. Laminating adhesives used to fabricate on-site and shop-applied composite wood and agrifiber assemblies must not contain added urea-formaldehyde.

C. Recycled Content:

1. Any products being installed or used that are listed on EPA Comprehensive Procurement Guidelines designated product list must meet or exceed the EPA’s recycled content recommendations. The EPA Comprehensive Procurement Guidelines categories include:

a. Building insulation.

b. Cement and concrete.

c. Consolidated and reprocessed latex paint.

d. Floor tiles.

e. Flowable fill.

f. Laminated paperboard.

g. Modular threshold ramps.

h. Nonpressure pipe.

i. Patio blocks.

j. Railroad grade crossing surfaces.

k. Roofing materials.

l. Shower and restroom dividers/partitions.

m. Structural fiberboard.

n. Nylon carpet and nylon carpet backing.

o. Compost and fertilizer made from recovered organic materials.

p. Hydraulic mulch.

q. Lawn and garden edging.

r. Plastic lumber landscaping timbers and posts.

s. Park benches and picnic tables.

t. Plastic fencing.

u. Playground equipment.

v. Playground surfaces.

w. Bike racks.

D. Biobased Content:

1. Materials and equipment being installed or used that are listed on the USDA BioPreferred program product category list must meet or exceed USDA's minimum biobased content threshold. Refer to individual specification sections for detailed requirements applicable to that section.

a. USDA BioPreferred program categories include:

1) Adhesive and Mastic Removers.

2) Carpets.

3) Cleaners.

4) Composite Panels.

5) Corrosion Preventatives.

6) Erosion Control Materials.

7) Dust Suppressants.

8) Fertilizers.

9) Floor Cleaners and Protectors.

10) Floor Coverings (Non-Carpet).

11) Glass Cleaners.

12) Hydraulic Fluids.

13) Industrial Cleaners.

14) Interior Paints and Coatings.

15) Mulch and Compost Materials.

16) Multipurpose Cleaners.

17) Multipurpose Lubricants.

18) Packaging Films.

19) Paint Removers.

20) Plastic Insulating Foam.

21) Pneumatic Equipment Lubricants.

22) Roof Coatings.

23) Wastewater Systems Coatings.

24) Water Tank Coatings.

25) Wood and Concrete Sealers.

26) Wood and Concrete Stains.

E. Materials, products, and equipment being installed which fall into a category covered by the WaterSense program must be WaterSense-labeled or meet or exceed WaterSense program performance requirements, unless disallowed for infection control reasons.

1. WaterSense categories include:

a. Bathroom Faucets

b. Commercial Toilets

c. Irrigation Controllers

d. Pre-Rinse Spray Valves

e. Residential Toilets

f. Showerheads

g. Spray Sprinkler Bodies

h. Urinals

F. Materials, products, and equipment being installed which fall into any of the following product categories must be Energy Star-labeled.

1. Applicable Energy Star product categories as of 09/14/2017 include:

a. Appliances:

1) Air Purifiers and Cleaners.

2) Clothes Dryers (Residential).

3) Clothes Washers (Commercial & Residential).

4) Dehumidifiers.

5) Dishwashers (Residential).

6) Freezers (Residential).

7) Refrigerators (Residential).

b. Electronics and Information Technology:

1) Audio/Video Equipment.

2) Computers.

3) Data Center Storage.

4) Digital Media Player.

5) Enterprise Servers.

6) Imaging Equipment.

7) Monitors.

8) Professional Displays.

9) Set-Top and Cable Boxes.

10) Telephones.

11) Televisions.

12) Uninterruptible Power Supplies.

13) Voice over Internet Protocol (VoIP) Phones.

c. Food Service Equipment (Commercial):

1) Dishwashers.

2) Fryers.

3) Griddles.

4) Hot Food Holding Cabinets.

5) Ice Makers.

6) Ovens.

7) Refrigerators and Freezers.

8) Steam Cookers.

9) Vending Machines.

d. Heating and Cooling Equipment:

1) Air-Source Heat Pumps (Residential).

2) Boilers.

3) Ceiling Fans (Residential).

4) Central Air Conditioners (Residential).

5) Ductless Heating and Cooling (Residential).

6) Furnaces (Residential).

7) Water Heaters.

8) Geothermal Heat Pumps (Residential).

9) Light Commercial Heating and Cooling Equipment.

10) Room Air Conditioners (Residential).

11) Ventilation Fans (Residential).

e. Other:

1) Decorative Light Strings.

2) Electric Vehicle Supply Equipment.

3) Laboratory-Grade Refrigerators and Freezers.

4) Light Bulbs.

5) Light Fixtures.

6) Pool Pumps.

7) Roof Products.

8) Water Coolers.

9) Windows, Doors, and Skylights.

G. Materials, products, and equipment being installed which fall into any of the following categories must be FEMP-designated. FEMP-designated product categories as of 09/14/2017 include:
   1. Boilers (Commercial).
   2. Dishwashers (Commercial).
   3. Electric Chillers, Air-Cooled (Commercial).
   4. Electric Chillers, Water-Cooled (Commercial).
   5. Exterior Lighting.
   6. Fluorescent Ballasts.
   7. Fluorescent Lamps, General Service.
   8. Ice Machines, Water-Cooled.
   9. Industrial Lighting (High/Low Bay).
   10. Light Emitting Diode (LED) Luminaires.

H. Electronic products and equipment being installed which fall into any of the following categories shall be EPEAT registered. Electronic products and equipment covered by EPEAT program as of 09/14/2017 include:
   1. Computers.
   2. Displays.
   3. Imaging Equipment.
   4. Televisions.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. Construction Indoor Air Quality Management:
   1. During construction, meet or exceed recommended control measures of ANSI/SMACNA 008-2008, Chapter 3.
   2. Protect stored on-site and installed absorptive materials from moisture damage.
   3. If permanently installed air handlers are used during construction, filtration media with a minimum efficiency reporting value (MERV) of 8 must be used at each return air grille, as determined by ASHRAE Standard 52.2-1999 (with errata but without addenda). Replace all filtration media immediately prior to occupancy.
   4. Perform building flush-out as follows:
      a. After construction ends, prior to occupancy and with interior finishes installed, perform a building flush-out by supplying a

total volume of 14000 cu. ft. of outdoor air per sq. ft. of floor area while maintaining an internal temperature of at least 60 degrees Fahrenheit and a relative humidity no higher than 60 percent. OR

b. If occupancy is desired prior to flush-out completion, the space may be occupied following delivery of a minimum of 3500 cu. ft. of outdoor air per sq. ft. of floor area to the space. Once a space is occupied, it must be ventilated at a minimum rate of 0.30 cfm per sq. ft. of outside air or design minimum outside air rate determined until a total of 14000 cu. ft./sq. ft. of outside air has been delivered to the space. During each day of flush-out period, ventilation must begin a minimum of three hours prior to occupancy and continue during occupancy.

-----END----

SECTION 01 91 00
GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 COMMISSIONING DESCRIPTION

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

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

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

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

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

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

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

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

1.2 CONTRACTUAL RELATIONSHIPS

A. For this construction project, the Department of Veterans Affairs contracts with a Contractor to provide construction services. The contracts are administered by the VA Contracting Officer and the 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 32.16.15 PROJECT SCHEDULES (SMALL PROJECTS – DESIGN/BID/BUILD)

C. Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

D. Section 01 81 13 SUSTAINABLE CONSTRUCTION REQUIREMENTS

E. Section 22 08 00 COMMISSIONING OF PLUMBING SYSTEMS.

F. Section 23 08 00 COMMISSIONING OF HVAC SYSTEMS.

G. Section 26 08 00 COMMISSIONING OF ELECTRICAL SYSTEMS.

H. Section 27 08 00 COMMISSIONING OF COMMUNICATIONS SYSTEMS.

I. Section 28 08 00 COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS.

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 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

List of Acronyms	
Acronym	Meaning
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
VA CFM	VA Office of Construction and Facilities Management
VACO	VA Central Office

List of Acronyms	
Acronym	Meaning
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)

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

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

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

Commissioning Design Review: The commissioning design review is a collaborative review of the design professionals design documents for items pertaining to the following: owner’s project requirements; basis of design; operability and maintainability (O&M) including documentation; functionality; training; energy efficiency, control systems’ sequence of operations including building automation system features; commissioning specifications and the ability to functionally test the systems.

Commissioning Issue: A condition identified by the Commissioning Agent or other member of the Commissioning Team that adversely affects the

commissionability, operability, maintainability, or functionality of a system, equipment, or component. A condition that 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 owners operators to operate the systems.

Test Procedure: A written protocol that defines methods, personnel, and expectations for tests conducted on components, equipment, assemblies, systems, and interfaces among systems.

Testing: The use of specialized and calibrated instruments to measure parameters such as: temperature, pressure, vapor flow, air flow, fluid flow, rotational speed, electrical characteristics, velocity, and other data 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**
Building Exterior Closure	
Roofing	Roof system (including parapet), roof openings (skylights, pipe chases, ducts, equipment curbs, etc.)
Note:	The emphasis on commissioning the above building envelope systems is on control of air flow, heat flow, noise, infrared, ultraviolet, rain penetration, moisture, durability, security, reliability, constructability, maintainability, and sustainability.

Systems To Be Commissioned	
System	**Description**
Fire Suppression	
Fire Sprinkler Systems	Wet pipe system, dry pipe system, pre-action system, special agent systems
Plumbing	
Domestic Water Distribution	Booster pumps, backflow preventers, water softeners, potable water storage tanks
Domestic Hot Water Systems	Water heaters**, heat exchangers, circulation pumps, point-of-use water heaters*
Sanitary Waste Interceptors	Grease interceptors, acid neutralizers
General Service Air Systems	Packaged compressor systems, air dryers, filtration
Medical Air Systems	Packaged medical air compressor units. Outlet certification, cross-connection verification
Water De-ionizing Systems	Package Water De-ionizing systems
HVAC	
Noise and Vibration Control	Noise and vibration levels for critical equipment such as Air Handlers, Clean Steam Generators, and Pumps will be commissioned as part of the system commissioning
Direct Digital Control System**	Operator Interface Computer, Operator Work Station (including graphics, point mapping, trends, alarms), Network Communications Modules and Wiring, Integration Panels. [DDC Control panels will be commissioned with the systems controlled by the panel]
Chilled Water System**	Pumps (primary, secondary, variable primary), VFDs associated with chilled water system components, DDC Control Panels (including integration with Building Control System)
HVAC Air Handling Systems**	Air handling Units, humidifiers, DDC control panels

Systems To Be Commissioned	
System	**Description**
HVAC Ventilation/Exhaust Systems	General exhaust, toilet exhaust, specialty exhaust, room pressurization control systems
HVAC Terminal Unit Systems**	VAV Terminal Units, CAV terminal units
Humidity Control Systems	Humidifiers, controls, interface with facility DDC
Hydronic Distribution Systems	Pumps, DDC control panels
Electrical	
Medium-Voltage Electrical Distribution Systems	Medium-Voltage Switchgear, Medium-Voltage Switches, Underground ductbank and distribution, Pad-Mount Transformers, Medium-Voltage Load Interrupter Switches,
Grounding & Bonding Systems	Witness 3rd party testing, review reports
Low-Voltage Distribution System	Normal power distribution system, Life-safety power distribution system, critical power distribution system, equipment power distribution system, switchboards, distribution panels, panelboards, verify breaker testing results (injection current, etc)
Lighting & Lighting Control** Systems	Emergency lighting, occupancy sensors, lighting control systems, architectural dimming systems, theatrical dimming systems, exterior lighting and controls
Cathodic Protection Systems	Review 3rd party testing results.
Lightning Protection System	Witness 3rd party testing, review reports

Systems To Be Commissioned	
System	**Description**
Communications	
Grounding & Bonding System	Witness 3rd party testing, review reports
Structured Cabling System	Witness 3rd party testing, review reports
Public Address & Mass Notification Systems	Witness 3rd party testing, review reports
Intercom & Program Systems	Witness 3rd party testing, review reports
Electronic Safety and Security	
Grounding & Bonding	Witness 3rd party testing, review reports
Physical Access Control Systems	Witness 3rd party testing, review reports
Access Control Systems	Witness 3rd party testing, review reports
Security Access Detection Systems	Witness 3rd party testing, review reports
Video Surveillance System	Witness 3rd party testing, review reports
Electronic Personal Protection System	Witness 3rd party testing, review reports
Fire Detection and Alarm System	100% device acceptance testing, battery draw-down test, verify system monitoring, verify interface with other systems.
Table Notes	
** Denotes systems that LEED requires to be commissioned to comply with the LEED Fundamental Commissioning pre-requisite.	

1.8 COMMISSIONING TEAM

A. The commissioning team shall consist of, but not be limited to, representatives of Contractor, including Project Superintendent and subcontractors, installers, schedulers, suppliers, and specialists deemed appropriate by the Department of Veterans Affairs (VA) and Commissioning Agent.

B. Members Appointed by Contractor:
   1. Contractor' Commissioning Manager: The designated person, company, or entity that plans, schedules and coordinates the commissioning activities for the construction team.
   2. Contractor's Commissioning Representative(s): Individual(s), each having authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated actions.

C. Members Appointed by VA:
   1. Commissioning Agent: The designated person, company, or entity that plans, schedules, and coordinates the commissioning team to implement the commissioning process. The VA will engage the CxA under a separate contract.
   2. User: Representatives of the facility user and operation and maintenance personnel.
   3. A/E: Representative of the Architect and engineering design professionals.

1.9 VA'S COMMISSIONING RESPONSIBILITIES

A. Appoint an individual, company or firm to act as the Commissioning Agent.

B. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities including, but not limited to, the following:
   1. Coordination meetings.
   2. Training in operation and maintenance of systems, subsystems, and equipment.
   3. Testing meetings.
   4. Witness and assist in Systems Functional Performance Testing.
   5. Demonstration of operation of systems, subsystems, and equipment.

C. Provide the Construction Documents, prepared by Architect and approved by VA, to the Commissioning Agent and for use in managing the commissioning process, developing the commissioning plan, systems manuals, and reviewing the operation and maintenance training plan.

1.10 CONTRACTOR'S COMMISSIONING RESPONSIBILITIES

A. The Contractor shall assign a Commissioning Manager to manage commissioning activities of the Contractor, and subcontractors.

B. The Contractor shall ensure that the commissioning responsibilities outlined in these specifications are included in all subcontracts and that subcontractors comply with the requirements of these specifications.

C. The Contractor shall ensure that each installing subcontractor shall assign representatives with expertise and authority to act on behalf of the subcontractor and schedule them to participate in and perform commissioning team activities including, but not limited to, the following:

1. Participate in commissioning coordination meetings.
2. Conduct operation and maintenance training sessions in accordance with approved training plans.
3. Verify that Work is complete and systems are operational according to the Contract Documents, including calibration of instrumentation and controls.
4. Evaluate commissioning issues and commissioning observations identified in the Commissioning Issues Log, field reports, test reports or other commissioning documents. In collaboration with entity responsible for system and equipment installation, recommend corrective action.
5. Review and comment on commissioning documentation.
6. Participate in meetings to coordinate Systems Functional Performance Testing.
7. Provide schedule for operation and maintenance data submittals, equipment startup, and testing to Commissioning Agent for incorporation into the commissioning plan.
8. Provide information to the Commissioning Agent for developing commissioning plan.
9. Participate in training sessions for VA's operation and maintenance personnel.
10. Provide technicians who are familiar with the construction and operation of installed systems and who shall develop specific test procedures to conduct Systems Functional Performance Testing of installed systems.

1.11 COMMISSIONING AGENT'S RESPONSIBILITIES

A. Organize and lead the commissioning team.

B. Prepare the commissioning plan. See Paragraph 1.11-A of this specification Section for further information.

C. Review and comment on selected submittals from the Contractor for general conformance with the Construction Documents. Review and comment on the ability to test and operate the system and/or equipment, including providing gages, controls and other components required to operate, maintain, and test the system. Review and comment on performance expectations of systems and equipment and interfaces between systems relating to the Construction Documents.

D. At the beginning of the construction phase, conduct an initial construction phase coordination meeting for the purpose of reviewing the commissioning activities and establishing tentative schedules for operation and maintenance submittals; operation and maintenance training sessions; TAB Work; Pre-Functional Checklists, Systems Functional Performance Testing; and project completion.

E. Convene commissioning team meetings for the purpose of coordination, communication, and conflict resolution; discuss status of the commissioning processes. Responsibilities include arranging for facilities, preparing agenda and attendance lists, and notifying participants. The Commissioning Agent shall prepare and distribute minutes to commissioning team members and attendees within five workdays of the commissioning meeting.

F. Observe construction and report progress, observations and issues. Observe systems and equipment installation for adequate accessibility for maintenance and component replacement or repair, and for general conformance with the Construction Documents.

G. Prepare Project specific Pre-Functional Checklists and Systems Functional Performance Test procedures.

H. Coordinate Systems Functional Performance Testing schedule with the Contractor.

I. Witness selected systems startups.

J. Verify selected Pre-Functional Checklists completed and submitted by the Contractor.

K. Witness and document Systems Functional Performance Testing.

L. Compile test data, inspection reports, and certificates and include them in the systems manual and commissioning report.

M. Review and comment on operation and maintenance (O&M) documentation and systems manual outline for compliance with the Contract Documents. Operation and maintenance documentation requirements are specified in Paragraph 1.25, Section 01 00 00 GENERAL REQUIREMENTS.

N. Review operation and maintenance training program developed by the Contractor. Verify training plans provide qualified instructors to conduct operation and maintenance training.

O. Prepare commissioning Field Observation Reports.

P. Prepare the Final Commissioning Report.

Q. Return to the site at 10 months into the 12 month warranty period and review with facility staff the current building operation and the condition of outstanding issues related to the original and seasonal Systems Functional Performance Testing. Also interview facility staff and identify problems or concerns they have 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 30 days of contract award, the Contractor shall designate a specific individual as the Commissioning Manager (CxM) to manage and lead the commissioning effort on behalf of the Contractor. The Commissioning Manager shall be the single point of contact and communications for all commissioning related services by the Contractor.

C. Within 60 days of contract award, the Contractor shall ensure that each subcontractor designates specific individuals as Commissioning Representatives (CXR) to be responsible for commissioning related tasks. The Contractor shall ensure the designated Commissioning Representatives participate in the commissioning process as team members providing commissioning testing services, equipment operation, adjustments, and corrections if necessary. The Contractor shall ensure that all Commissioning Representatives shall have sufficient authority to direct their respective staff to provide the services required, and to speak on behalf of their organizations in all commissioning related contractual matters.

1.15 QUALITY ASSURANCE

A. Instructor Qualifications: Factory authorized service representatives shall be experienced in training, operation, and maintenance procedures for installed systems, subsystems, and equipment.

B. Test Equipment Calibration: The Contractor shall comply with test equipment manufacturer's calibration procedures and intervals. Recalibrate test instruments immediately whenever instruments have been repaired following damage or dropping. Affix calibration tags to test instruments. Instruments shall have been calibrated within six months prior to use.

1.16 COORDINATION

A. Management: The Commissioning Agent will coordinate the commissioning activities with the VA and Contractor. The Commissioning Agent will submit commissioning documents and information to the VA. All commissioning team members shall work together to fulfill their contracted responsibilities and meet the objectives of the contract documents.

B. Scheduling: The Contractor shall work with the Commissioning Agent and the VA to incorporate the commissioning activities into the construction schedule. The Commissioning Agent will provide sufficient information (including, but not limited to, tasks, durations and predecessors) on commissioning activities to allow the Contractor and the VA to schedule commissioning activities. All parties shall address scheduling issues and make necessary notifications in a timely manner in order to expedite the project and the commissioning process. The Contractor shall update the Master Construction as directed by the VA.

C. Initial Schedule of Commissioning Events: The Commissioning Agent will provide the initial schedule of primary commissioning events in the Commissioning Plan and at the commissioning coordination meetings. The Commissioning Plan will provide a format for this schedule. As construction progresses, more detailed schedules will be developed by the Contractor with information from the Commissioning Agent.

D. Commissioning Coordinating Meetings: The Commissioning Agent will conduct periodic Commissioning Coordination Meetings of the commissioning team to review status of commissioning activities, to

discuss scheduling conflicts, and to discuss upcoming commissioning process activities.

E. Pretesting Meetings: The Commissioning Agent will conduct pretest meetings of the commissioning team to review startup reports, Pre-Functional Checklist results, Systems Functional Performance Testing procedures, testing personnel and instrumentation requirements.

F. Systems Functional Performance Testing Coordination: The Contractor shall coordinate testing activities to accommodate required quality assurance and control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting. The Contractor shall coordinate the schedule times for tests, inspections, obtaining samples, and similar activities.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. The Contractor shall provide all standard and specialized testing equipment required to perform Systems Functional Performance Testing. Test equipment required for Systems Functional Performance Testing will be identified in the detailed System Functional Performance Test Procedure prepared by the Commissioning Agent.

B. Data logging equipment and software required to test equipment shall be provided by the Contractor.

C. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the Specifications. If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers shall have a certified calibration within the past year to an accuracy of 0.5 °C (1.0 °F) and a resolution of + or - 0.1 °C (0.2 °F). Pressure sensors shall have an accuracy of + or - 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year. All equipment shall be calibrated according to the manufacturer's recommended intervals and following any repairs to the equipment. Calibration tags shall be affixed or certificates readily available.

PART 3 - EXECUTION

3.1 COMMISSIONING PROCESS ROLES AND RESPONSIBILITIES

A. The following table outlines the roles and responsibilities for the Commissioning Team members during the Construction Phase:

Construction Phase		CxA = Commissioning Agent RE = Resident Engineer 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	Construction Commissioning Kick Off meeting	L	A	P	P	O	
	Commissioning Meetings	L	A	P	P	O	
	Project Progress Meetings	P	A	P	L	O	
	Controls Meeting	L	A	P	P	O	
Coordination	Coordinate with [OGC's, AHJ, Vendors, etc.] to ensure that Cx interacts properly with other systems as needed to support the OPR and BOD.	L	A	P	P	N/A	
Cx Plan & Spec	Final Commissioning Plan	L	A	R	R	O	
Schedules	Duration Schedule for Commissioning Activities	L	A	R	R	N/A	

Department of Veterans Affairs
Ralph H. Johnson VA Health Care System
Charleston, SC

VA Project No.534-24-102
Renovate SPS Spaces
Construction Documents (100%): 12/12/2025

04-01-22

Construction Phase		CxA = Commissioning Agent RE = Resident Engineer 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
OPR and BOD	Maintain OPR on behalf of Owner	L	A	R	R	O	
	Maintain BOD/DID on behalf of Owner	L	A	R	R	O	
Document Reviews	TAB Plan Review	L	A	R	R	O	
	Submittal and Shop Drawing Review	R	A	R	L	O	
	Review Contractor Equipment Startup Checklists	L	A	R	R	N/A	
	Review Change Orders, ASI, and RFI	L	A	R	R	N/A	
Site Observations	Witness Factory Testing	P	A	P	L	O	
	Construction Observation Site Visits	L	A	R	R	O	
Functional Test Protocols	Final Pre-Functional Checklists	L	A	R	R	O	
	Final Functional Performance Test Protocols	L	A	R	R	O	
Technical Activities	Issues Resolution Meetings	P	A	P	L	O	

Construction Phase		CxA = Commissioning Agent RE = Resident Engineer 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
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 = Resident Engineer 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	
	Lessons Learned and Commissioning Report Review Meeting	L	A	P	P	O	

Department of Veterans Affairs
Ralph H. Johnson VA Health Care System
Charleston, SC

VA Project No.534-24-102
Renovate SPS Spaces
Construction Documents (100%): 12/12/2025

04-01-22

Acceptance Phase		CxA = Commissioning Agent RE = Resident Engineer 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
Coordination	Coordinate with [OGC's, AHJ, Vendors, etc.] to ensure that Cx interacts properly with other systems as needed to support OPR and BOD	L	P	P	P	O	
Cx Plan & Spec	Maintain/Update Commissioning Plan	L	A	R	R	O	
Schedules	Prepare Functional Test Schedule	L	A	R	R	O	
OPR and BOD	Maintain OPR on behalf of Owner	L	A	R	R	O	
	Maintain BOD/DID on behalf of Owner	L	A	R	R	O	
Document Reviews	Review Completed Pre-Functional Checklists	L	A	R	R	O	
	Pre-Functional Checklist Verification	L	A	R	R	O	
	Review Operations & Maintenance Manuals	L	A	R	R	R	
	Training Plan Review	L	A	R	R	R	
	Warranty Review	L	A	R	R	O	
	Review TAB Report	L	A	R	R	O	
Site Observations	Construction Observation Site Visits	L	A	R	R	O	
	Witness Selected Equipment Startup	L	A	R	R	O	

Acceptance Phase		CxA = Commissioning Agent RE = Resident Engineer 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	TAB Verification	L	A	R	R	O	
	Systems Functional Performance Testing	L	A	P	P	P	
	Retesting	L	A	P	P	P	
Technical Activities	Issues Resolution Meetings	P	A	P	L	O	
	Systems Training	L	S	R	P	P	
Reports and Logs	Status Reports	L	A	R	R	O	
	Maintain Commissioning Issues Log	L	A	R	R	O	
	Final Commissioning Report	L	A	R	R	R	
	Prepare Systems Manuals	L	A	R	R	R	

C. The following table outlines the roles and responsibilities for the Commissioning Team members during the Warranty Phase:

Department of Veterans Affairs
Ralph H. Johnson VA Health Care System
Charleston, SC

VA Project No.534-24-102
Renovate SPS Spaces
Construction Documents (100%): 12/12/2025

04-01-22

Warranty Phase		CxA = Commissioning Agent					L = Lead
Commissioning Roles & Responsibilities		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	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

A. Trending is a method of testing as a standalone method or to augment manual testing. The Contractor shall trend any and all points of the system or systems at intervals specified below.

B. Alarms are a means to notify the system operator that abnormal conditions are present in the system. Alarms shall be structured into three tiers – Critical, Priority, and Maintenance.

1. Critical alarms are intended to be alarms that require the immediate attention of and action by the Operator. These alarms shall be displayed on the Operator Workstation in a popup style window that is graphically linked to the associated unit's graphical display. The popup style window shall be displayed on top of any active window within the screen, including non DDC system software.
2. Priority level alarms are to be printed to a printer which is connected to the Operator’s Work Station located within the engineer’s office. Additionally Priority level alarms shall be able to be monitored and viewed through an active alarm application.

Priority level alarms are alarms which shall require reaction from the operator or maintenance personnel within a normal work shift, and not immediate action.

3. Maintenance alarms are intended to be minor issues which would require examination by maintenance personnel within the following shift. These alarms shall be generated in a scheduled report automatically by the DDC system at the start of each shift. The generated maintenance report will be printed to a printer located within the engineer's office.

C. The Contractor shall provide a wireless internet network in the building for use during controls programming, checkout, and commissioning. This network will allow project team members to more effectively program, view, manipulate and test control devices while being in the same room as the controlled device.

D. The Contractor shall provide graphical trending through the DDC control system of systems being commissioned. Trending requirements are indicated below and included with the Systems Functional Performance Test Procedures. Trending shall occur before, during and after Systems Functional Performance Testing. The Contractor shall be responsible for producing graphical representations of the trended DDC points that show each system operating properly during steady state conditions as well as during the System Functional Testing. These graphical reports shall be submitted to the COR and Commissioning Agent for review and analysis before, during dynamic operation, and after Systems Functional Performance Testing. The Contractor shall provide, but not limited to, the following trend requirements and trend submissions:

1. Pre-testing, Testing, and Post-testing – Trend reports of trend logs and graphical trend plots are required as defined by the Commissioning Agent. The trend log points, sampling rate, graphical plot configuration, and duration will be dictated by the Commissioning Agent. At any time during the Commissioning Process the Commissioning Agent may recommend changes to aspects of trending as deemed necessary for proper system analysis. The Contractor shall implement any changes as directed by the COR. Any pre-test trend analysis comments generated by the Commissioning Team should be

addressed and resolved by the Contractor, as directed by the COR, prior to the execution of Systems Functional Performance Testing.

2. Dynamic plotting – The Contractor shall also provide dynamic plotting during Systems Functional Performance testing at frequent intervals for points determined by the Systems Functional Performance Test Procedure. The graphical plots will be formatted and plotted at durations listed in the Systems Functional Performance Test Procedure.
3. Graphical plotting - The graphical plots shall be provided with a dual y-axis allowing 15 or more trend points (series) plotted simultaneously on the graph with each series in distinct color. The plots will further require title, axis naming, legend etc. all described by the Systems Functional Performance Test Procedure. If this cannot be sufficiently accomplished directly in the Direct Digital Control System then it is the responsibility of the Contractor to plot these trend logs in Microsoft Excel.
4. The following tables indicate the points to be trended and alarmed by system. The Operational Trend Duration column indicates the trend duration for normal operations. The Testing Trend Duration column indicates the trend duration prior to Systems Functional Performance Testing and again after Systems Functional Performance Testing. The Type column indicates point type: AI = Analog Input, AO = Analog Output, DI = Digital Input, DO = Digital Output, Calc = Calculated Point. In the Trend Interval Column, COV = Change of Value. The Alarm Type indicates the alarm priority; C = Critical, P = Priority, and M = Maintenance. The Alarm Range column indicates when the point is considered in the alarm state. The Alarm Delay column indicates the length of time the point must remain in an alarm state before the alarm is recorded in the DDC. The intent is to allow minor, short-duration events to be corrected by the DDC system prior to recording an alarm.

Terminal Unit (VAV, CAV, etc.) Trending and Alarms							
Point	**Type**	**Trend Interval**	**Operational Trend Duration**	**Testing Trend Duration**	**Alarm Type**	**Alarm Range**	**Alarm Delay**

Terminal Unit (VAV, CAV, etc.) Trending and Alarms							
Point	**Type**	**Trend Interval**	**Operational Trend Duration**	**Testing Trend Duration**	**Alarm Type**	**Alarm Range**	**Alarm Delay**
Space Temperature	AI	15 Min	12 hours	3 days	P	±5°F from SP	10 min
Air Flow	AI	15 Min	12 hours	3 days	P	±5°F from SP	10 min
SA Temperature	AI	15 Min	12 hours	3 days	P	±5°F from SP	10 min
Local Setpoint	AI	15 Min	12 hours	3 days	M	±10°F from SP	60 min
Space Humidity	AI	15 Min	12 hours	3 days	P	> 60% RH	5 min
Unoccupied Override	DI	COV	12 hours	3 days	M	N/A	12 Hours
Refrigerator Alarm	DI	COV	12 hours	3 days	C	N/A	10 min
Damper Position	AO	15 Minutes	12 hours	3 days	N/A		
Heating coil Valve Position	AO	15 Minutes	12 hours	3 days	N/A		

E. The Contractor shall provide the following information prior to Systems Functional Performance Testing. Any documentation that is modified after submission shall be recorded and resubmitted to the COR and Commissioning Agent.

1. Point-to-Point checkout documentation;
2. Sensor field calibration documentation including system name, sensor/point name, measured value, DDC value, and Correction Factor.
3. A sensor calibration table listing the referencing the location of procedures to following in the O&M manuals, and the frequency at which calibration should be performed for all sensors, separated by system, subsystem, and type. The calibration requirements shall be submitted both in the O&M manuals and separately in a standalone document containing all sensors for inclusion in the commissioning documentation. The following table is a sample that can be used as a template for submission.

SYSTEM		
Sensor	**Calibration Frequency**	**O&M Calibration Procedure Reference**
Discharge air temperature	Once a year	Volume I Section D.3.aa
Discharge static pressure	Every 6 months	Volume II Section A.1.c

4. Loop tuning documentation and constants for each loop of the building systems. The documentation shall be submitted in outline or table separated by system, control type (e.g. heating valve temperature control); proportional, integral and derivative constants, interval (and bias if used) for each loop. The following table is a sample that can be used as a template for submission.

AIR HANDLING UNIT AHU-1				
Control Reference	Proportional Constant	Integral Constant	Derivative Constant	Interval
Heating Valve Output	1000	20	10	2 sec.

3.6 SYSTEMS FUNCTIONAL PERFORMANCE TESTING

A. This paragraph applies to Systems Functional Performance Testing of systems for all referenced specification Divisions.

B. Objectives and Scope: The objective of Systems Functional Performance Testing is to demonstrate that each system is operating according to the Contract Documents. Systems Functional Performance Testing facilitates bringing the systems from a state of substantial completion to full dynamic operation. Additionally, during the testing process, areas of noncompliant performance are identified and corrected, thereby improving the operation and functioning of the systems. In general, each system shall be operated through all modes of operation (seasonal, occupied, unoccupied, warm-up, cool-down, part- and full-load, fire alarm and emergency power) where there is a specified system response. The Contractor shall verify each sequence in the sequences of operation. Proper responses to such modes and conditions as power failure, freeze condition, low oil pressure, no flow, equipment failure, etc. shall also be tested.

C. Development of Systems Functional Performance Test Procedures: Before Systems Functional Performance Test procedures are written, the Contractor shall submit all requested documentation and a current list of change orders affecting equipment or systems, including an updated points list, program code, control sequences and parameters. Using the testing parameters and requirements found in the Contract Documents and approved submittals and shop drawings, the Commissioning Agent will develop specific Systems Functional Test Procedures to verify and document proper operation of each piece of equipment and system to be commissioned. The Contractor shall assist the Commissioning Agent in developing the Systems Functional Performance Test procedures as requested by the Commissioning Agent i.e. by answering questions about equipment, operation, sequences, etc. Prior to execution, the Commissioning Agent will provide a copy of the Systems Functional Performance Test procedures to the VA, the Architect/Engineer, and the Contractor, who shall review the tests for feasibility, safety, equipment and warranty protection.

D. Purpose of Test Procedures: The purpose of each specific Systems Functional Performance Test is to verify and document compliance with the stated criteria of acceptance given on the test form. Representative test formats and examples are found in the Commissioning Plan for this project. (The Commissioning Plan is issued as a separate document and is available for review.) The test procedure forms developed by the Commissioning Agent will include, but not be limited to, the following information:

1. System and equipment or component name(s)
2. Equipment location and ID number
3. Unique test ID number, and reference to unique Pre-Functional Checklists and startup documentation, and ID numbers for the piece of equipment
4. Date
5. Project name
6. Participating parties
7. A copy of the specification section describing the test requirements
8. A copy of the specific sequence of operations or other specified parameters being verified

9. Formulas used in any calculations
10. Required pretest field measurements
11. Instructions for setting up the test.
12. Special cautions, alarm limits, etc.
13. Specific step-by-step procedures to execute the test, in a clear, sequential and repeatable format
14. Acceptance criteria of proper performance with a Yes / No check box to allow for clearly marking whether 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.

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SECTION 02 41 19

SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies removal and disposal of selected construction materials.

1.2 RELATED WORK

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

B. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS

1.3 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure at the Second and Third Floors of the Ralph H. Johnson VA Health Care System, Building No. 1, Charleston, SC.
2. Work at the Second Floor will be to provide access for inter-disciplines to install their work. This work will occur in an occupied location so careful removals shall be required at times as designated by the COR.
3. Demolition and removal of selected site elements.
4. Salvage of existing items to be reused or recycled.

B. Related Requirements:

1. Applicable Specification Sections for demolishing, cutting, patching, or relocating mechanical items.
2. Applicable Specification Sections for demolishing, cutting, patching, or relocating electrical items.

1.4 DEFINITIONS

A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.

B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to The Government ready for reuse.

C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.

D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

1.5 MATERIALS OF THE GOVERNMENTSHIP

A. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain The Government's property, demolished materials shall become Contractor's property and shall be removed from Project site. The Government shall have first right of refusal for all salvaged/demolished items.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to The Government that may be uncovered during demolition remain the property of The Government.

1. Coordinate with The Government and the COR who will establish special procedures for removal and salvage. The Government shall have first right of refusal for all salvaged/demolished items.

1.6 SUBMITTALS

A. Qualification Data: For refrigerant recovery technician.

B. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of CORs and the Governments, and other information specified.

C. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property for dust and noise control] Indicate proposed locations and construction of barriers.

D. Schedule of Selective Demolition Activities: Indicate the following:

1. Inform the COR and obtain clearance to perform the work from The COR of all activities noted below one week in advance in writing.
2. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure The Government's on-site operations are uninterrupted.
3. Interruption of utility services. Indicate how long utility services will be interrupted.
4. Coordination for shutoff, capping, and continuation of utility

services.

5. Use of elevator and stairs.
6. Coordination of The Government's continuing occupancy of portions of existing building and of The Government's partial occupancy of completed Work.

E. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by demolition operations. Comply with Section 01 32 33 "Photographic Documentation." Submit before Work begins.

F. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

G. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

1.7 CLOSEOUT SUBMITTALS

A. Inventory: Submit a list of items that have been removed and salvaged.

1.8 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

1.9 FIELD CONDITIONS

A. The Government will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so the Government's operations will not be disrupted.

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

C. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities.

1. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from authorities having jurisdiction.

D. The Government assumes no responsibility for condition of areas to be selectively demolished.

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

E. Notify COR of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

F. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. Hazardous materials will be removed by The Government before start of the Work.
2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and The Government. Hazardous materials will be removed by The Government under a separate contract.

G. Hazardous Materials: Present in buildings and structures to be selectively demolished. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.

1. Hazardous material remediation is specified elsewhere in the Contract Documents.
2. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.
3. The Government will provide material safety data sheets for suspected hazardous materials that are known to be present in buildings and structures to be selectively demolished because of building operations or processes performed there.

H. Historic Areas: Demolition and hauling equipment and other materials shall be of sizes that clear surfaces within historic spaces, areas, rooms, and openings, including temporary protection, by 12 inches or more.

I. Storage or sale of removed items or materials on-site is not permitted.

J. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

1.10 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties. Notify warrantor before proceeding. Existing warranties

include the following:

1. If possible, retain original Installer or fabricator to patch the exposed Work listed below that is damaged during selective demolition. If it is impossible to engage original Installer or fabricator, engage another recognized experienced and specialized firm.
   a. Roofing.
   b. Firestopping.
   c. Wall covering.
   d. HVAC enclosures, cabinets, or covers.

B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

1.11 COORDINATION

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

PART 2 - PRODUCTS

2.1 REPAIR MATERIALS

A. Use repair materials identical to existing materials.
   1. If identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
   2. Use materials whose installed performance equals or surpasses that of existing materials

B. Comply with material and installation requirements specified in individual Specification Sections

2.2 PERFORMANCE REQUIREMENTS

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

B. Standards: Comply with ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by The Government.

The Government does not guarantee that existing conditions are same as those indicated in Project Record Documents.

C. Engage a professional Engineer to survey the condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
   1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

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

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

F. Verify that hazardous materials have been remediated before proceeding with building demolition operations.

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

H. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video.
   1. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.
   2. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.2 PREPARATION

A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

B. Do not interrupt existing utilities serving occupied or operating facilities unless authorized in writing by The Government and authorities

having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to The Government and to authorities having jurisdiction.

1. Provide at least 72 hours' notice to The Government if shutdown of service is required during changeover.

C. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. The Government will arrange to shut off indicated services/systems when requested by Contractor.
2. Arrange to shut off utilities with utility companies and COR.
3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.
   a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
   b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
   c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
   d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
   e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to The Government.
   f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
   g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.
   h. Piping, equipment or ducts abandoned in place: remove to the extent required by the COR.

3.4 PROTECTION

A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
4. Cover and protect furniture, furnishings, and equipment that have not been removed and are to remain in place.

B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

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

C. Remove temporary barricades and protections where hazards no longer exist.

3.5 SELECTIVE DEMOLITION, GENERAL

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

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily

cover openings to remain. Obtain burn permit from the COR prior to any torch use.

3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire- suppression devices during flame-cutting operations.
5. Maintain fire watch during and for at least two (2) hours after flame-cutting operations.
6. Maintain adequate ventilation when using cutting torches.
7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

C. Removed and Salvaged Items:
1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to The Government.
4. Transport items to The Government's storage area designated by The Government.
5. Protect items from damage during transport and storage.

D. Removed and Reinstalled Items:
1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation

requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.

E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by COR or Architect, items may be removed to a suitable, protected storage location during selective demolition and reinstalled in their original locations after selective demolition operations are complete.

3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings If needed, insert requirements for other types of finishes.

B. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight.

1. Remove existing roof membrane, flashings, copings, and roof accessories.
2. Remove existing roofing system down to substrate.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
4. Comply with requirements specified in Section 01 74 19 "Construction Waste Management and Disposal."

B. Burning: Do not burn demolished materials.

3.8 CLEANING

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

SECTION 02 83 33.13
LEAD-BASED PAINT REMOVAL AND DISPOSAL

PART 1 - GENERAL

1.1 SUMMARY

A. This section specifies the abatement and disposal of lead-based paint (LBP)/ lead-containing material (LCM) and the controls needed to limit occupational and environmental exposure to lead hazards.

B. See Mabbett & Associates, Inc., Regulated Building Materials Survey Report for VA Project No. 534-14-102, dated December 12, 2024, for a summary of paint chip samples for accessible substrates and components.

C. The Occupational Safety Health Administration (OSHA) does not recognize a “safe” level of lead in paint or construction debris, since even low amounts of lead in paint may result in airborne concentrations of lead during removal, depending on the method of removal used. An employer or contractor who disturbs or removes LBP/LCM must comply with OSHA Standard 29 CFR 1926.62, "Lead Exposure in Construction".

D. All LBP/LCM identified, regardless of the lead content identified using paint chip analysis and XRF, should either be, recycled, sampled/analyzed by toxicity characteristic leaching procedure (TCLP) and then handled/disposed accordingly, or segregated from other large-scale debris and then managed as hazardous waste in accordance with federal, state and local hazardous waste disposal regulations.

1.2 RELATED WORK

A. Section 09 91 00, PAINTING: Surface Preparation Disturbing Lead-Based Paint.

1.3 DEFINITIONS

A. Action Level: Employee exposure, without regard to use of respirator, to an airborne lead concentration of 30 micrograms(µ) per cubic meter (m^3) of air determined as an 8-hour Time-Weighted Average (TWA). As used in this section, ”30 micrograms per cubic meter of air" refers to OSHA 29 CFR 1926.62 Lead in Construction Action Level (AL).

B. Area Monitoring: Sampling of lead concentrations within lead control area and inside physical boundaries which are representative of airborne lead concentrations which may reach breathing zone of personnel potentially exposed to lead.

C. Breathing Zone: Area within hemisphere, forward of shoulders, with 150 mm to 225 mm (6 to 9 inches) radius and center at nose or mouth of employee.

D. Certified Industrial Hygienist (CIH): As used in this section, refers to an Industrial Hygienist Certified in the Comprehensive Practice of Industrial Hygiene by the American Board of Industrial Hygiene and Board for Global EHS Credentialing, employed by Contractor.

E. Change Rooms and Shower Facilities: Rooms within designated physical boundary around lead control area equipped with separate storage facilities for clean protective work clothing and equipment and for street clothes which prevents cross contamination.

F. Competent Person: Person capable of identifying lead hazards in work area and authorized by contractor to take corrective action. Meets the OSHA definition of Competent Person.

G. Decontamination Room: Room for removal of contaminated personal protective equipment (PPE).

H. Eight-Hour Time Weighted Average (TWA): Airborne concentration of lead averaged over 8-hour workday to which an employee is exposed.

I. High Efficiency Particulate Air (HEPA) Filter Equipment:
HEPA filtered vacuuming equipment with UL 586 filter system capable of collecting and retaining lead-contaminated paint dust. HEPA filter means 99.97 percent efficient against 0.3 micron (0.012 mil) size particles.

J. Lead: Metallic lead, inorganic lead compounds, and organic lead soaps. Excluded from this definition are other organic lead compounds.

K. Lead Control Area: Enclosed area or structure with full containment to prevent spreading lead dust, paint chips, and debris from lead-based paint removal operations. Lead control area is isolated by physical boundaries to prevent unauthorized entry of personnel.

L. Lead Permissible Exposure Limit (PEL): Fifty micrograms per cubic meter of air (50 $\mu g/m^3$) determined as an 8-hour TWA as determined by 29 CFR Part 1926.62. When employee is exposed for more than 8-hours per work day, determine PEL by the following formula. PEL micrograms/cubic meter (parts per million) of air = 400/No. of hrs. worked per day.

M. Personnel Monitoring: Sampling of lead concentrations within employee breathing zone to determine 8-hour time weighted average concentration

according to 29 CFR Part 1926.62. Take samples that are representative of the various employees' work tasks.

N. Physical Boundary: Area physically roped or partitioned off around enclosed lead control area to limit unauthorized entry of personnel. As used in this section, "inside boundary" shall mean same as "outside lead control area."

1.4 APPLICABLE PUBLICATIONS

A. Comply with references to extent specified in this section.

B. American National Standards Institute (ANSI):

Z9.2-2018.....Fundamentals Governing the Design & Operation of Local Exhaust Ventilation Systems.

C. Code of Federal Regulations (CFR):

29 CFR Part 1910.....Occupational Safety and Health Standards.

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

40 CFR Part 260.....Hazardous Waste Management System: General.

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

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

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

40 CFR Part 264.....Standards for Owners and Operations of Hazardous Waste Treatment, Storage, and Disposal Facilities.

40 CFR Part 265.....Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities.

40 CFR Part 268.....Land Disposal Restrictions.

49 CFR Part 172.....Hazardous Material Table, Special Provisions, Hazardous Material Communications, Emergency Response Information, and Training Requirements, and Security Plans.

49 CFR Part 178.....Specifications for Packaging.

D. Underwriters Laboratories (UL):

586-09.....High-Efficiency, Particulate, Air Filter Units.

1.5 PRE-REMOVAL MEETINGS

A. Conduct pre-removal meeting at project site minimum 30 days before beginning Work of this section.

1. Required Participants:
   a. Contracting Officer's Representative.
   b. VPIH.
   c. Architect/Engineer.
   d. Contractor.
2. Meeting Agenda: Distribute agenda to participants minimum 3 days before meeting.
   a. Respiratory protection program.
   b. Hazard communication program.
   c. Hazardous waste management plan.
   d. Safety and health regulation compliance.
   e. Employee training.
   f. Removal schedule.
   g. Removal sequence.
   h. Preparatory work.
   i. Protection before, during, and after removal.
   j. Removal.
   k. Inspecting and testing.
   l. Other items affecting successful completion.
3. Document and distribute meeting minutes to participants to record decisions affecting installation.

1.6 SUBMITTALS

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

B. Manufacturer's Literature and Data:
   1. Description of each product.
      a. Paint removal products.
      b. Vacuum filters.
      c. Respirators.
   2. Safety Data Sheet for each paint removal product.
   3. Installation instructions.
      a. Paint removal products.

C. Test Reports: Submit testing laboratory reports.
   1. Submit air monitoring results within three working days, signed by testing laboratory employee performing air monitoring, employee analyzing sample, and CIH.

D. Certificates: Certify completed lead training.
   1. Submit certificate for each employee signed and dated by CIH and employee stating employee was trained.
E. Qualifications: Substantiate qualifications comply with specifications.
   1. Paint removal contractor.
   2. Testing laboratory.
      a. Name, address, and telephone number.
      b. Current evidence of participation in American Industrial Hygiene Association (AIHA) Laboratory Accreditation Program (LAP), LLC, Environmental Lead Laboratory Accreditation Program (ELLAP).
      c. Copy of current AIHA accreditation certificate.
   3. Industrial hygienist.
      a. Name, address, and telephone number.
      b. Resume showing previous experience.
      c. Copy of current ABIH CIH certification.
   4. Paint disposal facility.
      a. Name, address, and telephone number.
      b. Current license or authorization to receive and dispose lead contaminated waste.
F. Record Documents:
   1. Completed and signed hazardous waste manifest from waste transporter.
   2. Toxicity Characteristic Leaching Procedure (TCLP) test results to determine if waste is hazardous.
   3. Paint disposal facility receipts and disposition reports.
   4. Certification of medical examinations.
   5. Medical Opinion that employee is qualified to wear a respirator, that employees has been trained and fit tested for the respirator.
   6. Employee training certification.

1.7 QUALITY ASSURANCE

A. Safety and Health Regulation Compliance:
   1. Comply with laws, ordinances, rules, and regulations of Federal, State, and Local authorities having jurisdiction regarding removing, handling, storing, transporting, and disposing lead waste materials.
      a. Comply with applicable requirements of 29 CFR Part 1926.62.

b. Notify Contracting Officer's Representative and request resolution of conflicts between regulations and specified requirements before starting work.

2. Comply with the following local laws, ordinances, criteria, rules and regulations regarding removing, handling, storing, transporting, and disposing lead-contaminated materials:

B. South Carolina Department of Environmental Services, Regulation 61-79,

B. Hazardous Waste Management Regulations Paint Removal Contractor: Experienced contractor, registered or licensed by applicable state agency regulating lead-based paint removal.

C. Testing Laboratory: State certified independent testing laboratory experienced in airborne lead monitoring, testing, and reporting.

1. Successful participant in American Industrial Hygiene Association (AIHA) Laboratory Accreditation Program (LAP), LLC, Environmental Lead Laboratory Accreditation Program (ELLAP).

D. Certified Industrial Hygienist: Certified as CIH by American Board of Industrial Hygiene in comprehensive practice and responsible for:

1. Certify Training.
2. Review and approve lead-based paint removal plan for conformance to applicable referenced standards.
3. Inspect lead-based paint removal work for conformance with approved plan.
4. Direct monitoring.
5. Ensure work is performed according to specifications.
6. Ensure personnel and environment hazardous exposures are adequately controlled.

E. Paint Disposal Facility: State certified disposal facility qualified to receive and dispose lead-based paint.

F. Lead-based Paint Removal Plan:

1. Submit detailed, site-specific plan describing lead-based paint removal procedures.
2. Include sketch showing location, size, and details of lead control areas, decontamination rooms, change rooms, shower facilities, and mechanical ventilation system.
3. Include eating, drinking, and restroom procedures, interface of trades, work sequencing, collected wastewater and paint debris disposal plan, air sampling plan, respirators, protective equipment,

and detailed description of containment methods ensuring airborne lead concentrations do not exceed action level outside lead control area.

a. Eating, drinking, and smoking are not acceptable within lead control area.

4. Include air sampling, training and strategy, sampling methodology, frequency, duration, and qualifications of air monitoring personnel.

G. Respiratory Protection Program: Establish and implement program required by 29 CFR Part 1910.134 and 29 CFR Part 1926.62.

1. Provide each employee negative pressure or other appropriate respirator.

a. Respirator fit each employee's respirator at initial fitting and at least annually thereafter, as required by 29 CFR Part 1910.134 Respiratory Protection.

H. Hazard Communication Program: Establish and implement program required by 29 CFR Part 1910.1200 which is the same as 29 CFR 1926.59.

I. Hazardous Waste Management Plan: Establish and implement plan according to applicable requirements of Federal, State, and Local hazardous waste regulations including the following:

1. Identification of hazardous wastes associated with work.
2. Estimated quantities of generated and disposed waste.
3. Names and qualifications of each contractor transporting, storing, treating, and disposing wastes. Include facility location and 24-hour point of contact.
4. Names and qualifications (experience and training) of personnel working on-site with hazardous wastes.
5. List of required waste handling equipment including cleaning, volume reduction, and transport equipment.
6. Spill prevention, containment, and cleanup contingency implementation measures.
7. Work plan and schedule for waste containment, removal, and disposal with daily waste cleaned up and containerization.
8. Hazardous waste disposal cost.

1.8 WARRANTY

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

PART 2 - PRODUCTS

2.1 PAINT REMOVAL PRODUCTS

A. Chemical Stripper: Biodegradable, non-toxic, capable of removing existing paint layers in one application, and acceptable to CIH.

2.2 ACCESSORIES

A. Waste Collection Drums: 49 CFR Part 178; Type 1A2, steel, removable head, 200 L (55 gal.) capacity, capable of containing waste without loss.

B. Vacuum Cleaner: HEPA filtered type.

C. Scrapers:

1. Metal type for use on metal, concrete, and masonry surfaces.
2. Plastic type for use on wood, plaster, gypsum board, and other surfaces.

D. Rinse Water: Potable.

E. Cleaning Cloths: Cotton.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before exposure to lead-contaminated dust, provide workers with comprehensive medical examination required by 29 CFR Part 1926.62 (j) Medical Surveillance.

B. Maintain complete and accurate employee medical records according to 29 CFR Part 1910.1020.

C. Train each employee performing paint removal, disposal, and air sampling operations according to 29 CFR Part 1926.62.

1. Certify training is completed before employee is permitted to work on project and enter lead control area.

3.2 PREPARATION

A. Protect existing work indicated to remain.

1. Perform paint removal work without damaging and contaminating adjacent work.
2. Restore damage and contamination to original condition.

B. Notify Contracting Officer 20 days before starting paint removal work.

C. Lead Control Area Requirements:

1. Establish lead control area by completely isolating lead-based paint removal work area.
2. Contain removal operations using negative pressure full containment system with minimum one change room and HEPA filtered exhaust.

D. Boundary Requirements: Provide physical boundaries around lead control area by isolating area or providing curtains, portable partitions or other enclosures to ensure that airborne lead concentrations do not meet or exceed action level outside of lead control area.

E. Heating, Ventilating and Air Conditioning (HVAC) Systems: Shut down, lock out, and isolate HVAC systems supplying exhausting, and passing through lead control areas. Seal HVAC inlets and outlet within lead control area with 6-mil plastic sheet and tape. Tape seal seams in HVAC components passing through lead control area.

F. Change Room and Shower Facilities: Provide clean change rooms and shower facilities within physical boundary around lead control area according to 29 CFR Part 1926.62.

G. Mechanical Ventilation System:

1. Provide ventilation system to control personnel exposure to lead using HEPA equipped negative air machines.
2. Design, construct, install, and maintain HEPA filtered fixed local exhaust ventilation system according to ANSI Z9.2 and approved by CIH.
3. Exhaust ventilation air to exterior wherever possible.
4. When exhaust ventilation air must be recirculated into work area, provide HEPA filter with reliable back-up filter and controls to monitor lead concentration in return air and to bypass recirculation system automatically when system fails.

H. Personnel Protection: Provide and use required protective clothing and equipment within lead control area.

I. Warning Signs: Provide warning signs complying with 29 CFR Part 1926.62 at lead control area approaches. Locate signs so personnel read signs and take necessary precautions before entering lead control area.

3.3 WORK PROCEDURES

A. Remove lead-based paint according to approved lead-based paint removal plan.

1. Perform work only in presence of CIH or Industrial Hygienist (IH) Technician under direction of CIH ensuring continuous inspection of work in progress and direction of air monitoring activities.
2. Handle, store, transport, and dispose lead or and lead contaminated waste according to 40 CFR Part 260, 40 CFR Part 261, 40 CFR Part 262, 40 CFR Part 263, 40 CFR Part 264, and

40 CFR Part 265. Comply with land disposal restriction notification requirements as required by 40 CFR Part 268.

B. Use procedures and equipment required to limit occupational and environmental lead exposure when lead-based paint is removed according to 29 CFR Part 1926.62.

C. Dispose removed paint and waste according to Environmental Protection Agency (EPA), federal, state, and local requirements.

D. Personnel Exiting Procedures:

1. When personnel exit lead control area, comply with the following procedures:
   a. Vacuum exposed clothing surfaces.
   b. Remove protective clothing and equipment in decontamination room. Place clothing in approved impermeable disposal bag.
   c. Shower.
   d. Dress in clean clothes before leaving lead control area.

E. Monitoring - General:

1. Monitor airborne lead concentrations according to 29 CFR Part 1910.1025by testing laboratory as directed by CIH.
2. Take personal air monitoring samples on employees anticipated to have greatest exposure risk as determined by CIH. Additionally, take air monitoring samples on minimum 25 percent of work crew or minimum of two employees, whichever is greater, during each work shift.
3. Submit results of air monitoring samples, signed by CIH, within 24 hours after taking air samples. Notify Contracting Officer's Representative immediately of lead exposure at or exceeding action level outside of lead control area.

F. Monitoring During Paint Removal:

1. Perform personal and area monitoring during entire paint removal operation.
2. Conduct area monitoring at physical boundary daily for each work shift to ensure unprotected personnel are not exposed above action level anytime.
3. For outdoor operations, take at least one sample on each shift leeward of lead control area. When adjacent areas are contaminated, clean area of contamination and have CIH visually inspect and certify lead contamination is cleaned.

4. Stop work when outside boundary lead levels meet or exceed action level. Notify Contracting Officer's Representative, immediately.
5. Correct conditions causing increased lead concentration as directed by CIH.
6. Review sampling data collected during work stoppage to determine if conditions require additional work method modifications as determined by CIH.
7. Resume paint removal when approved by CIH.

3.4 LEAD-BASED PAINT REMOVAL

A. Remove paint within areas indicated on drawings completely exposing substrate. Minimize damage to substrate.

B. Comply with paint removal processes described lead paint removal plan.

C. Lead-Based Paint Removal: Select processes for each application to minimize work area lead contamination and waste.

3.5 SUBSTRATE SURFACE PREPARATION

A. Protect substrates from deterioration and contamination until refinished.

1. Protect metal substrates from flash rusting.

B. Prepare and paint substrates according to Section 09 91 00, PAINTING.

3.6 FIELD QUALITY CONTROL

A. Field Tests: Performed by testing laboratory specified in Section 01 45 29, TESTING LABORATORY SERVICES.

B. Perform sampling and testing for:

1. Air monitoring.
2. Lead-Based Paint.

3.7 CLEANING AND DISPOSAL

A. Cleaning:

1. Maintain lead control area surfaces free of accumulating paint chips and dust. Confine dust, debris, and waste to work area.
2. HEPA vacuum clean and wet wipe with detergent solution work area daily, at end of each shift, and when paint removal operation is complete.

B. CIH Certification: Certify in writing that inside and outside lead control area air monitoring samples are less than action level, employee respiratory protection was adequate, the work was performed according to 29 CFR Part 1926.62, and no visible accumulations of lead-based paint and dust remain on worksite.

1. Do not remove lead control area or roped-off boundary and warning signs before Contracting Officer's Representative's receipt of CIH's certification.
2. Re-clean areas showing dust or residual paint chips.

C. Testing: Where indicated and when directed by Contracting Officer's Representative, test lead-based paint residue and used abrasive according to 40 CFR Part 261 for hazardous waste.

D. Waste Collection:

1. Collect lead-contaminated materials including waste, scrap, debris, bags, containers, equipment, and clothing, which may produce airborne lead contamination.
2. Place lead contaminated materials in waste disposal drums. Label each drum identifying waste type according to 49 CFR Part 172 and date waste materials were first put into drum. Obtain and complete the Uniform Hazardous Waste Manifest forms. Comply with land disposal restriction notification requirements required by 40 CFR Part 268:
3. Coordinate temporary storage location on project site with Contracting Officer's Representative.

E. Waste Disposal:

1. Do not store hazardous waste drums in temporary storage location longer than 90 calendar days from drum label date.
2. Remove, transport, and deliver drums to paint disposal facility.
   a. Obtain signed receipt including date, time, quantity, and description of materials received according to 40 CFR Part 262.
   b. Obtain final report of materials disposition after disposal completion.

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11-01-18

SECTION 05 12 00
STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Structural steel shapes, plates, and bars.
2. Structural pipe.
3. Bolts, nuts, and washers.

1.2 RELATED REQUIREMENTS

A. Materials Testing And Inspection During Construction: Section 01 45 29, TESTING LABORATORY SERVICES.

B. Steel Finishes: Section 09 06 00, SCHEDULE FOR FINISHES.

C. Painting: Section 09 91 00, PAINTING.

1.3 APPLICABLE PUBLICATIONS

A. Comply with references to extent specified in this section.

B. American Institute of Steel Construction (AISC):

1. AISC Manual - Steel Construction Manual, 14th Ed.
2. 303-16 - Code of Structural Steel Buildings and Bridges.
3. 360-16: Specification for Structural Steel Buildings.

C. The American Society of Mechanical Engineers (ASME):

1. B18.22.1-09 - Washers: Helical Spring-Lock, Tooth Lock, and Plain Washers.

D. American Welding Society (AWS):

1. D1.1/D1.1M-15 - Structural Welding Code - Steel.

E. ASTM International (ASTM):

1. A6/A6M-14 - General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
2. A36/A36M-14 - Carbon Structural Steel.
3. A53/A53M-12 - Pipe, Steel, Black and Hot-Dip, Zinc-Coated, Welded and Seamless.
4. A123/A123M-15 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
5. A242/A242M-13 - High-Strength Low-Alloy Structural Steel.
6. A283/A283M-13 - Low and Intermediate Tensile Strength Carbon Steel Plates.

7. A307-14 - Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength.
8. A500/A500M-13 - Cold-Formed Welded and Seamless Carbon Steel Structural Tubing and Rounds and Shapes.
9. A501/A501M-14 - Hot-Formed Welded and Seamless Carbon Steel Structural Tubing and Rounds and Shapes.
10. A572/A572M-15 - High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
11. A992/A992M-15 - Structural Shapes.
12. F2329/F2329M-15 - Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy steel Bolts, Screws, washers, Nuts, and Special Threaded Fasteners.
13. F3125/F3125M-15 - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions

F. Master Painters Institute (MPI):
1. No. 18 - Primer, Zinc Rich, Organic.

G. Military Specifications (Mil. Spec.):
1. MIL-P-21035 - Paint, High Zinc Dust Content, Galvanizing, Repair.

H. Occupational Safety and Health Administration (OSHA):
1. 29 CFR 1926.752(e) - Guidelines For Establishing The Components Of A Site-Specific Erection Plan.
2. 29 CFR 1926-2001 - Safety Standards for Steel Erection.

I. Research Council on Structural Connections (RCSC) of The Engineering Foundation:
1. Specification for Structural Joints Using ASTM F3125 Bolts.

1.4 SUBMITTALS

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

B. Submittal Drawings:
1. Show size, configuration, and fabrication and installation details.

C. Test Reports: Certify products comply with specifications.
1. Welders' qualifying tests.

D. Certificates: Certify each product complies with specifications.
1. Structural steel.

2. Steel connections.
3. Welding materials.
4. Shop coat primer paint.

E. Qualifications: Substantiate qualifications comply with specifications.
1. Fabricator.
2. Installer.
3. Welders and welding procedures.

1.5 QUALITY ASSURANCE

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

B. Installer Qualifications:.
1. Regularly installs specified products.
2. Installed specified products with satisfactory service on five similar installations for minimum five years.

C. Before commencement of Work, ensure steel erector provides written notification required by OSHA 29 CFR 1926.752(e). Submit a copy of the notification to Contracting Officer's Representative.

D. Welders and Welding Procedures Qualifications: AWS D1.1/D1.1M.

1.6 WARRANTY

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

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

A. Delegated Design: Prepare submittal documents including design calculations and drawings signed and sealed by registered design professional, licensed in state where project is located.

B. Design structural steel framing connections complying with specified performance:
1. Load Capacity: Resist loads indicated on drawings Account for connection and member loads and eccentricities.
a. Request additional design criteria when necessary to complete connection design.
2. Configuration: Design and detail all connections for each member size, steel grade and connection type to resist the loads and

reactions indicated on the drawings or specified herein. Use details consistent with details shown on drawings, supplementing where necessary. The details shown on drawings are conceptual and do not indicate the required weld sizes or number of bolts unless specifically noted. Use rational engineering design and standard practice in detailing, accounting for all loads and eccentricities in both the connection and the members. Promptly notify the Contracting Officer Representative of any location where the connection design criteria is not clearly indicated. The design of all connections is subject to the review and acceptance of the Contracting Officer's Representative. Submit structural calculations prepared and sealed by a qualified engineer registered in the state where the project is located. Submit calculations for review before preparation of detail drawings.

2.2 MATERIALS

A. W-Shapes:
   1. ASTM A992/A992M.
B. Channel and Angles:
   1. ASTM A36/A36M.
C. Plates and Bars:
   1. ASTM A36/A36M.
D. Hollow Structural Sections:
   1. ASTM A500/A500M.
E. Structural Pipe: ASTM A53/A53M, Grade B.
F. Bolts, Nuts and Washers: Galvanized for galvanized framing and plain finish for other framing.
   1. High-strength bolts, including nuts and washers: ASTM F3125.
   2. Bolts and nuts, other than high-strength: ASTM A307, Grade A.
   3. Plain washers, other than those in contact with high-strength bolt heads and nuts: ASME B18.22.1.
G. Welding Materials: AWS D1.1, type to suit application.

2.3 PRODUCTS - GENERAL

A. Basis of Design: Section 09 06 00, SCHEDULE FOR FINISHES.

2.4 FABRICATION

A. Fabricate structural steel according to Chapter M, AISC 360.
B. Shop and Field Connections:

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

2.5 FINISHES

A. Shop Priming:
   1. Prime paint structural steel according to AISC 303, Section 6.
      a. Interstitial Space Structural Steel: Prime paint, unless indicated to receive sprayed on fireproofing.

B. Shop Finish Painting: Apply primer and finish paint as specified in Section 09 91 00, PAINTING.

C. Do not paint:
   1. Surfaces within 50 mm (2 inches) of field welded joints.
   2. Surfaces indicated to be encased in concrete.
   3. Surfaces receiving sprayed on fireproofing.
   4. Beam top flanges receiving shear connector studs applied.

D. Structural Steel Galvanizing: ASTM A123/A123M, hot dipped, after fabrication. Touch-up after erection: Clean and wire brush any abraded and other spots worn through zinc coating, including threaded portions of bolts and welds and touch-up with galvanizing repair paint.
   1. Galvanize structural steel framing installed at exterior locations.

E. Bolts, Nuts, and Washers Galvanizing: ASTM F2329, hot-dipped.

2.6 ACCESSORIES

A. General: Shop paint steel according to AISC 303, Section 6.

B. Finish Paint System: Primer and finish as specified in Section 09 91 00, PAINTING.

C. Galvanizing Repair Paint: MPI No. 18.

PART 3 - EXECUTION

3.1 ERECTION

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

B. Set structural steel accurately at locations and elevations indicated on drawings.

C. Maintain erection tolerances of structural steel within AISC 303 requirements.

1. Pour Stop Elevation Tolerance: 6 mm (1/4 inch), maximum, before concrete placement.

D. Weld and bolt connections as specified for shop connections.

3.2 FIELD PAINTING

A. After welding, clean and prime weld areas to match adjacent finish.

B. Touch-up primer damaged by construction operations.

C. Apply galvanizing repair paint to galvanized coatings damaged by construction operations.

D. Finish Painting: As specified in Section 09 91 00, PAINTING.

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10-01-17

SECTION 06 10 00
ROUGH CARPENTRY

PART 1 - GENERAL

1.1 DESCRIPTION:

A. This section specifies wood blocking, and nailer construction.

1.2 RELATED WORK:

A. Sustainable design requirements: Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

B. Roofing: Section 07 54 23 Thermoplastic Poluolefing (TPO) Roofing

1.3 SUBMITTALS:

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

B. Sustainable Design Submittals, as described below:

1. Postconsumer and preconsumer recycled content as specified in PART 2 - PRODUCTS.
2. Volatile organic compounds per volume as specified in PART 2 - PRODUCTS.
3. For composite wood products, submit documentation indicating that product contains no added urea formaldehyde.

C. Shop Drawings showing framing connection details, fasteners, connections and dimensions.

D. Manufacturer’s Literature and Data:

1. Submit data for lumber, panels, hardware and adhesives.
2. Submit data for wood-preservative treatment from chemical treatment manufacturer and certification from treating plants that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
3. Submit data for fire retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
4. For products receiving a waterborne treatment, submit statement that moisture content of treated materials was reduced to levels specified before shipment to project site.

E. Manufacturer's certificate for unmarked lumber.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING:

A. Protect lumber and other products from dampness both during and after delivery at site.

B. Pile lumber in stacks in such manner as to provide air circulation around surfaces of each piece.

C. Stack plywood and other board products so as to prevent warping.

D. Locate stacks on well drained areas, supported at least 152 mm (6 inches) above grade and cover with well-ventilated sheds having firmly constructed over hanging roof with sufficient end wall to protect lumber from driving rain.

1.5 QUALITY ASSURANCE:

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

1.6 GRADING AND MARKINGS:

A. Any unmarked lumber or plywood panel for its grade and species will not be allowed on VA Construction sites for lumber and material not normally grade marked, provide manufacturer's certificates (approved by an American Lumber Standards approved agency) attesting that lumber and material meet the specified the specified requirements.

1.7 APPLICABLE PUBLICATIONS:

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

B. American Forest and Paper Association (AFPA):

NDS-15.....National Design Specification for Wood Construction

WCD1-01.....Details for Conventional Wood Frame Construction

C. American Institute of Timber Construction (AITC):

A190.1-07.....Structural Glued Laminated Timber

D. American Society of Mechanical Engineers (ASME):

B18.2.1-12(R2013).....Square and Hex Bolts and Screws

B18.2.2-10.....Square and Hex Nuts

B18.6.1-81(R2008).....Wood Screws

E. American Plywood Association (APA):

E30-11.....Engineered Wood Construction Guide

F. ASTM International (ASTM):

A653/A653M-13.....Steel Sheet Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot Dip Process

C954-11.....Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases to Steel Studs from 0.033 inch (2.24 mm) to 0.112-inch (2.84 mm) in thickness

C1002-14.....Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Metal Studs

D198-14.....Test Methods of Static Tests of Lumber in Structural Sizes

D2344/D2344M-13.....Test Method for Short-Beam Strength of Polymer Matrix Composite Materials and Their Laminates

D2559-12a.....Adhesives for Structural Laminated Wood Products for Use Under Exterior (Wet Use) Exposure Conditions

D3498-03(R2011).....Adhesives for Field-Gluing Plywood to Lumber Framing for Floor Systems

D6108-13.....Test Method for Compressive Properties of Plastic Lumber and Shapes

D6109-13.....Test Methods for Flexural Properties of Unreinforced and Reinforced Plastic Lumber and Related Products

D6111-13a.....Test Method for Bulk Density and Specific Gravity of Plastic Lumber and Shapes by Displacement

D6112-13.....Test Methods for Compressive and Flexural Creep and Creep-Rupture of Plastic Lumber and Shapes

F844-07a(R2013).....Washers, Steel, Plan (Flat) Unhardened for General Use

F1667-13.....Nails, Spikes, and Staples

G. American Wood Protection Association (AWPA):

AWPA Book of Standards

H. Commercial Item Description (CID):

A-A-55615.....Shield, Expansion (Wood Screw and Lag Bolt Self Threading Anchors)

I. Forest Stewardship Council (FSC):

FSC-STD-01-001(Ver. 4-0)FSC Principles and Criteria for Forest Stewardship

J. Military Specification (Mil. Spec.):

MIL-L-19140E.....Lumber and Plywood, Fire-Retardant Treated

K. Environmental Protection Agency (EPA):

40 CFR 59(2014).....National Volatile Organic Compound Emission Standards for Consumer and Commercial Products

L. U.S. Department of Commerce Product Standard (PS)

PS 1-95.....Construction and Industrial Plywood

PS 20-10.....American Softwood Lumber Standard

M. ICC Evaluation Service (ICC ES):

AC09.....Quality Control of Wood Shakes and Shingles

AC174.....Deck Board Span Ratings and Guardrail Systems (Guards and Handrails)

PART 2 - PRODUCTS

2.1 LUMBER:

A. Unless otherwise specified, each piece of lumber must bear grade mark, stamp, or other identifying marks indicating grades of material, and rules or standards under which produced.

1. Identifying marks are to be in accordance with rule or standard under which material is produced, including requirements for qualifications and authority of the inspection organization, usage of authorized identification, and information included in the identification.
2. Inspection agency for lumber approved by the Board of Review, American Lumber Standards Committee, to grade species used.

B. Lumber Other Than Structural:

1. Unless otherwise specified, species graded under the grading rules of an inspection agency approved by Board of Review, American Lumber Standards Committee.
2. Framing lumber: Minimum extreme fiber stress in bending of 7584 kPa (1100 PSI).

3. Furring, blocking, nailers and similar items 101 mm (4 inches) and narrower Standard Grade; and, members 152 mm (6 inches) and wider, Number 2 Grade.
4. Board Sub-flooring: Shiplap edge, 25 mm (1 inch) thick, not less than 203 mm (8 inches) wide.

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

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

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

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

2.2 PLYWOOD:

A. Comply with PS 1.

B. Bear the mark of a recognized association or independent inspection agency that maintains continuing control over quality of plywood which identifies compliance by veneer grade, group number, span rating where applicable, and glue type.

2.3 ROUGH HARDWARE AND ADHESIVES:

A. Anchor Bolts:
   1. ASME B18.2.1 and ASME B18.2.2 galvanized, 13 mm (1/2 inch) unless shown otherwise.
   2. Extend at least 203 mm (8 inches) into masonry or concrete with ends bent 50 mm (2 inches).

B. Miscellaneous Bolts: Expansion Bolts: C1D A-A-55615; lag bolt, long enough to extend at least 65 mm (2-1/2 inches) into masonry or concrete. Provide 13 mm (1/2 inch) bolt unless shown otherwise.

C. Washers
   1. ASTM F844.
   2. Provide zinc or cadmium coated steel or cast iron for washers exposed to weather.

D. Screws:
   1. Wood to Wood: ASME B18.6.1 or ASTM C1002.
   2. Wood to Steel: ASTM C954, or ASTM C1002.

E. Nails:
   1. Size and type best suited for purpose unless noted otherwise. Provide aluminum-alloy nails, plated nails, or zinc-coated nails, for nailing wood work exposed to weather and on roof blocking.
   2. ASTM F1667:
      a. Common: Type I, Style 10.
      b. Concrete: Type I, Style 11.
      c. Barbed: Type I, Style 26.
      d. Underlayment: Type I, Style 25.
      e. Masonry: Type I, Style 27.
      f. Provide special nails designed for use with ties, strap anchors, framing connectors, joists hangers, and similar items. Nails not less than 32 mm (1-1/4 inches) long, 8d and deformed or annular ring shank.

PART 3 - EXECUTION

3.1 INSTALLATION OF FRAMING AND MISCELLANEOUS WOOD MEMBERS:

A. Conform to applicable requirements of the following:
   1. AFPA NDS for timber connectors.
   2. AITC A190.1 Timber Construction Manual for heavy timber construction.
   3. AFPA WCD1 for nailing and framing unless specified otherwise.
   4. APA for installation of plywood or structural use panels.
   5. TPI for metal plate connected wood trusses.

B. Fasteners:
   1. Nails
      a. Nail in accordance with the Recommended Nailing Schedule as specified in AFPA WCD1 where detailed nailing requirements are not specified in nailing schedule. Select nail size and nail spacing sufficient to develop adequate strength for the connection without splitting the members.
      b. Use special nails with framing connectors.
      c. Use 8d or larger nails for nailing through 25 mm (1 inch) thick lumber and for toe nailing 50 mm (2 inch) thick lumber.
      d. Use 16d or larger nails for nailing through 50 mm (2 inch) thick lumber.
      e. Select the size and number of nails in accordance with the Nailing Schedule except for special nails with framing anchors.
      f. Nailing Schedule; Using Common Nails:
   2. Bolts:
      a. Fit bolt heads and nuts bearing on wood with washers.
      b. Countersink bolt heads flush with the surface of nailers.
      c. Embed in concrete and solid masonry or provide expansion bolts. Special bolts or screws designed for anchor to solid masonry or concrete in drilled holes may be used.
      d. Provide toggle bolts to hollow masonry or sheet metal.
      e. Provide bolts to steel over 2.84 mm (0.112 inch, 11 gage) in thickness. Secure wood nailers to vertical structural steel members with bolts, placed one at ends of nailer and 610 mm (24 inch) intervals between end bolts. Provide clips to beam flanges.

3. Drill Screws to steel less than 2.84 mm (0.112 inch) thick.
   a. ASTM C1002 for steel less than 0.84 mm (0.033 inch) thick.
   b. ASTM C954 for steel over 0.84 mm (0.033 inch) thick.
4. Power actuated drive pins may be provided where practical to anchor to solid masonry, concrete, or steel.
5. Do not anchor to wood plugs or nailing blocks in masonry or concrete. Provide metal plugs, inserts or similar fastening.
6. Screws to Join Wood:
   a. Where shown or option to nails.
   b. ASTM C1002, sized to provide not less than 25 mm (1 inch) penetration into anchorage member.
   c. Spaced same as nails.

C. Cut notch, or bore in accordance with AFPA WCD1 passage of ducts wires, bolts, pipes, conduits and to accommodate other work. Repair or replace miscut, misfit or damaged work.

E. Blocking Nailers, and Furring:
1. Install furring, blocking, nailers, and grounds where shown.
2. Provide longest lengths practicable.
3. Provide fire retardant treated wood blocking where shown at openings and where shown or specified.
4. Layers of Blocking or Plates:
   a. Stagger end joints between upper and lower pieces.
   b. Nail at ends and not over 610 mm (24 inches) between ends.
   c. Stagger nails from side to side of wood member over 127 mm (5 inches) in width.

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SECTION 07 01 50.19

PREPARATION FOR RE-ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Partial roof removal for new roof repair system installation.
2. Roofing membrane and selective roofing system component removal for new roof membrane installation.
3. Existing roofing membrane preparation for new roofing membrane system installation.

B. Existing Roofing System: TPO System components include:

1. Roof insulation and drainage board .
2. Roofing membrane.
3. Cover board.
4. Roof insulation.
5. Vapor retarder.
6. Substrate board.

1.2 RELATED WORK

A. Section 07 54 23, THERMOPLASTIC POLYOLEFIN (TPO) ROOFING: New Roofing System.

B. Section 07 60 00, FLASHING AND SHEET METAL: Sheet Metal Counterflashing.

1.3 APPLICABLE PUBLICATIONS

A. Comply with references to extent specified in this section.

B. American National Standards Institute/Single-Ply Roofing Institute (ANSI/SPRI):

FX-1 (R2016).....Standard Field Test Procedure for Determining the Withdrawal Resistance of Roofing Fasteners.

C. American Society for Nondestructive Testing (ASNT):

SNT-TC-1A (2019).....Personnel Qualification and Certification for Nondestructive Testing.

D. ASTM International (ASTM):

C208-12(2017)e2.....Cellulosic Fiber Insulating Board.

C578-19.....Rigid, Cellular Polystyrene Thermal Insulation.

C728-17a.....Perlite Thermal Insulation Board.

C1177/C1177M-17.....Glass Mat Gypsum Substrate for Use as Sheathing.

C1153-10(2015).....Location of Wet Insulation in Roofing Systems Using Infrared Imaging.

C1278/C1278M-17.....Standard Specification Fiber-Reinforced Gypsum Panel.

D4263-83(2018).....Indicating Moisture in Concrete by the Plastic Sheet Method.

E. U.S. Department of Commerce National Institute of Standards and Technology (NIST):

DOC PS 1-19.....Structural Plywood.

DOC PS 2-18.....Performance Standard for Wood-Based Structural-Use Panels.

1.4 PREINSTALLATION MEETINGS

A. Conduct preinstallation meeting minimum 30 days before beginning Work of this section.

1. Required Participants:
   a. Contracting Officer's Representative.
   b. Architect/Engineer.
   c. Inspection and Testing Agency.
   d. Contractor.
   e. Installer.
   f. Manufacturer's field representative.
   g. Other installers responsible for adjacent and intersecting work, including mechanical and electrical equipment installers.
2. Meeting Agenda: Distribute agenda to participants minimum 3 days before meeting.
   a. Removal and installation schedule.
   b. Removal and installation sequence.
   c. Preparatory work.
   d. Protection before, during, and after installation.
   e. Removal and installation.
   f. Temporary roofing including daily terminations.
   g. Transitions and connections to other work.
   h. Inspecting and testing.
   i. Other items affecting successful completion.

3. Document and distribute meeting minutes to participants to record decisions affecting installation.

1.5 SUBMITTALS

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

B. Submittal Drawings:

1. Show size, configuration, and installation details.

C. Manufacturer's Literature and Data:

1. Description of each product.
2. Description of temporary roof system and components.
3. List of patching materials.
4. Recover board fastening requirements.
5. Temporary roofing installation instructions and removal instructions. preparation instructions to receive new roofing.
6. Existing roofing warrantor's instructions.

D. Photographs: Document existing conditions potentially affected by roofing operations before work begins.

E. Field Inspection Reports:

1. Certify warrantor inspected completed roofing and existing warranty remains in effect.

F. Infrared Roof Moisture Survey Report.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:

1. Licensed to perform asbestos abatement in Project jurisdiction when removal of asbestos-containing material is required.
2. Approved by existing roofing system warrantor when work affects existing roofing system under warranty.

1.7 FIELD CONDITIONS

A. Building Occupancy: Perform work to minimize disruption to normal building operations.

1. Verify occupants are evacuated from affected building areas when working on structurally impaired roof decking above occupied areas.
2. Provide notice minimum 72 hours before beginning activities affecting normal building operations.
3. Examine site conditions before beginning work of this section.

B. Weather Limitations: Proceed with reroofing preparation only during dry weather conditions as specified for new roofing installation.
   1. Remove only as much roofing in one day as can be made watertight in same day.
C. Hazardous Materials are known to exist in existing roofing system.
   1. Coordinate reroofing preparation with asbestos roofing abatement to prevent water from entering existing roofing system and building.
   2. Hazardous material report is available in the COR offices_____ for review and use.

1.8 WARRANTY

A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."
B. Existing Warranties: Perform work to maintain existing roofing warranty in effect.
   1. Notify warrantor before beginning, and upon completion of reroofing.
   2. Obtain warrantor's instructions for maintaining existing warranty.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Patching Materials: Match existing roofing system materials.
B. Metal Flashing: See Section 07 60 00, FLASHING AND SHEET METAL.
C. Temporary Protection Materials:
   1. Expanded Polystyrene (EPS) Insulation: ASTM C578-19.
   2. Plywood: NIST DOC PS 1-19, Grade CD Exposure 1-18.
   3. Oriented Strand Board (OSB): NIST DOC PS 2-18, Exposure 1.
D. Temporary Roofing System Materials: Contractor's option.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Infrared Roof Moisture Survey: Ground-based, walk-over type performed according to ASTM C1153-10(2015).
   1. Record the entire survey on DVD and provide one copy to Contracting Officer's Representative with report.
   2. Include in report thermograms of suspect areas and corresponding daytime photos of same locations.
   3. Conduct inspection by NDT test technician certified to at least Level 2 in Thermal/Infrared test method according to ASNT SNT-TC-1A.

4. Mark out roof areas determined to be wet to indicate minimum areas to be removed.

3.2 PREPARATION

A. Examine and verify substrate suitability for product installation.

B. Protect existing roofing system indicated to remain.

1. Cover roof membrane with temporary protection materials without impeding drainage.
2. Limit traffic and material storage to protected areas.
3. Maintain temporary protection until replacement roofing is completed.

C. Protect existing construction and completed work from damage.

D. Protect landscaping from damage.

E. Maintain access to existing walkways and adjacent occupied facilities.

F. Coordinate use of rooftop fresh air intakes with Contracting Officer's Representative to minimize effect on indoor air quality.

G. Ensure temporary protection materials are available for immediate use in case of unexpected rain.

H. Ensure roof drainage remains functional.

1. Keep drainage systems clear of debris.
2. Prevent water from entering building and existing roofing system.

I. Coordinate rooftop utilities remaining active during roofing work with Contacting Officer's Representative.

3.3 RE-ROOFING PREPARATION - GENERAL

A. Notify Contacting Officer's Representative of planned operations, daily.

1. Identify location and extent of roofing removal.
2. Request authorization to proceed.

3.4 OVERBURDEN REMOVAL

A. Remove aggregate ballast.

1. Store aggregate ballast for reuse.

B. Remove loose aggregate from bituminous membrane surface.

C. Remove pavers and paver support.

1. Store undamaged pavers and paver supports for reuse.
2. Dispose of damaged pavers.

D. Remove plants, planting medium, water retention mat, and root barrier from vegetated roof assembly.

1. Store materials and plants for reuse.
2. Protect plants from root exposure and drying.

E. Remove insulation and drainage board from protected roofing membrane.
1. Store insulation and drainage board for reuse.

3.5 PARTIAL ROOFING SYSTEM REMOVAL

A. Remove existing roofing completely, exposing structural roof deck at locations and to extent indicated on drawings.
1. Remove cover board, roof insulation, vapor retarder, and substrate board .
2. Remove or cut-off roofing system fasteners.

3.6 ROOFING MEMBRANE AND SELECTIVE ROOFING SYSTEM COMPONENT REMOVAL

A. Remove existing roofing membrane, only, in locations and to extent indicated on drawings.

B. Visually inspect cover board, roof insulation, vapor retarder, and substrate board for moisture immediately after roof membrane removal.
1. Coordinate with Contracting Officer's Representative to observe inspections.
2. Identify wet roofing system components required to be removed.
3. Mark roofing system removal locations and extents.

C. Remove wet roofing system components.
1. Remove or cut-off roofing system fasteners when removals expose structural roof deck.

D. Patch selective roofing system removals immediately after inspection and repair.

E. Install patching materials to match existing roofing system.

F. Patch roofing membrane to maintain building watertight, unless new roofing membrane is installed same day as removal and repair.

3.7 DECK PREPARATION

A. Inspect structural roof deck after roofing system removal.

B. Concrete Roof Decks:
1. Visually confirm concrete roof deck is dry.
2. Perform moisture test according to ASTM D4263-83(2018) each day for each separate roof area.
a. Proceed with roofing work only when moisture is not observed.

C. Steel Roof Decks:
1. Visually inspect structural roof deck installation and fasteners.

a. Notify Contracting Officer's Representative of unsuitable conditions and inadequate fastenings potentially affecting roof system performance.

2. Secure roof deck with additional fastenings as indicated on drawings. determined by Contracting Officer's Representative.

3. Replace roof deck as indicated on drawings. determined by Contracting Officer's Representative.

a. Replacement Roof Deck: See Section 05 31 00, STEEL DECKING. Section 06 10 00, ROUGH CARPENTRY.

3.8 DISPOSAL

A. Collect waste materials in containers.

B. Remove waste materials from project site, regularly, to prevent accumulation.

C. Legally dispose of waste materials.

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01-01-21

SECTION 07 21 13
THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Thermal insulation.

   Acoustical insulation.

   a. Semi-rigid insulation at interior framed partitions.

   b. Batt and blanket insulation at interior framed partitions and ceilings .

1.2 RELATED WORK

A. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS: Adhesives VOC Limits.

B. Section 07 84 00, FIRESTOPPING: Safing Insulation.

1.3 APPLICABLE PUBLICATIONS

A. Comply with references to extent specified in this section.

B. ASTM International (ASTM):

C516-19.....Vermiculite Loose Fill Thermal Insulation.

C549-18.....Perlite Loose Fill Insulation.

C552-17e1 .....Cellular Glass Thermal Insulation.

C553-13(2019).....Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

C578-19.....Rigid, Cellular Polystyrene Thermal Insulation.

C591-20.....Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.

C612-14(2019).....Mineral Fiber Block and Board Thermal Insulation.

C665-17.....Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.

C728-17a.....Perlite Thermal Insulation Board.

C954-18.....Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Base to

Steel Studs From 0.033 (0.84 mm) inch to 0.112 inch (2.84 mm) in thickness.

C1002-18.....Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.

D312/D312M-16a.....Asphalt Used in Roofing.

E84-20.....Surface Burning Characteristics of Building Materials.

F1667-18a.....Driven Fasteners: Nails, Spikes, and Staples.

1.4 SUBMITTALS

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

B. Submittal Drawings:

1. Show insulation type, thickness, and R-value for each location.

C. Manufacturer's Literature and Data:

1. Description of each product.
2. Adhesive indicating manufacturer recommendation for each application.

D. Sustainable Construction Submittals:

1. Recycled Content: Identify post-consumer and pre-consumer recycled content percentage by weight.
2. Low Pollutant-Emitting Materials: Show volatile organic compound types and quantities.

1.5 DELIVERY

A. Deliver products in manufacturer's original sealed packaging.

B. Mark packaging, legibly. Indicate manufacturer's name or brand, type, production run number, and manufacture date.

C. Before installation, return or dispose of products within distorted, damaged, or opened packaging.

1.6 STORAGE AND HANDLING

A. Store products indoors in dry, weathertight facility.

B. Protect products from damage during handling and construction operations.

C. Protect foam plastic insulation from UV exposure.

1.7 WARRANTY

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

PART 2 - PRODUCTS

2.1 INSULATION - GENERAL

A. Insulation Thickness:
   1. Provide thickness required by R-value shown on drawings.
   2. Provide thickness indicated when R-value is not shown on drawings.

B. Insulation Types:
   1. Provide one insulation type for each application.

C. Sustainable Construction Requirements:
   1. Insulation Recycled Content:
      a. Polyisocyanurate/polyurethane rigid foam: 9 percent recovered material.
      b. Polyisocyanurate/polyurethane foam-in-place: 5 percent recovered material.
      c. Glass fiber reinforced: 6 percent recovered material.
      d. Phenolic rigid foam: 5 percent recovered material.
      e. Rock wool material: 75 percent recovered material.
   2. Low Pollutant-Emitting Materials: Comply with VOC limits specified in Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS for the following products:
      a. Non-Flooring Adhesives and Sealants.

2.2 ACOUSTICAL INSULATION

A. Semi Rigid, Batts and Blankets:
   1. Widths and lengths to fit tight against framing.
   2. Mineral Fiber boards: ASTM C553, Type II, flexible, or Type III, semi rigid FSK faced unfaced .
      a. Density: nominal 4.5 pound.
   3. Mineral Fiber Batt or Blankets: ASTM C665 FSK faced unfaced .
   4. Maximum Surface Burning Characteristics: ASTM E84.
      a. Flame Spread Rating: 25.
      b. Smoke Developed Rating: 450.

B. Sound Deadening Board:
   1. Mineral Fiber Board: ASTM C612, Type IB.

a. Thickness: 13 mm (1/2 inch).

2. Perlite Board: ASTM C728.

a. Thickness: 13 mm (1/2 inch).

2.3 ACCESSORIES

A. Fasteners:

1. Staples or Nails: ASTM F1667, zinc-coated, size and type to suit application.
2. Screws: ASTM C954 or ASTM C1002, size and length to suit application with washer minimum 50 mm (2 inches) diameter.
3. Impaling Pins: Steel pins with head minimum 50 mm (2 inches) diameter.
   a. Length: As required to extend beyond insulation and retain cap washer when washer is placed on pin.
   b. Adhesive: Type recommended by manufacturer to suit application.

B. Insulation Adhesive: Nonflammable type recommended by insulation manufacturer to suit application.

C. Tape: Pressure sensitive adhesive on one face.

PART 3 - EXECUTION

3.1 PREPARATION

A. Examine and verify substrate suitability for product installation.

B. Protect existing construction and completed work from damage.

C. Clean substrates. Remove contaminants capable of affecting subsequently installed product's performance.

3.2 INSTALLATION - GENERAL

A. Install products according to manufacturer's instructions and approved submittal drawings.

1. When manufacturer's instructions deviate from specifications, submit proposed resolution for Contracting Officer's Representative consideration.

B. Install insulation with vapor barrier facing the heated side, unless indicated otherwise.

C. Install board and block insulation with joints close and flush, in regular courses, and with end joints staggered.

D. Install batt and blanket insulation with joints tight. Fill framing voids completely. Seal penetrations, terminations, facing joints, facing cuts, tears, and unlapped joints with tape.

E. Fit insulation tight against adjoining construction and penetrations, unless indicated otherwise.

3.3 ACOUSTICAL INSULATION

A. General:

1. Install insulation without voids.
2. Pack insulation around door frames and windows, in building expansion joints, door soffits, and other voids.
3. Pack behind outlets, around pipes, ducts, and services encased in walls.
4. Hold insulation in place with pressure sensitive tape.
5. Lap facer flanges together over framing for continuous surface. Seal all penetrations through the insulation and facers.
6. Do not compress insulation below required thickness except where embedded items prevent required thickness.

B. Semi Rigid, Batts and Blankets:

1. When insulation is not full thickness of cavity, adhere insulation to one side of cavity, maintaining continuity of insulation and covering penetrations or embedments.
   a. Wood Framing:
      1) Fasten blanket insulation between wood framing and joists with nails or staples through flanged edges of insulation.
      2) Space fastenings maximum 150 mm (6 inches) on center.
   b. Metal Framing:
      1) Fasten insulation between metal framing with pressure sensitive tape continuous along flanged edges.
      2) At metal framing or ceilings suspension systems, install blanket insulation above suspended ceilings or metal framing at right angles to the main runners or framing.
      3) Tape insulation tightly together so no gaps occur and metal framing members are covered by insulation.

C. Sound Deadening Board: Secure with adhesive to masonry and concrete walls and with screws to metal and wood framing . Secure sufficiently

in place until subsequent cover is installed. Seal all cracks with caulking.

3.4 CLEANING

A. Remove excess adhesive before adhesive sets.

3.5 PROTECTION

A. Protect insulation from construction operations.

B. Repair damage.

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12-01-21

SECTION 07 51 00

BUILT-UP BITUMINOUS ROOFING

PART 1 GENERAL

1.1 DESCRIPTION

A. This section includes bituminous built-up roofing, aggregate surfacing, with base flashing for repairs and alterations to existing construction.

1.2 APPLICABLE PUBLICATIONS

A. Applicable publications listed below form a part of this Specification as referenced. Publications are referenced in the text by the number designation only.

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

A240/A240M-15.....Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels and for General Applications.

B209-14.....Aluminum and Aluminum-Alloy Sheet and Plate

D41-11.....Asphalt Primer Used in Roofing, Dampproofing and Waterproofing

D43-00(R2012).....Coal Tar Primer Used in Roofing, Dampproofing and Waterproofing

D227-11.....Coal-Tar Saturated Organic Felt Used in Roofing and Waterproofing

D312-00(R2006).....Asphalt Used in Roofing

D448-12.....Sizes of Aggregate for Road and Bridge Construction

D450-13.....Coal-Tar Pitch Used in Roofing, Dampproofing and Waterproofing

D751-11.....Test Methods for Coated Fabrics

D1863-11.....Mineral Aggregate Used on Built-Up Roofs

D2178-13.....Asphalt Glass Felt Used in Roofing and Waterproofing

D3884-13.....Abrasion Resistance of Textile Fabrics (Rotary Platform Double-Head Method)

D3909-97(R2012).....Asphalt Roll Roofing (Glass Felt) Surfaced with Mineral Granules

D4586-12.....Asphalt Roof Cement, Asbestos Free

D4601-12.....Asphalt Coated Fiberglass Base Sheet Used In Roofing

D4897-01(2009).....Asphalt Coated Glass Fiber Venting Base Sheet Used in Roofing

D6163-00(2008).....Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Glass Fiber Reinforcements

D6866-21.....Standard Test Methods for Determining the Biobased Content of Solid, Liquid and Gaseous Samples Using Radiocarbon Analysis.

F1667-15.....Driven Fasteners: Nails, Spikes, Staples

C. FM Global (FMG):

P7825C-05.....Approval Guide Building Materials (Roofing Products)

4450:.....Approved Standard for Class 1 Insulated Steel Deck Roofs

4470:.....Approved Standard for Class 1 Roof Coverings

D. National Roofing Contractors Association (NRCA):

"Quality Control Guidelines for the Application of Built-up Roofing."

"The NRCA Roofing and Waterproofing Manual"

1.3 WARRANTY

A. Roofing system is subject to terms of "Warranty of Construction", FAR clause 52.246-21, except that warranty period is extended to five years.

B. Verify existing warranty before construction. Do not invalidate existing warranty.

1.4 QUALITY CONTROL

A. Applicator Qualifications: Installer experienced in installation of systems similar in complexity to that required for this Project, including specific requirements indicated:
   1. Work shall be performed by installer approved in writing by roofing material manufacturer.
   2. Work shall comply with printed instructions of the roofing materials manufacturer.

B. Product/Material Qualifications:
   1. Provide manufacturer’s label on each container or certification with each load of bulk bitumen, indicating Flash Point (FP), Finished Blowing Temperature (FBT), Softening Point (SP), Equiviscous Temperature (EVT).
   2. Provide manufacturer’s certification that field applied bituminous coatings and mastics, and field applied roof coatings comply with limits for Volatile Organic Compounds (VOC) per the National Volatile Organic Compound Emission Standards for Architectural Coatings pursuant to Section 183(e) of the Clean Air Act with limits as follows:
      a. Bituminous Coatings and Mastics: 500 g/l (4.2#/gal.).
      b. Roof Coatings: 250 g/l (2.1#/gal.).
   3. Obtain products from single manufacturer or from sources recommended by manufacturer for use with roofing system.
   4. All roof coatings shall have a minimum biobased content of 20% in accordance with ASTM D6866 for certification purposes.

C. Comply with the recommendations of the NRCA “Roofing and Waterproofing Manual” applicable to built-up roofing for storage, handling and installation.

D. FMG Listing: Provide roofing membrane, base flashing, and component materials that comply with requirements in FMG 4450 and FMG 4470 as part of a roofing system and that are listed in FMG "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FMG markings.
   1. Fire/Windstorm Classification: Match existing conditions.
   2. Hail Resistance: SH .

1.5 SUBMITTALS

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

B. Product Data:

1. Asphalt materials, each type.
2. Coal-tar materials, each type.
3. Roofing cement, each type.
4. Roof walkway.
5. Fastening requirements.

C. Certificates:

1. Indicate materials and method of application of roofing system meet requirements of FMG.
2. Statements of qualification for manufacturers and installers.
3. Inspection Report: Copy of roofing system manufacturer's inspection report certifying completed roofing complies with manufacturer’s warranty requirements.

D. Warranty: As specified in Part 1 of this Section:

1. Warranty sample form with specific language to address Contract provisions.

E. Contract Close-out Submittals:

1. Maintenance Manuals.
2. Warranty signed by installer and manufacturer.

1.6 DELIVERY, STORAGE AND MARKING

A. Deliver roofing materials to the site in original sealed packages or containers marked with the name and brand or trademark of the manufacturer or seller.

B. Keep roofing materials dry and store in a dry, weather-tight facility or under canvas covers. Do not use polyethylene or plastic covers to protect materials. Store above ground or deck level on wood pallets. Cover ground under pallet stored materials with plastic.

1. Store rolled materials (felts, base sheets, and paper) on end. Do not store hems on top of rolled materials.
2. Aggregates shall be maintained surface dry as defined by ASTM D1863.

C. Protect from damage due to handling, weather and construction operations before, during and after installation.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

B. Environmental Controls: Refer to Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

C. Protection of interior spaces: Refer to Section 01 00 00, GENERAL REQUIREMENTS.

PART 2 – PRODUCTS

2.1 ROOFING SYSTEM

A. Repair built-up roofing membrane system according to roofing system manufacturer's written instructions and applicable recommendations of NRCA "Quality Control Guidelines for the Application of Built-up Roofing."

B. Glass sheet, asphalt bitumen, mineral surfaced.

1. Substrate: Concrete deck.
2. Components: Quantity as required.
   a. Base Sheet: 1 Ply dry
   b. Base Sheet: 1 Ply
   c. Ply Sheet: 2 Plies
   d. Mineral Surfaced Cap Sheet: 1 Ply
   e. Asphalt On Base Sheet 10-17.5 kg/10 sq. meters (20-35 lbs/100 sq. ft.)
   f. Asphalt Between Each Ply 10-17.5 kg/10 sq. meters (20-35 lbs/100 sq. ft.)

2.2 MATERIALS-TO MATCH EXISTING

A. Primer: ASTM D41.

B. Base Sheet: ASTM D4601, Type II, nonperforated, asphalt-impregnated and coated, glass-fiber sheet, dusted with fine mineral surfacing on both sides.

C. Venting Base Sheet: ASTM D4897, Type II, venting, nonperforated, heavyweight, asphalt-impregnated and -coated, glass-fiber base

sheet with coarse granular surfacing or embossed venting channels on bottom surface.

D. Asphalt: ASTM D312, Type III or IV for roof membrane. Use Type I for pour coat unless specified otherwise.

E. Ply Sheet/Backer Sheet: ASTM D2178, Type VI, heavy-duty ply sheet.

F. Cap Sheet: ASTM D3909, asphalt-impregnated and -coated, glass-fiber cap sheet, with white coarse mineral-granule top surfacing and fine mineral surfacing on bottom surface.

G. Roof Cement: ASTM D4586, Type I Type II .

2.3 COAL-TAR MATERIALS-TO MATCH EXISTING

A. Primer: ASTM D43.

B. Organic Felt: ASTM D227, except bitumen shall be low fuming, non-blooming type.

C. Coal-Tar Bitumen: ASTM D450, Type III.

D. Roof Cement: Roofing manufacturer’s standard, asbestos free.

2.4 MISCELLANEOUS MATERIALS-TO MATCH EXISTING

A. Aggregate:

1. ASTM D1863, except the use of crushed stone is prohibited.
2. Slag or gravel. Use slag on slopes over 1:10 (one inch per foot).

2.5 FASTENERS

A. Nails and Staples: ASTM.

B. Nails for Securing Venting Base Sheet to Insulating Concrete:

1. Self-clinching type of galvanized steel having an integral flat cap at least 25 mm (one-inch) across.
2. Holding power of nails not less than 27 Kg (60 pounds) when pulled from approximate 400 Kg/m³ (26 pound per cubic foot) dense concrete.

2.6 PROTECTION MAT OR SEPARATION SHEETS

A. Protection Mat:

1. Water pervious; either woven or non-woven pervious sheet of long chain polymeric filaments or yarns such as polypropylene, black polyethylene, polyester, or polyamide; or, polyvinylidene-chloride formed into a pattern with distinct and measurable openings.

2. Filter fabric equivalent opening size (EOS): Not finer than the U.S.A. Standard Sieve Number 120 and not coarser than the U.S.A. Standard Sieve Number 100. EOS is defined as the number of the U.S.A. Standard Sieve having openings closest in size to the filter cloth openings.
3. Edges of fabric selvaged or otherwise finished to prevent raveling.
4. Abrasion resistance:
   a. Abrade in conformance with ASTM D3884 using rubber-hose abrasive wheels with one kg load per wheel and 1000 revolutions.
   b. Result; 25 kg (55 pounds) minimum in any principle direction.
5. Puncture strength:
   a. ASTM D751 - tension testing machine with ring clamp; steel ball replaced with a prescribed solid steel cylinder with a hemispherical tip centered within the ring clamp.
   b. Result; 57 kg (125 pounds) minimum.
6. Non-degrading under a wet or humid condition within minimum 4°C (40°F) to maximum 66°C (150°F) when exposed to ultraviolet light.
7. Minimum sheet width: 2400 mm (8 feet).

PART 3 – EXECUTION

3.1 GENERAL

A. Do not apply if deck will be used for subsequent work platform, storage of materials, or staging or scaffolding will be erected thereon.

B. Phased construction is not permitted. The complete installation of roofing system is required in the same day except for area where temporary protection is required when work is stopped. Complete installation includes pavers and ballast for ballasted systems.

3.2 EXAMINATION

A. Verification of Conditions: Examine substrates, areas and conditions under which Work is to be performed and identify conditions detrimental to proper or timely completion:

1. Do not proceed until unsatisfactory conditions, including moisture, have been corrected.
2. Do not install roofing materials over wet insulation.
3. Do not install roofing materials unless roof openings, wood nailers, edge venting, insulation board, flashing, curbs, and roof joints are constructed.
4. Do not install roof materials unless deck and/or insulation provides designed drainage to working drains.

B. Uninsulated Concrete Decks, except Insulating Concrete:
1. Test deck for moisture prior to application of roofing materials.
2. Test by pouring one pint of hot bitumen at 204 degrees C (400 degrees F.) or EVT on deck at start of each day's Work and at start of each new roof area or plane. Do not proceed if test sample foams or can be easily (cleanly) stripped after cooling.

C. Insulating Concrete: Allow deck to dry before installing materials.

D. Do not apply roof system if roofed deck will be used as a work platform.

E. Existing Intake Louvers:
1. Use large fans during placement to direct airflow away from existing intake louvers.
2. If required to install roof near intake louvers after work hours, it shall be done so without additional cost to the Government.

3.3 PREPARATION

A. Sweep substrate to broom clean condition. Remove all dust, dirt and debris.

B. Remove surface irregularities that may damage materials or cause installation defects.

C. Prime concrete deck or precast units.
1. Keep primer back 100-mm (4 inches) from joints in precast units.

3.4 INSTALLATION

A. Comply with roofing system manufacturer's written instructions and applicable recommendations of NRCA "Quality Control Guidelines for the Application of Built-up Roofing."

B. Cooperate with inspection and test agencies required to perform services in connection with built-up roofing system installation.

C. General:

1. Provide uniform and positive adhesion between all installed materials, including adhesion to insulation or substrate, and between each ply of felt.
2. Substrate Penetrations: Do not allow bitumen to penetrate joints or enter building. Where mopping is applied directly to a substrate, tape joints. When applying steep asphalt, hold mopping back 50mm (2 inches) from each side of joint.

D. Asphalt/ Coal-Tar Products Schedule:

1. Use asphalt only with asphalt-saturated or asphalt-impregnated felts.
2. Use Type I asphalt for pour coats up to 1:10 (one inch per foot) slope.
3. Coats on slopes oven 1:10 (one inch per foot).
4. Use asphalt roof cement with asphalt products.
5. Use coal tar and coal tar roof cement with coal-tar-saturated felts, except asphalt-saturated felt base flashing with asphalt roof cement may be used in conjunction with coal-tar roofing.

E. Bitumen Schedule:

1. Per square, unless otherwise specified.
2. Between substrate and plies of organic felt:
   a. Asphalt 7 to 11 Kg (15 to 25 pounds).
   b. Coal tar, 9 to 14 Kg (20 to 30 pounds).
3. Between substrate and plies of glass fiber felts asphalt, 9 to 14 kg (20 to 30 pounds).
4. Glaze Coats:
   a. Asphalt 7 to 11 Kg (15 to 25 pounds).
   b. Coal tar, 9 to 14 Kg (20 to 30 pounds).
5. Pour coats:
   a. Asphalt 25 to 30 Kg (55 to 65 pounds).

a. Coal tar, 32 to 36 Kg (70 to 80 pounds).

F. Heating Bitumen:

1. Heat the asphalt to the equiviscous temperature (EVT) plus or minus 4 C (25 degrees F) at the time of application.
   a. Do not heat asphalt greater than 38 C (100 degrees F) above the EVT.
   b. When the EVT is not furnished do not heat asphalt above 246 C (475 degrees F) for Type I and 275 C (525 degrees) F for Type II and IV, with an application not less than 218 C (425 degrees F) and 246 C (475 degrees F) respectively.
2. Do not heat coal-tar bitumen above 218 C (425 degrees F) with an application temperature ranging from 163 C (325 degrees F) to 204 C (400 degrees F).
3. Do not heat bitumen above the flash point temperature.
4. Provide heating kettles with a thermometer kept in operating condition. Attend, during heating, to insure the bitumen is heated within the temperatures specified.
5. Do not mix different types of bitumen in kettle.

G. Terminations:

1. Where cants occur at vertical surfaces, cut off plies of membrane 50mm (2 inches) above top of cant strip, (except at prefabricated curbs, scuttles and other roof accessories having integral cants) extend membrane over cant and up vertical surface to top of curb or blocking.
2. Where wood blocking occurs at roof edge, under gravel stops or penetrations to receive base flashing, nail a continuous strip of 400 mm (16-inch) wide, loose applied organic felt envelope over the blocking before the first ply sheet is applied.
   a. Install strip on top of venting base sheet.
   b. After membrane is installed, turn the dry felt back over the roofing and secure in place with hot bitumen before gravel stops or metal flanges extending onto the membrane are installed.
3. Where fascia/cant occurs at roof edges, extend membrane beyond outside face and cut off after base flashing is installed. Do

not cut off venting base sheet outside cant face, extend down over outer cant face to allow for venting.

H. Base Sheet:
1. One ply of base sheet dry to deck, except mop between laps. Lap and attach as specified to deck.
2. For base sheet applied to wood deck of insulated assemblies: Refer to Section 07 22 00, ROOF AND DECK INSULATION.

I. Venting Base Sheet:
1. At vertical surfaces: Extend venting base sheet up vertical surface over cants to top of base flashing or curb.
2. At roof edge under gravel stops install venting base sheet over blocking: Extend base sheet not less than 50 mm (2-inches) beyond outer edge and turn down to allow venting at the edge.
3. At roof edge over fascia-cant: Extend base sheet over top of cant and turn down over outer face of cant to allow venting at the edge.
4. For base sheet applied to deck of insulated roof assemblies: Refer to Section 07 22 00, ROOF AND DECK INSULATION.

J. Roof Ply Installation:
1. Install, asphalt, glass fiber felt coal tar bitumen, organic felt construction. Base sheet is not considered a ply.
2. Extend the first ply 100 mm (4-inches) beyond the insulation and the second ply 75 mm (3-inches) beyond the first. Lap ends 75 mm (3-inches) with joints broken 450 mm (18-inches) in each ply.

K. Laps for felts and base sheet:
1. Base sheet, lapped 50 mm (2-inches).
2. Two plies of felt with 450 mm (18-inches) and 900 mm (36-inch) starting widths, lapped 480 mm (19-inches).
3. Three plies of felt with 300 mm (12-inches) 600 mm (24-inches) and 900 mm (36-inch) starting widths, lapped 624 mm (24-1/2 inches).
4. Four plies of felt with 230, 460, 690 and 900 mm (9, 18, 27 and 36-inch) starting widths, lapped 700 mm (27-1/2 inches).

5. End joints of felt and base sheet, lapped 50 mm (2-inches).
5. Stagger end joints in relation to joints in adjacent and
5. proceeding plies.

L. Flashing:

1. Prime vertical surfaces of masonry and concrete with asphalt primer except where vented base sheet is required to provide edge venting.
2. Apply flashing on top of built-up roofing, up face of cant and vertical surfaces, at least 200 mm (8-inches) above the roof, full height beneath counter flashing or top of curb flashing:
   a. At fascia-cants, extend to top of cant and cut off.
   b. Extend plies of roofing into reglet the full depth of the reglet.
3. 3. Except at metal fascia cants, secure top edge of base flashing with nails on a line approximately one inch below top edge, spaced not more than 200 mm (8-inches) on center.
   a. Cover all nail heads with roof cement.
   b. Cover the top of the base flashing with counter flashing as specified in Section 07 60 00, FLASHING AND SHEET METAL. At the cants secure the top edge of the flashing with fascia compression clamp as specified in Section 07 60 00, FLASHING AND SHEET METAL.
4. Install flashing using longest pieces practicable. Complete splices between flashing and main roof sheet before bonding to vertical surface. Seal splice not less than 76mm (3-inches) beyond fasteners that attach membrane to blocking. Apply bonding adhesive to both flashing and surface to which flashing is being adhered per manufacturer recommendations. Nail top of flashing 300mm (12-inches) on center under metal counter flashing or cap.
   a. Parapet Walls: Extend up parapet and turn over top edge. Apply with 100 percent adhesive.
5. Install flashing over cants to make system watertight.
6. Install flashing before final roofing coat and aggregate are installed.

M. Stripping:

1. Set flanges of metal flashing in roof cement before the final bituminous coat and roof aggregate are installed and nail to blocking per Section 07 60 00, FLASHING AND SHEET METAL.
2. Before the final bituminous coat and aggregate are installed, cover that portion of the horizontal flanges of metal base flashing, gravel stops and other flanges, extending onto the roofing with flashing sheet consisting of two plies of organic felt with coal tar bitumen.

N. Aggregate Surfacing:
1. After bituminous base flashing and stripping has been installed, uniformly coat the entire roof surface, except cants, with bitumen pour coat at the rate scheduled.
2. Use type III asphalt on slopes over 1:10 (one inch per foot).
3. While still hot, embed aggregate to cover the roofing sheet completely without bare spots, but not less than 20 Kg/m² (400 pounds/) of dry gravel or 15 Kg/m² (300 pounds/100 square feet) of dry slag per. Do not leave any exposed bitumen.
4. Do not embed aggregate under roof walkways.
5. In cold weather preheat aggregate prior to application.
6. Do not place aggregate material in piles or rows on bare or glaze coated felt.
7. If aggregate surfacing is delayed, promptly apply glaze coat of hot roofing asphalt at rate scheduled.

3.5 REPAIR AND ALTERATIONS TO EXISTING ROOF

A. Areas to be altered or repaired, remove loose aggregate and aggregate not firmly embedded where new penetrations occur or repairs are required:
1. Remove aggregate 900 mm (3 feet) beyond areas to be cut.
   a. Clean, dry and store aggregate away from roof area until ready to reuse.
   b. Remove unsuitable and excess aggregate not used from Project.

B. Cut and remove existing roof membrane for new work to be installed. Clean cut edges and install a temporary seal to cut surfaces. Use roof cement and one layer of 7 Kg (15 pound) felt strip cut to extend 150 mm (6 inches) on each side of cut

surface. Bed strip in roof cement and cover with roof cement to completely embed the felt.

C. Bend up cap flashing or temporarily remove at built-up base flashing to be repaired. Brush and scrape away deteriorated and loose bitumen, felts or surface material of built-up base flashing.

D. Repairs to existing membrane and base flashing:

1. Remove temporary patches prior to starting new work.
2. Blisters and fish mouths:
   a. Cut blisters open and turn membrane back to fully adhered portion. Cut fish mouths so membrane can be turned back and subsequently laid flat.
   b. Heat membrane to facilitate bending and to dry surface of exposed blister areas.
   c. Mop turned back membrane in hot bitumen. Roll to insure full adhesion and embedment in substrate.
   d. Cover cut areas with two plies of felt. Extend first ply 100 mm (4-inches) beyond cut area edge. Extend second 100 mm (4 inches) beyond first ply. Mop down in hot bitumen as specified for new work. Resurface to match existing.
3. Exposed Felts:
   a. Cut away exposed deteriorated edges of sheets.
   b. Glaze coat felt edges.
   c. Resurface to match existing.
4. Built-up Base Flashing:
   a. Restore felts and cap sheet removed, lapping 100 mm (4-inches) over existing.
   b. Install new felts and cap sheet as specified for new work.
5. Horizontal Metal Flanges:
   a. Remove loose, buckled or torn stripping.
   b. Remove loose fasteners and install new fasteners.
   c. Restrip flanges as specified for new work.
6. Resurfacing:
   a. Over repaired membrane, embed aggregate as specified for new work.

b. Cover all membrane areas. Do not leave any exposed membrane surface.

E. Match existing roofing materials and construction. Use bitumen compatible with existing for roof repair and alteration.

F. Perform alterations, maintenance and repairs to roof membrane immediately after membrane has been cut or damaged, with permanent new work as specified in this specification. Repair items damaged in surface preparation and aggregate removal.

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SECTION 07 54 23
THERMOPLASTIC POLYOLEFIN (TPO) ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Patching of Thermoplastic Polyolefin (TPO) sheet roofing adhered mechanically fastened to roof deck upon the removal of existing ductwork and reinstallation.

1.2 RELATED WORK

A. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS: Non-Flooring Adhesives and Sealants VOC Limits.

B. Section 07 01 50.19, PREPARATION FOR REROOFING: Preparation of Existing Membrane Roofs and Repair Areas.

1.3 APPLICABLE PUBLICATIONS

A. Comply with references to extent specified in this section.

B. American National Standards Institute/Single-Ply Roofing Institute (ANSI/SPRI):

FX-1-16.....Standard Field Test Procedure for Determining the Withdrawal Resistance of Roofing Fasteners.

C. American Society of Civil Engineers/Structural Engineering Institute (ASCE/SEI):

7-16.....Minimum Design Loads for Buildings and Other Structures.

D. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE):

90.1-13.....Energy Standard for Buildings Except Low-Rise Residential Buildings.

E. ASTM International (ASTM):

C67-20.....Sampling and Testing Brick and Structural Clay Tile.

C140/C140M-20a.....Sampling and Testing Concrete Masonry Units and Related Units.

C1371-15.....Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers.

C1549-16.....Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer.

D1876-08(2015)e1.....Peel Resistance of Adhesives (T-Peel Test).

D4263-83(2018).....Indicating Moisture in Concrete by the Plastic Sheet Method.

D4434/D4434M-15.....Poly(Vinyl Chloride) Sheet Roofing.

D6878/D6878M-13.....Thermoplastic Polyolefin Based Sheet Roofing.

E408-13.....Total Normal Emittance of Surfaces Using Inspection-Meter Techniques.

E1918-16.....Measuring Solar Reflectance of Horizontal and Low-Sloped Surfaces in the Field.

E1980-11(2019).....Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces.

F. Cool Roof Rating Council (CRRC):

1-20.....Product Rating Program.

G. National Roofing Contractors Association (NRCA):

Manual-19.....The NRCA Roofing Manual: Membrane Roofing Systems.

H. U.S. Department of Agriculture (USDA):

BioPreferred® Program Catalog.

I. UL LLC (UL):

580-06.....Tests for Uplift Resistance of Roof Assemblies.

1897-20.....Uplift Tests for Roof Covering Systems.

J. U.S. Department of Commerce National Institute of Standards and Technology (NIST):

DOC PS 1-19.....Structural Plywood.

DOC PS 2-18.....Performance Standard for Wood-Based Structural-Use Panels.

K. U.S. Environmental Protection Agency (EPA):

Energy Star.....ENERGY STAR Program Requirements for Roof Products Version 3.0.

1.4 PREINSTALLATION MEETINGS

A. Conduct pre-installation meeting at project site minimum 30 days before beginning Work of this section.

1. Required Participants:

a. Contracting Officer's Representative.
b. Architect/Engineer.
c. Inspection and Testing Agency.
d. Contractor.
e. Installer.
f. Manufacturer's field representative.
g. Other installers responsible for adjacent and intersecting work, including roof deck, flashings, roof penetrations, roof accessories, utility penetrations, rooftop curbs and equipment and _____ .

2. Meeting Agenda: Distribute agenda to participants minimum 3 days before meeting.
   a. Installation schedule.
   b. Installation sequence.
   c. Preparatory work.
   d. Protection before, during, and after installation.
   e. Installation.
   f. Terminations.
   g. Transitions and connections to other work.
   h. Inspecting and testing.
   i. Other items affecting successful completion.
   j. Pullout test of fasteners.
   k. Material storage, including roof deck load limitations.
3. Document and distribute meeting minutes to participants to record decisions affecting installation.

1.5 SUBMITTALS

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

B. Submittal Drawings:
   1. Roof membrane layout.
   2. Roofing membrane fastener pattern and spacing.
   3. Roofing membrane seaming and joint details.
   4. Roof membrane penetration details.
   5. Base flashing and termination details.
   6. Paver layout.
   7. Paver anchoring locations and details.

C. Manufacturer's Literature and Data:
   1. Description of each product.
   2. Minimum fastener pullout resistance.
   3. Installation instructions.
   4. Warranty.
D. Samples:
   1. Roofing Membrane: 150 mm (6 inch) square.
   2. Base Flashing: 150 mm (6 inch) square.
   3. Fasteners: Each type.
   4. Roofing Membrane Seam: 300 mm (12 inches) square.
E. Sustainable Construction Submittals:
   1. Solar Reflectance Index (SRI) for roofing membrane.
   2. Biobased Content:
      a. Show type and quantity for each product.
   3. Low Pollutant-Emitting Materials:
      a. Show volatile organic compound types and quantities.
   4. Energy Star label for roofing membrane.
F. Certificates: Certify products comply with specifications.
   1. Fire and windstorm classification.
   2. Energy performance requirements.
G. Qualifications: Substantiate qualifications comply with specifications.
   1. Installer, including supervisors with project experience list.
   2. Manufacturer's field representative with project experience list.
H. Field quality control reports.
I. Temporary protection plan. Include list of proposed temporary materials.
J. Operation and Maintenance Data:
   1. Maintenance instructions.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Approved by roofing system manufacturer as installer for roofing system with specified warranty.
   2. Regularly installs specified products.
   3. Installed specified products with satisfactory service on five similar installations for minimum five years.

a. Project Experience List: Provide contact names and addresses for completed projects.

4. Employs full-time supervisors experienced installing specified system and able to communicate with Contracting Officer's Representative and installer's personnel.

B. Manufacturer's Field Representative:

1. Manufacturer's full-time technical employee or independent roofing inspector.
2. Individual certified by Roof Consultants Institute as Registered Roof Observer.

1.7 DELIVERY

A. Deliver products in manufacturer's original sealed packaging.

B. Mark packaging, legibly. Indicate manufacturer's name or brand, type, and manufacture date.

C. Before installation, return or dispose of products within distorted, damaged, or opened packaging.

1.8 STORAGE AND HANDLING

A. Comply with NRCA Manual storage and handling requirements.

B. Store products indoors in dry, weathertight facility.

C. Store adhesives according to manufacturer's instructions.

D. Protect products from damage during handling and construction operations.

E. Products stored on the roof deck must not cause permanent deck deflection.

1.9 FIELD CONDITIONS

A. Environment:

1. Product Temperature: Minimum 4 degrees C (40 degrees F) for minimum 48 hours before installation.
2. Weather Limitations: Install roofing only during dry current and forecasted weather conditions.

1.10 WARRANTY

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

B. Manufacturer's Warranty: Warrant roofing system against material and manufacturing defects and agree to repair any leak caused by a defect in the roofing system materials or workmanship of the installer.

1. Warranty Period: 10 years.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Roofing System: Thermoplastic Polyolefin (TPO) sheet roofing adhered mechanically fastened to roof deck.

2.2 SYSTEM PERFORMANCE

A. Design roofing system complying with specified performance:
   1. Load Resistance: ASCE/SEI 7; Design criteria: as indicated on Drawings.
      a. Uplift Pressures:
         1) Corner Uplift Pressure: _____ kPa/square meter (_____ per square foot).
         2) Perimeter Uplift Pressure: _____ kPa/square meter (_____ per square foot).
         3) Field-of-Roof Uplift Pressure: _____ kPa/square meter (_____ per square foot).
   2. Energy Performance:
      a. EPA Energy Star Listed for low-slope roof products.
      b. ASTM E1980; Minimum 78 Solar Reflectance Index (SRI).
      c. CRRC-1; Minimum 0.70 initial solar reflectance and minimum 0.75 emissivity.
      d. Three-Year Aged Performance: Minimum 0.55 solar reflectance tested in according to ASTM C1549 or ASTM E1918, and minimum 0.75 thermal emittance tested in according to ASTM C1371 or ASTM E408.
         1) Where tested aged values are not available:
            a) Calculate compliance adjusting initial solar reflectance according to ASHRAE 90.1.
            b) Provide roofing system with minimum 64 three-year aged Solar Reflectance Index calculated according to ASTM E1980 with 12 W/square meter/degree K (2.1 BTU/hour/square foot) convection coefficient.

2.3 PRODUCTS - GENERAL

A. Provide roof system components from one manufacturer.

B. Sustainable Construction Requirements:
   1. Solar Reflectance Index: 78 minimum.

2. Biobased Content: Where applicable, provide products designated by USDA and meeting or exceeding USDA recommendations for bio-based content, and products meeting Rapidly Renewable Materials and certified sustainable wood content definitions; refer to www.biopreferred.gov.
3. Low Pollutant-Emitting Materials: Comply with VOC limits specified in Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS for the following products:
   a. Non-flooring adhesives and sealants.

2.4 TPO ROOFING MEMBRANE

A. TPO Sheet: ASTM D6878/D6878M, internally fabric or scrim reinforced, 1.5 mm (60 mils) thick, with fabric backing .

2.5 MEMBRANE ACCESSORY MATERIALS

A. Sheet Flashing: Manufacturer's standard sheet flashing of same material, type, reinforcement, thickness, and color as TPO sheet membrane.
B. Factory Formed Flashings: Inside and outside corners, pipe boots, and other special flashing shapes to minimize field fabrication.
C. Bonding Adhesive: Manufacturer's standard, water based.
D. Metal Termination Bars: Manufacturer's standard, stainless-steel or aluminum, 25 mm wide by 3 mm thick (1-inch wide by 1/8 inch thick) factory drilled for fasteners.
E. Battens: Manufacturer's standard, galvannealed or galvanized steel sheet, 25 mm wide by 1.3 mm thick (1-inch wide by 0.05 inch thick), factory punched for fasteners.
F. Fasteners: Manufacturer's standard coated steel with metal or plastic plates, to suit application.
G. Primers, Sealers, T-Joint Covers, Lap Sealants, and Termination Reglets: As specified by roof membrane manufacturer.
H. Adhesive and sealant materials recommended by roofing system manufacturer for intended use, identical to materials utilized in approved listed roofing system, and compatible with roofing membrane.

2.6 ACCESSORIES

A. Temporary Protection Materials:
   1. Expanded Polystyrene (EPS) Insulation: ASTM C578.
   2. Plywood: NIST DOC PS 1, Grade CD Exposure 1.

3. Oriented Strand Board (OSB): NIST DOC PS 2, Exposure 1.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine and verify substrate suitability with roofing Installer and roofing inspector present.
   1. Verify roof penetrations are complete, secured against movement, and firestopped.
   2. Verify roof deck is adequately secured to resist wind uplift.
   3. Verify roof deck is clean, dry, and in-plane ready to receive roofing system.

B. Correct unsatisfactory conditions before beginning roofing work.

3.2 PREPARATION

A. Complete roof deck construction before beginning roofing work:
   1. Curbs, blocking, edge strips, nailers, cants, and other components to which insulation, roofing, and base flashing is attached in place ready to receive insulation and roofing.
   2. Coordinate roofing membrane installation with flashing work and roof insulation work so insulation and flashing are installed concurrently to permit continuous roofing operations.
   3. Complete installation of flashing, insulation, and roofing in same day except for the area where temporary protection is required when work is stopped for inclement weather or end of work day.

B. Dry out surfaces including roof deck flutes, that become wet from any cause during progress of the work before roofing work is resumed. Apply materials to dry substrates, only.

C. Broom clean roof decks. Remove dust, dirt and debris.

D. Remove projections capable of damaging roofing materials.

E. Concrete Decks, except Insulating Concrete:
   1. Test concrete decks for moisture according to ASTM D4263 before installing roofing materials.
   2. Prime concrete decks. Keep primer back 100 mm (4 inches) from precast concrete deck joints.
   3. Allow primer to dry before application of bitumen.

F. Insulating Concrete Decks:
   1. Allow to dry out minimum five days after installation before installing roofing materials.

2. Allow additional drying time when precipitation occurs before installing roofing materials.

G. Poured Gypsum Decks: Dry out poured gypsum according to manufacturer's instructions before installing roofing materials.

H. Existing Membrane Roofs and Repair Areas:

1. Comply with requirements in Section 07 01 50.19 PREPARATION FOR REROOFING.

3.3 TEMPORARY PROTECTION

A. Install temporary protection consisting of a temporary seal and water cut-offs at the end of each day's work and when work is halted for an indefinite period or work is stopped when precipitation is imminent.

B. Install temporary cap flashing over top of base flashings where permanent flashings are not in place to protect against water intrusion into roofing system. Securely anchor in place to prevent blow off and damage by construction activities.

C. Temporarily seal exposed insulation surfaces within roofing membrane.

1. Apply temporary seal and water cut off by extending roofing membrane beyond insulation and securely embedding edge of the roofing membrane in 6 mm (1/4 inch) thick by 50 mm (2 inches) wide strip of temporary closure sealant. Weight roofing membrane edge with sandbags, to prevent displacement; space sandbags maximum 2400 mm (8 feet) on center.

2. Direct water away from work. Provide drainage, preventing water accumulation.

3. Check daily to ensure temporary seal remains watertight. Reseal open areas and weight down.

D. Before the work resumes, cut off and discard portions of roof membrane in contact with temporary seal.

1. Cut minimum 150 mm (6 inches) back from sealed edges and surfaces.

E. Remove sandbags and store for reuse.

3.4 INSTALLATION - GENERAL

A. Install products according to manufacturer's instructions and approved submittal drawings.

1. When manufacturer's instructions deviate from specifications, submit proposed resolution for Contracting Officer's Representative consideration.

B. Comply with NRCA Manual installation requirements.

C. Comply with UL 580 UL 1897 for uplift resistance.

D. Do not allow membrane and flashing to contact surfaces contaminated with asphalt, coal tar, oil, grease, or other substances incompatible with TPO.

3.5 ROOFING INSTALLATION

A. Install the membrane so the sheets run perpendicular to the long dimension of the insulation boards.

B. Begin installation at the low point of the roof and work towards the high point. Lap membrane shingled in water flow direction.

C. Position the membrane free of buckles and wrinkles.

D. Roll membrane out; inspect for defects as membrane is unrolled. Remove defective areas:

1. Lap edges and ends of sheets 50 mm (2 inches) or more as recommended by the manufacturer.
2. Heat weld laps. Apply pressure as required. Seam strength of laps as required by ASTM D4434/D4434M.
3. Check seams to ensure continuous adhesion and correct defects.
4. Finish seam edges with beveled bead of lap sealant.
5. Finish seams same day as membrane is installed.
6. Anchor membrane perimeter to roof deck or parapet wall as indicated on drawings.
7. Repair areas of welded seams where samples have been taken or marginal welds, bond voids, or skips occurs.
8. Repair fishmouths and wrinkles by cutting to lay flat and installing patch over cut area extending 100 mm (4 inches) beyond cut.

E. Membrane Perimeter Anchorage:

1. Install batten at perimeter of each roof area, curb flashing, expansion joints and similar penetrations on top of roof membrane as indicated on drawings.
2. Mechanically Fastening:
   a. Space fasteners maximum 300 mm (12 inches) on center, starting 25 mm (1 inch) from ends.
   b. When battens are cut, round edges and corners before installing.

c. After mechanically fastening strip cover and seal strip with a 150 mm (6 inch) wide roof membrane strip; heat weld to roof membrane and seal edges.

d. At gravel stops fascia-cants turn roofing membrane down over front edge of the blocking, cant, or nailer. Secure roofing membrane to vertical portion of nailer; or, if required by the membrane manufacturer, with fasteners spaced maximum 150 mm (6 inches) on centers.

e. At parapet walls intersecting building walls and curbs, secure roofing membrane to structural deck with fasteners 150 mm (6 inches) on centers or as shown in NRCA manual.

F. Adhered System:

1. Apply bonding adhesive in quantities required by roof membrane manufacturer.
2. Fold sheet back on itself, clean and coat the bottom side of the membrane and the top of substrate with adhesive. Do not coat the lap joint area.
3. After adhesive has set according to adhesive manufacturer's instruction, roll roofing membrane into adhesive minimizing voids and wrinkles.
4. Repeat for other half of sheet.

G. Mechanically Fastened System Installation:

1. Secure roofing membrane to structural deck with fasteners through battens to achieve specified wind uplift performance.
   a. Drill pilot holes for fasteners installed into cast-in-place concrete. Drill hole minimum 10 mm (3/8 inch) deeper than fastener penetration.
2. When fasteners are installed within membrane laps, locate battens minimum 13 mm (1/2 inch) from the edge of sheets.
3. Apply lap sealant under battens and anchor to deck while lap sealant is still fluid. Cover fastener head with fastener sealer.
4. Where fasteners are installed over roofing membrane after seams are welded, cover fasteners with minimum 200 mm (8 inch) diameter TPO membrane cap centered over fasteners. Where battens are used cover battens with minimum 200 mm (8 inch) wide TPO strip cap centered

over batten. Splice caps to roofing membrane and finish edges with lap sealant.

3.6 FLASHING INSTALLATION

A. Install flashings same day as roofing membrane is installed. When flashing cannot be completely installed in one day, complete installation until flashing is watertight and provide temporary covers or seals.

B. Flashing Roof Drains:

1. Install roof drain flashing as recommended by roofing membrane manufacturer.
   a. Coordinate to set the metal drain flashing in asphalt roof cement, holding cement back from the edge of the metal flange.
   b. Do not allow the roof cement to come in contact with TPO roofing membrane.
   c. Adhere roofing membrane to metal flashing with bonding adhesive.
2. Turn down the metal drain flashing and roofing membrane into drain body. Install clamping ring and strainer.

C. Installing Base Flashing and Pipe Flashing:

1. Install flashing sheet to pipes, wall or curbs to minimum200 mm (8 inches) above roof surfaces and extending roofing manufacturer's standard lap dimension onto roofing membranes.
   a. Adhere flashing with bonding adhesive.
   b. Form inside and outside corners of flashing sheet according to NRCA manual. Form pipe flashing according to NRCA manual.
   c. Lap ends roofing manufacturer's standard dimension.
   d. Heat weld flashing membranes together and flashing membranes to roofing membranes. Finish exposed edges with lap sealant.
   e. Install flashing membranes according to NRCA manual.
2. Anchor top of flashing to walls and curbs with fasteners spaced maximum150 mm (6 inches) on center. Use surface mounted fastening strip with sealant on ducts. Use pipe clamps on pipes or other round penetrations.
3. Apply sealant to top edge of flashing.

3.7 FIELD QUALITY CONTROL

A. Field Tests: Performed by testing laboratory specified in Section 01 45 29, TESTING LABORATORY SERVICES.

1. Fastener Pull Out Tests: ANSI/SPRI FX-1; one test for every 230 square meter (2,500 square feet) of deck. Perform tests for each combination of fastener type and roof deck type before installing roof insulation.
   a. Test at locations selected by Contracting Officer's Representative.
   b. Do not proceed with roofing work when pull out resistance is less than manufacturer's required resistance.
   c. Test Results:
      1) Repeat tests using different fastener type or use additional fasteners achieve pull out resistance required to meet specified wind uplift performance.
      2) Patch cementitious deck to repair areas of fastener tests holes.
2. Examine and probe roofing membrane and flashing seams in presence of Contracting Officer's Representative and Manufacturer's field representative.
3. Probe seams to detect marginal bonds, voids, skips, and fishmouths.
4. Cut 100 mm (4 inch) wide by 300 mm (12 inch) long samples through seams where directed by Contracting Officer's Representative.
5. Cut one sample for every 450 m (1500 feet) of seams.
6. Cut samples perpendicular to seams.
7. Failure of samples to pass ASTM D1876 test will be cause for rejection of work.
8. Repair areas where samples are taken and where marginal bond, voids, and skips occur.
9. Repair fishmouths and wrinkles by cutting to lay flat. Install patch over cut area extending 100 mm (4 inches) beyond cut.

B. Manufacturer Services:
   1. Inspect initial installation, installation in progress, and completed work.
   2. Issue supplemental installation instructions necessitated by field conditions.
   3. Prepare and submit inspection reports.

4. Certify completed installation complies with manufacturer's instructions and warranty requirements.

3.8 CLEANING

A. Remove excess adhesive before adhesive sets.

B. Clean exposed roofing surfaces. Remove contaminants and stains to comply with specified solar reflectance performance .

3.9 PROTECTION

A. Protect roofing system from traffic and construction operations.

1. Protect roofing system when used for subsequent work platform, materials storage, or staging.
2. Distribute scaffolding loads to exert maximum 50 percent roofing system materials compressive strength.

B. Loose lay temporary insulation board overlaid with plywood or OSB.

1. Weight boards to secure against wind uplift.

C. Remove protective materials immediately before acceptance.

D. Repair damage.

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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. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS: Sustainable Design Requirements.

B. Section 07 81 00, APPLIED FIREPROOFING: Spray applied fireproofing.

C. Section 07 92 00, JOINT SEALANTS: Sealants and application.

D. Section 23 31 00, HVAC DUCTS AND CASINGS: Fire and smoke damper assemblies in ductwork.

E. Section 23 37 00, AIR OUTLETS AND INLETS: Fire and smoke damper assemblies in ductwork.

1.3 SUBMITTALS

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

B. Sustainable Design Submittals, as described below:

1. Volatile organic compounds per volume as specified in PART 2 - PRODUCTS.

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):

E84-20.....Surface Burning Characteristics of Building Materials

E699-16.....Standard Specification for Agencies Involved in Testing, Quality Assurance, and Evaluating of Manufactured Building Components

E814-13a(2017).....Fire Tests of Penetration Firestop Systems

E2174-20a.....Standard Practice for On-Site Inspection of Installed Firestop Systems

E2393-20.....Standard 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

4991-13.....Approval of Firestop Contractors

D. Underwriters Laboratories, Inc. (UL):

Annual Issue Building Materials Directory

E. Annual Issue Fire Resistance Directory

723-Edition 11(2018)....Standard for Test for Surface Burning Characteristics of Building Materials

1479-04(2015).....Fire Tests of Penetration Firestops

F. Intertek Testing Services - Warnock Hersey (ITS-WH):

Annual Issue Certification Listings

G. 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 inches) nominal pipe or 0.01 square meter (16 square inches) 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 inches) 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. Provide silicone sealant in smoke partitions as specified in Section 07 92 00, JOINT SEALANTS.

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.

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SECTION 07 92 00

JOINT SEALANTS

PART 1 - GENERAL

1.1 DESCRIPTION:

A. This section covers interior and exterior sealant and their application, wherever required for complete installation of building materials or systems.

1.2 RELATED WORK (INCLUDING BUT NOT LIMITED TO THE FOLLOWING):

A. Sustainable Design Requirements: Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

B. Firestopping Penetrations: Section 07 84 00, FIRESTOPPING.

C. Glazing: Section 08 80 00, GLAZING.

D. Sound Rated Gypsum Partitions/Sound Sealants: Section 09 29 00, GYPSUM BOARD.

E. H. Mechanical Work: Section 22 05 11 COMMON WORK RESULTS FOR PLUMBING, and Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

1.3 QUALITY ASSURANCE:

A. Installer Qualifications: An experienced installer with a minimum of three (3) years' experience and who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance. Submit qualification.

B. Source Limitations: Obtain each type of joint sealant through one (1) source from a single manufacturer.

C. Product Testing: Obtain test results from a qualified testing agency based on testing current sealant formulations within a 12-month period.

1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021.
2. Test elastomeric joint sealants for compliance with requirements specified by reference to ASTM C920, and where applicable, to other standard test methods.
3. Test elastomeric joint sealants according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C920 for adhesion and cohesion under cyclic movement, adhesion-in peel, and indentation hardness.

4. Test other joint sealants for compliance with requirements indicated by referencing standard specifications and test methods.

1.4 CERTIFICATION:

A. Contractor is to submit to the COR written certification that joints are of the proper size and design, that the materials supplied are compatible with adjacent materials and backing, that the materials will properly perform to provide permanent watertight, airtight or vapor tight seals (as applicable), and that materials supplied meet specified performance requirements.

1.5 SUBMITTALS:

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

B. Sustainable Design Submittals, as described below:

1. Volatile organic compounds per volume as specified in PART 2 - PRODUCTS.

C. Installer qualifications.

D. Contractor certification.

E. Manufacturer's installation instructions for each product used.

F. Cured samples of exposed sealants for each color.

G. Manufacturer's Literature and Data:

1. Primers
2. Sealing compound, each type, including compatibility when different sealants are in contact with each other.

H. Manufacturer warranty.

1.6 PROJECT CONDITIONS:

A. Environmental Limitations:

1. Do not proceed with installation of joint sealants under following conditions:
   a. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 4.4 degrees C (40 degrees F).
   b. When joint substrates are wet.

B. Joint-Width Conditions:

1. Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.

C. Joint-Substrate Conditions:

1. Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

1.7 DELIVERY, HANDLING, AND STORAGE:

A. Deliver materials in manufacturers' original unopened containers, with brand names, date of manufacture, shelf life, and material designation clearly marked thereon.

B. Carefully handle and store to prevent inclusion of foreign materials.

C. Do not subject to sustained temperatures exceeding 32 degrees C (90 degrees F) or less than 5 degrees C (40 degrees F).

1.8 DEFINITIONS:

A. Definitions of terms in accordance with ASTM C717 and as specified.

B. Backing Rod: A type of sealant backing.

C. Bond Breakers: A type of sealant backing.

D. Filler: A sealant backing used behind a back-up rod.

1.9 WARRANTY:

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

B. Manufacturer Warranty: Manufacturer shall warranty their sealant for a minimum of five (5) years from the date of installation and final acceptance by the Government. Submit manufacturer warranty.

1.10 APPLICABLE PUBLICATIONS:

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

B. ASTM International (ASTM):

C509-06.....Elastomeric Cellular Preformed Gasket and Sealing Material

C612-14.....Mineral Fiber Block and Board Thermal Insulation

C717-14a.....Standard Terminology of Building Seals and Sealants

C734-06(R2012).....Test Method for Low-Temperature Flexibility of Latex Sealants after Artificial Weathering

C794-10.....Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants

C919-12.....Use of Sealants in Acoustical Applications.

C920-14a.....Elastomeric Joint Sealants.

C1021-08(R2014).....Laboratories Engaged in Testing of Building Sealants

C1193-13.....Standard Guide for Use of Joint Sealants.

C1248-08(R2012).....Test Method for Staining of Porous Substrate by Joint Sealants

C1330-02(R2013).....Cylindrical Sealant Backing for Use with Cold Liquid Applied Sealants

C1521-13.....Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints

D217-10.....Test Methods for Cone Penetration of Lubricating Grease

D1056-14.....Specification for Flexible Cellular Materials—Sponge or Expanded Rubber

E84-09.....Surface Burning Characteristics of Building Materials

C. Sealant, Waterproofing and Restoration Institute (SWRI).
The Professionals' Guide

D. Environmental Protection Agency (EPA):
40 CFR 59(2014).....National Volatile Organic Compound Emission Standards for Consumer and Commercial Products

PART 2 - PRODUCTS

2.1 SEALANTS:

A. Floor Joint Sealant:
1. ASTM C920, Type S or M, Grade P, Class 25, Use T. S-#
2. S-# Provide location(s) of floor joint sealant as follows.
a. Seats of metal thresholds exterior doors.
b. Control and expansion joints in floors, slabs, ceramic tile, and walkways.

B. Interior Sealants:
1. VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system are to comply with the following limits for VOC content when calculated according to 40 CFR 59, (EPA Method 24):
a. Architectural Sealants: 250 g/L.
b. Sealant Primers for Nonporous Substrates: 250 g/L.
c. Sealant Primers for Porous Substrates: 775 g/L.

2. S-# Vertical and Horizontal Surfaces: ASTM C920, Type S or M, Grade NS, Class 25, Use NT.
4. Provide location(s) of interior sealant as follows:
   a. Typical narrow joint 6 mm, (1/4 inch) or less at walls and adjacent components.
   b. Perimeter of doors, windows, access panels which adjoin concrete or masonry surfaces.
   c. Joints formed between tile floors and tile base cove; joints between tile and dissimilar materials; joints occurring where substrates change.
   d. Behind escutcheon plates at valve pipe penetrations and showerheads in showers.

C. Acoustical Sealant:
1. Conforming to ASTM C919; flame spread of 25 or less; and a smoke developed rating of 50 or less when tested in accordance with ASTM E84. Acoustical sealant have a consistency of 250 to 310 when tested in accordance with ASTM D217; remain flexible and adhesive after 500 hours of accelerated weathering as specified in ASTM C734; and be non-staining.
2. Provide location(s) of acoustical sealant as follows:
   a. Exposed acoustical joint at sound rated partitions.
   b. Concealed acoustic joints at sound rated partitions.
   c. Joints where item pass-through sound rated partitions.

2.2 COLOR:

A. Sealants used with exposed masonry are to match color of mortar joints.
B. Sealants used with unpainted concrete are to match color of adjacent concrete.
C. Color of sealants for other locations to be light gray or aluminum, unless otherwise indicated in construction documents.

2.3 JOINT SEALANT BACKING:

A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
B. Cylindrical Sealant Backings: ASTM C1330, of type indicated below and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

1. Type C: Closed-cell material with a surface skin.

C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D1056 or synthetic rubber (ASTM C509), nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 32 degrees C (minus 26 degrees F). Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and otherwise contribute to optimum sealant performance.

D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.4 FILLER:

A. Mineral fiberboard: ASTM C612, Class 1.

B. Thickness same as joint width.

C. Depth to fill void completely behind back-up rod.

2.5 PRIMER:

A. As recommended by manufacturer of caulking or sealant material.

B. Stain free type.

2.6 CLEANERS-NON POROUS SURFACES:

A. Chemical cleaners compatible with sealant and acceptable to manufacturer of sealants and sealant backing material. Cleaners to be free of oily residues and other substances capable of staining or harming joint substrates and adjacent non-porous surfaces and formulated to promote adhesion of sealant and substrates.

PART 3 - EXECUTION

3.1 INSPECTION:

A. Inspect substrate surface for bond breaker contamination and unsound materials at adherent faces of sealant.

B. Coordinate for repair and resolution of unsound substrate materials.

C. Inspect for uniform joint widths and that dimensions are within tolerance established by sealant manufacturer.

3.2 PREPARATIONS:

A. Prepare joints in accordance with manufacturer's instructions and SWRI (The Professionals’ Guide).

B. Clean surfaces of joint to receive caulking or sealants leaving joint dry to the touch, free from frost, moisture, grease, oil, wax, lacquer paint, or other foreign matter that would tend to destroy or impair adhesion.
   1. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants.
   2. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air. Porous joint surfaces include but are not limited to the following:
      a. Concrete.
      b. Masonry.
      c. Unglazed surfaces of ceramic tile.
   3. Remove laitance and form-release agents from concrete.
   4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous surfaces include but are not limited to the following:
      a. Metal.
      b. Glass.
      c. Porcelain enamel.
      d. Glazed surfaces of ceramic tile.
C. Do not cut or damage joint edges.
D. Apply non-staining masking tape to face of surfaces adjacent to joints before applying primers, caulking, or sealing compounds.
   1. Do not leave gaps between ends of sealant backings.
   2. Do not stretch, twist, puncture, or tear sealant backings.
   3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
E. Apply primer to sides of joints wherever required by compound manufacturer's printed instructions or as indicated by pre-construction joint sealant substrate test.
   1. Apply primer prior to installation of back-up rod or bond breaker tape.

2. Use brush or other approved means that will reach all parts of joints. Avoid application to or spillage onto adjacent substrate surfaces.

3.3 BACKING INSTALLATION:

A. Install backing material, to form joints enclosed on three sides as required for specified depth of sealant.

B. Where deep joints occur, install filler to fill space behind the backing rod and position the rod at proper depth.

C. Cut fillers installed by others to proper depth for installation of backing rod and sealants.

D. Install backing rod, without puncturing the material, to a uniform depth, within plus or minus 3 mm (1/8 inch) for sealant depths specified.

E. Where space for backing rod does not exist, install bond breaker tape strip at bottom (or back) of joint so sealant bonds only to two opposing surfaces.

3.4 SEALANT DEPTHS AND GEOMETRY:

A. At widths up to 6 mm (1/4 inch), sealant depth equal to width.

B. At widths over 6 mm (1/4 inch), sealant depth 1/2 of width up to 13 mm (1/2 inch) maximum depth at center of joint with sealant thickness at center of joint approximately 1/2 of depth at adhesion surface.

3.5 INSTALLATION:

A. General:

1. Apply sealants and caulking only when ambient temperature is between 5 degrees C and 38 degrees C (40 degrees and 100 degrees F).
2. Do not install polysulfide base sealants where sealant may be exposed to fumes from bituminous materials, or where water vapor in continuous contact with cementitious materials may be present.
3. Do not install sealant type listed by manufacture as not suitable for use in locations specified.
4. Apply caulking and sealing compound in accordance with manufacturer's printed instructions.
5. Avoid dropping or smearing compound on adjacent surfaces.
6. Fill joints solidly with compound and finish compound smooth.
7. Tool exposed joints to form smooth and uniform beds, with slightly concave surface conforming to joint configuration per Figure 5A in ASTM C1193 unless shown or specified otherwise in construction

documents. Remove masking tape immediately after tooling of sealant and before sealant face starts to "skin" over. Remove any excess sealant from adjacent surfaces of joint, leaving the working in a clean finished condition.

8. Finish paving or floor joints flush unless joint is otherwise detailed.
9. Apply compounds with nozzle size to fit joint width.
10. Test sealants for compatibility with each other and substrate. Use only compatible sealant. Submit test reports.
11. Replace sealant which is damaged during construction process.

C. For application of sealants, follow requirements of ASTM C1193 unless specified otherwise. Take all necessary steps to prevent three-sided adhesion of sealants.

D. Interior Sealants: Where gypsum board partitions are of sound rated, fire rated, or smoke barrier construction, follow requirements of ASTM C919 only to seal all cut-outs and intersections with the adjoining construction unless specified otherwise.

1. Apply a 6 mm (1/4 inch) minimum bead of sealant each side of runners (tracks), including those used at partition intersections with dissimilar wall construction.
2. Coordinate with application of gypsum board to install sealant immediately prior to application of gypsum board.
3. Partition intersections: Seal edges of face layer of gypsum board abutting intersecting partitions, before taping and finishing or application of veneer plaster-joint reinforcing.
4. Openings: Apply a 6 mm (1/4 inch) bead of sealant around all cutouts to seal openings of electrical boxes, ducts, pipes and similar penetrations. To seal electrical boxes, seal sides and backs.
5. Control Joints: Before control joints are installed, apply sealant in back of control joint to reduce flanking path for sound through control joint.

3.6 FIELD QUALITY CONTROL:

A. Field-Adhesion Testing: Field-test joint-sealant adhesion to joint substrates according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.

1. Extent of Testing: Test completed elastomeric sealant joints as follows:
   a. Perform 10 tests for first 305 m (1000 feet) of joint length for each type of elastomeric sealant and joint substrate.
   b. Perform one test for each 305 m (1000 feet) of joint length thereafter or one test per each floor per elevation.

B. Inspect joints for complete fill, for absence of voids, and for joint configuration complying with specified requirements. Record results in a field adhesion test log.

C. Inspect tested joints and report on following:
   1. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate.
   2. Compare these results to determine if adhesion passes sealant manufacturer’s field-adhesion hand-pull test criteria.
   3. Whether sealants filled joint cavities and are free from voids.
   4. Whether sealant dimensions and configurations comply with specified requirements.

D. Record test results in a field adhesion test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.

E. Repair sealants pulled from test area by applying new sealants following same procedures used to originally seal joints. Ensure that original sealant surfaces are clean and new sealant contacts original sealant.

F. Evaluation of Field-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements, will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.7 CLEANING:

A. Fresh compound accidentally smeared on adjoining surfaces: Scrape off immediately and rub clean with a solvent as recommended by manufacturer

of the adjacent material or if not otherwise indicated by the caulking or sealant manufacturer.

B. Leave adjacent surfaces in a clean and unstained condition.

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SECTION 08 11 13

HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Hollow metal doors hung in hollow metal frames at interior locations.
2. Hollow metal door frames for wood doors and borrowed lights at interior locations.
3. Glazed openings in hollow metal doors.

1.2 RELATED WORK

A. Section 08 71 00, DOOR HARDWARE: Door Hardware:

B. Section 08 80 00, GLAZING: Glazing.

C. Card Readers and Biometric Devices: Section 28 13 00, PHYSICAL ACCESS CONTROL SYSTEM.

D. Security Monitors: Section 28 23 00, VIDEO SURVEILLANCE.

1.3 APPLICABLE PUBLICATIONS

A. Comply with references to extent specified in this section.

B. American National Standard Institute (ANSI):

A250.8-2014.....Standard Steel Doors and Frames

C. ASTM International (ASTM):

A240/A240M-15b.....Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

A653/A653M-15.....Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip

A1008/A1008M-15.....Steel, Sheet, Cold-Rolled, Carbon, Structural, High Strength Low Alloy and High Strength Low Alloy with Improved Formability, Solution Hardened, and Bake Hardenable

B209-14.....Aluminum and Aluminum-Alloy Sheet and Plate

B209M-14.....Aluminum and Aluminum-Alloy Sheet and Plate (Metric)

B221-14.....Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

B221M-13.....Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)

E90-09.....Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements

D. Federal Specifications (Fed. Spec.):

L-S-125B.....Screening, Insect, Nonmetallic

E. Master Painters Institute (MPI):

No. 18.....Primer, Zinc Rich, Organic

F. National Association of Architectural Metal Manufacturers (NAAMM):

AMP 500-06.....Metal Finishes Manual

G. National Fire Protection Association (NFPA):

80-16.....Fire Doors and Other Opening Protectives

H. UL LLC (UL):

10C-09.....Positive Pressure Fire Tests of Door Assemblies

1784-15.....Air Leakage Tests of Door Assemblies and Other Opening Protectives

I. Department of Veterans Affairs

VA Physical Security and Resiliency Design Manual October 1, 2020

1.4 SUBMITTALS

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

B. Submittal Drawings:

1. Show size, configuration, and fabrication and installation details.

C. Manufacturer's Literature and Data:

1. Description of each product.
2. Include schedule showing each door and frame requirements fire label and smoke control label for openings.
3. Installation instructions.

D. Sustainable Construction Submittals:

1. Recycled Content: Identify post-consumer and pre-consumer recycled content percentage by weight.

E. Test reports: Certify each product complies with specifications.

1. Sound rated door.

F. Qualifications: Substantiate qualifications comply with specifications.

1. Manufacturer with project experience list .

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Regularly manufactures specified products.
2. Manufactured specified products with satisfactory service on five similar installations for minimum five years.
   a. Project Experience List: Provide contact names and addresses for completed projects.

1.6 DELIVERY

A. Fasten temporary steel spreaders across the bottom of each door frame before shipment.

B. Deliver products in manufacturer's original sealed packaging.

C. Mark packaging, legibly. Indicate manufacturer's name or brand, type, production run number, and manufacture date.

D. Before installation, return or dispose of products within distorted, damaged, or opened packaging.

1.7 STORAGE AND HANDLING

A. Store products indoors in dry, weathertight conditioned facility.

B. Protect products from damage during handling and construction operations.

1.8 WARRANTY

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

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

A. Design hollow metal doors and frames complying with specified performance:

1. Fire Doors and Frames: UL 10C; NFPA 80 labeled.
   a. Fire Ratings: See drawings.
2. Smoke Control Doors and Frames: UL 1784; NFPA 80 labeled, maximum 0.15424 cubic meter/second/square meter (3.0 cubic feet/minute/square foot) at 24.9 Pa (0.10 inches water gauge) pressure differential.
3. Sound Rated Doors and Frames: Minimum 45 sound transmission class (STC) when tested according to ASTM E90.

2.2 MATERIALS

A. Stainless Steel: ASTM A240/A240M; Type 304 and Type 316 .

B. Sheet Steel: ASTM A1008/A1008M, cold-rolled.

C. Galvanized Sheet Steel: ASTM A653.

D. Aluminum Sheet: ASTM B209M (ASTM B209).

E. Aluminum Extrusions: ASTM B221M (ASTM B221).

2.3 PRODUCTS - GENERAL

A. Basis of Design: Section 09 06 00, SCHEDULE FOR FINISHES.

B. Provide hollow metal doors and frames from one manufacturer.

C. Sustainable Construction Requirements:

1. Steel Recycled Content: 30 percent total recycled content, minimum.
2. Stainless Steel Recycled Content: 70 percent total recycled content, minimum.
3. Aluminum Recycled Content: 80 percent total recycled content, minimum.

2.4 HOLLOW METAL DOORS

A. Hollow Metal Doors: ANSI A250.8; 44 mm (1-3/4 inches) thick. See drawings for sizes and designs.

1. Interior Doors: Level 2 and Physical Performance Level B, heavy duty; Model 2, seamless at _____ locations .

B. Door Faces:

1. Interior Doors: Stainless steel Sheet steel Galvanized sheet steel minimum Z275 (G90) coating .

C. Door Cores:

1. Interior Doors: Kraft paper honeycomb or vertical steel stiffeners .
2. Fire Doors: Manufacturer's standard complying with specified fire rating performance.

2.5 HOLLOW METAL FRAMES

A. Hollow Metal Frames: ANSI A250.8; face welded . See drawings for sizes and designs.

1. Interior Frames:
   a. Level 2 and Level 3 Hollow Metal Doors: 1.3 mm (0.053 inch) thick.
   b. Level 1 Hollow Metal Doors: 1.0 mm (0.042 inch) thick.
   c. Wood Doors and Borrowed Lights : 1.0 mm (0.042 inch) 1.3 mm (0.053 inch) thick.
2. Interior Borrowed Light Frames: 1.3 mm (0.051 inch) thick.

B. Frame Materials:

1. Interior Frames: Stainless steel Sheet steel Galvanized sheet steel minimum Z275 (G90) coating .

2.6 FABRICATION

A. Hardware Preparation: ANSI A250.8; for hardware specified in Section 08 71 00, DOOR HARDWARE.

B. Hollow Metal Door Fabrication:
   1. Close top edge of exterior doors flush and seal to prevent water intrusion.
   2. Fill spaces between vertical steel stiffeners with insulation.

C. Fire and Smoke Control Doors:
   1. Close top and vertical edges flush.
   2. Apply steel astragal to active leaf at pair and double egress doors.
      a. Exception: Where vertical rod exit devices are specified for both leaves swinging in same direction.
   3. Fire and Smoke Control Door Clearances: NFPA 80.

D. Custom Metal Hollow Doors:
   1. Provide custom hollow metal doors where nonstandard steel doors are shown on drawings.
      a. Provide door sizes, design, materials, construction, gauges, and finish as specified for standard steel doors.

E. Sound Rated Doors:
   1. Seals: Integral spring type automatic door bottom seal.
   2. Fabricate vision panel cutouts and frames to receive double glazing as shown on drawings.

F. Hollow Metal Frame Fabrication:
   1. Fasten mortar guards to back of hardware reinforcements, except on lead-lined frames.
   2. Concealed Closers in Head Frame: Provide 1 mm (0.042 inch) thick steel removable stop sections for access to concealed face plates and control valves, except when cover plates are furnished with closer.
   3. Terminated Stops: ANSI A250.8.
   4. Borrowed Light and Panel Opening Frames:
      a. Provide integral stop on exterior, corridor, or secure side of door.
      b. Design rabbet width and depth to receive glazing material or panel shown on drawings.

5. Frame Anchors:
   a. Floor anchors:
      1) Provide extension type floor anchors to compensate for depth of floor fills.
      2) Provide 1.3 mm (0.053 inch) thick steel clip angles welded to jamb and drilled to receive floor fasteners.
      3) Provide 50 mm by 50 mm by 9 mm (2 inch by 2 inch by 3/8 inch) clip angle for lead lined frames, drilled for floor fasteners.
      4) Provide mullion 2.3 mm (0.093 inch) thick steel channel anchors, drilled for two floor fasteners and frame anchor screws.
      5) Provide continuous 1 mm (0.042 inch) thick steel rough bucks drilled for floor fasteners and frame anchor screws for sill sections.
         a) Space floor bolts50 mm (24 inches) on center.
   b. Jamb anchors:
      1) Place anchors on jambs:
         a) Near top and bottom of each frame.
         b) At intermediate points at maximum 600 mm (24 inches) spacing.
      2) Form jamb anchors from steel minimum 1 mm (0.042 inch) thick.
      3) Anchors for stud partitions: Provide tabs for securing anchor to sides of studs. Provide one of the following:
         a) Welded type.
         b) Lock-in snap-in type.
      4) Anchors for frames set in prepared openings:
         a) Steel pipe spacers 6 mm (1/4 inch) inside diameter, welded to plate reinforcing at jamb stops, or hat shaped formed strap spacers 50 mm (2 inches) wide, welded to jamb near stop.
         b) Drill jamb stop and strap spacers for 6 mm (1/4 inch) flat head bolts to pass through frame and spacers.
         c) Two piece frames: Subframe or rough buck drilled for 6 mm (1/4 inch) bolts.
      5) Anchors for observation windows and other continuous frames set in stud partitions.

a) Weld clip anchors to sills and heads of continuous frames over 1200 mm (4 feet) long.
b) Space maximum 600 mm (24 inches) on centers.

6) Modify frame anchors to fit special frame and wall construction.
7) Provide special anchors where shown on drawings and where required to suit application.

G. Sound Rated Door Frames:
1. Seals: Integral continuous gaskets on frames.

H. Louver Fabrication:
1. Fabricate louvers as complete units.
2. Weld stationary blades to frames.
3. Factory install louvers in door cutouts, welded to door.

2.7 FINISHES

A. Steel and Galvanized Steel : ANSI A250.8; shop primed.
B. Stainless Steel: NAAMM AMP 500; No. 4 polished finish.
1. Blend welds to match adjacent finish.
C. Finish exposed surfaces after fabrication.
D. Aluminum Anodized Finish: NAAMM AMP 500.
1. Clear Anodized Finish: AA-C22A41; Class I Architectural, 0.018 mm (0.7 mil) thick.
2. Color Anodized Finish: AA-C22A42 or AA-C22A44; Class I Architectural, 0.018 mm (0.7 mil) thick.
3. Clear Anodized Finish: AA-C22A31; Class II Architectural, 0.01 mm (0.4 mil) thick.
4. Color Anodized Finish: AA-C22A32 or AA-C22A34; Class II Architectural, 0.01 mm (0.4 mil) thick.

2.8 ACCESSORIES

A. Primers: ANSI A250.8.
B. Barrier Coating: ASTM D1187/D1187M.
C. Welding Materials: AWS D1.1/D1.1M, type to suit application.
D. Clips Connecting Members and Sleeves: Match door faces.
E. Fasteners: Galvanized steel stainless steel .
1. Metal Framing: Steel drill screws.
F. Anchors: Galvanized steel and stainless steel .
G. Galvanizing Repair Paint: MPI No. 18.
H. Insulation: Unfaced mineral wool.

PART 3 - EXECUTION

3.1 PREPARATION

A. Examine and verify substrate suitability for product installation.

B. Protect existing construction and completed work from damage.

C. Apply barrier coating to metal surfaces in contact with cementitious materials to minimum 0.7 mm (30 mils) dry film thickness.

3.2 INSTALLATION - GENERAL

A. Install products according to manufacturer's instructions and approved submittal drawings .

1. When manufacturer's instructions deviate from specifications, submit proposed resolution for Contracting Officer's Representative consideration.
2. Install fire doors and frames according to NFPA 80.
3. Install smoke control doors and frames according to NFPA 105.

3.3 FRAME INSTALLATION

A. Apply barrier coating to concealed surfaces of frames built into masonry.

B. Plumb, align, and brace frames until permanent anchors are set.

1. Use triangular bracing near each corner on both sides of frames with temporary wood spreaders at midpoint.
2. Use wood spreaders at bottom of frame when shipping spreader is removed.
3. Where construction permits concealment, leave shipping spreaders in place after installation, otherwise remove spreaders when frames are set and anchored.
4. Remove wood spreaders and braces when walls are built and jamb anchors are secured.

C. Floor Anchors:

1. Anchor frame jambs to floor with two expansion bolts.
   a. Other Frames: Use 6 mm (1/4 inch) diameter bolts.
2. Power actuated drive pins are acceptable to secure frame anchors to concrete floors.

D. Jamb Anchors:

1. Metal Framed Walls: Secure anchors to sides of studs with two fasteners through anchor tabs.

E. Frames for Sound Rated Doors: Fill frames with insulation.

F. Touch up damaged factory finishes.

1. Repair galvanized surfaces with galvanized repair paint.
2. Repair painted surfaces with touch up primer.

3.4 DOOR INSTALLATION

A. Install doors plumb and level.

B. Adjust doors for smooth operation.

C. Touch up damaged factory finishes.

1. Repair galvanized surfaces with galvanized repair paint.
2. Repair painted surfaces with touch up primer.

3.5 CLEANING

A. Clean exposed door and frame surfaces. Remove contaminants and stains.

3.6 PROTECTION

A. Protect doors and frames from traffic and construction operations.

B. Remove protective materials immediately before acceptance.

C. Repair damage.

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SECTION 08 14 00

INTERIOR WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior flush wood doors transparent finish.

1.2 RELATED WORK

A. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS: Paints and Coatings and Composite Wood and Agrifiber VOC Limits.

B. Section 08 71 00, DOOR HARDWARE: Door Hardware including hardware location (height).

C. Section 08 11 13, HOLLOW METAL DOORS AND FRAMES: Installation of Doors.

D. Section 08 80 00 GLAZING: Installation of glazing.

E. Section 08 71 00, DOOR HARDWARE: Installation of Door Hardware.

F. Section 09 06 00, SCHEDULE FOR FINISHES: Door Finish.

1.3 APPLICABLE PUBLICATIONS

A. Comply with references to extent specified in this section.

B. American National Standards Institute/Window and Door Manufacturers Association (ANSI/WDMA):

1. I.S. 1A-13 - Architectural Wood Flush Doors.
2. I.S. 6A-13 - Interior Architectural Stile and Rails Doors.

C. ASTM International (ASTM):

1. E90-09(2016) - Laboratory Measurements of Airborne Sound Transmission Loss of Building Partitions and Elements.

D. National Fire Protection Association (NFPA):

1. 80-16 - Fire Doors and Other Opening Protectives.
2. 252-12 - Fire Tests of Door Assemblies.

E. UL LLC (UL):

1. 10C-09 - Positive Pressure Fire Tests of Door Assemblies.

F. Window and Door Manufacturers Association (WDMA):

1. TM 7-14 - Cycle-Slam Test.
2. TM 8-14 - Hinge Loading Test.
3. TM 10-14 - Screw Holding Capacity.

1.4 SUBMITTALS

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

B. Submittal Drawings:

1. Show size, configuration, and fabrication and installation details.
2. Include details of glazing .
3. Indicate project specific requirements not included in Manufacturer's Literature and Data submittal.

C. Manufacturer's Literature and Data:

1. Description of each product.
2. Fire rated doors showing conformance with NFPA 80 .

D. Samples:

1. Corner section of flush veneered door 300 mm (12 inches) square, showing details of construction, labeled to show grade and type number and conformance to specified standard.
2. Veneer sample 200 mm by 275 mm (8 inch by 11 inch) showing specified wood species sanded to receive a transparent finish. Factory finish veneer sample where the prefinished option is accepted.

E. Sustainable Construction Submittals:

1. Low Pollutant-Emitting Materials:
   a. Show volatile organic compound types and quantities.

F. Test Reports: Indicate each product complies with specifications.

1. Screw Holding Capacity Test.
2. Cycle-Slam Test.
3. Hinge-Loading Test.

G. Operation and Maintenance Data:

1. Care instructions for each exposed finish product.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Regularly and presently manufactures specified products.
2. Manufactures specified products with satisfactory service on five similar installations for minimum five years.

1.6 DELIVERY

A. Deliver products in manufacturer's original sealed packaging.

1. Minimum 0.15 mm (6 mil) polyethylene bags or cardboard packaging to remain unbroken during delivery and storage.

B. Mark packaging, legibly. Indicate manufacturer's name or brand, type, color, and manufacture date.
   1. Identify door opening corresponding to Door Schedule.
C. Before installation, return or dispose of products within distorted, damaged, or opened packaging. Retain packaging for door protection after installation.

1.7 STORAGE AND HANDLING

A. Store products indoors in dry, weathertight conditioned facility.
   1. Store doors according to ANSI/WDMA I.S. 1A.
B. Protect products from damage during handling and construction operations.

1.8 FIELD CONDITIONS

A. Environment:
   1. Product Temperature: Minimum 21 degrees C (70 degrees F) for minimum 48 hours before installation.
   2. Work Area Ambient Temperature Range: 21 to 27 degrees C (70 to 80 degrees F) continuously, beginning 48 hours before installation.
   3. Install products when building is permanently enclosed and when wet construction is completed, dried, and cured.

   Comply with door manufacturer's instructions for relative humidity.

1.9 WARRANTY

A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."
B. Manufacturer's Warranty: Warrant interior factory finished flush wood doors against material and manufacturing defects.
   1. Warranty Period: Lifetime of original installation.

PART 2 - PRODUCTS

2.1 PRODUCTS - GENERAL

A. Basis of Design: Section 09 06 00, SCHEDULE FOR FINISHES.
B. Provide each product from one manufacturer.
C. Sustainable Construction Requirements:
   1. Low Pollutant-Emitting Materials: Comply with VOC limits specified in Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS for the following products:
   2. Paints and coatings.
   3. Composite wood and agrifiber.

2.2 FLUSH WOOD DOORS

A. General:

1. ANSI/WDMA I.S. 1A, Extra Heavy Duty.
2. Adhesive: Type II.
3. Core: Structural composite lumber, except when mineral core is required for fire rating.
4. Thickness: 44 mm (1-3/4 inches) unless otherwise shown or specified.

B. Faces:

1. ANSI/WDMA I.S. 1A.
2. One species throughout project unless scheduled or otherwise shown.
3. Transparent Finished Faces: Premium Grade. rotary cut, white maple
3. white birch red oak white oak _____ . A Grade AA Grade face veneer.
4. Match face veneers for doors for uniform effect of color and grain at joints.
5. Door Edges: Same species as door face veneer, except maple is acceptable for stile face veneer on birch doors.
6. In existing buildings, where doors are required to have transparent finish, use wood species, grade, and assembly of face veneers to match adjacent existing doors.
7. Painted Finishes: Custom Grade, mill option close grained hardwood, premium or medium density overlay.
8. Factory sand doors for finishing.

C. Wood For Stops, Louvers, Muntins and Moldings For Flush Doors Required to Have Transparent Finish:

1. Solid wood of same species as face veneer, except maple is acceptable on birch doors.
2. Glazing:
   a. On non-fire-rated doors, use applied wood stops nailed tightly on room side and attached on opposite side with flathead, countersunk wood screws, spaced approximately 125 mm (5 inches) on center.

D. Fire-Rated Wood Doors:

1. Fire Resistance Rating:
   a. B Label: 1-1/2 hours.

b. C Label: 3/4 hour.

2. Provide 20-minute smoke-rated doors in smoke-rated barriers.

3. Labels:

a. Comply with NFPA 252, UL 10C, and labeled by qualified testing and inspection agency showing fire resistance rating.

1) Metal labels with raised or incised markings.

4. Performance Criteria for Stiles of Doors Utilizing Standard Mortise Leaf Hinges:

a. Hinge Loading: WDMA TM 8. Average of 10 test samples for Extra Heavy Duty doors.

b. Direct Screw Withdrawal: WDMA TM 10 for Extra Heavy Duty doors. Average of 10 test samples using a steel, fully threaded #12 wood screw.

c. Cycle-Slam: 1,000,000 cycles with no loose hinge screws or other visible signs of failure when tested according to WDMA TM 7.

5. Hardware Reinforcement:

a. Provide fire smoke rated doors with hardware reinforcement blocking.

b. Size of lock blocks as required to secure hardware specified.

c. Top, Bottom and Intermediate Rail Blocks: Minimum 125 mm (5 inches) by full core width.

d. Reinforcement blocking in compliance with labeling requirements. Mineral material similar to core is not acceptable.

6. Other Core Components: Manufacturer's standard as allowed by labeling requirements.

7. Glazed Vision Panel Frame: Steel approved for use in labeled doors.

8. Astragal: Steel type for pairs of doors.

E. Smoke Barrier Doors:

1. Glazed Vision Panel Frame: Steel approved for use in labeled doors and as required by code.

2. Astragal: Steel type for pairs of doors, including double egress doors.

F. Sound Rated Doors:

1. Fabricated as specified for flush wood doors with additional construction requirements to comply with specified sound transmission class (STC).

2. STC Rating of door assembly in place when tested according to ASTM E90 by independent acoustical testing laboratory minimum 35 _____ .
   a. Accessories:
      1) Frame Gaskets and Automatic Door Bottom Seal: As specified in Section 08 71 00, DOOR HARDWARE.

2.3 FABRICATION

A. Factory machine interior wood doors to receive hardware, bevels, undercuts, cutouts, accessories and fitting for frame.
   1. Factory fit fire rated doors according to NFPA 80.
B. Rout doors for hardware using templates and location heights specified in Section 08 71 00, DOOR HARDWARE.
C. Factory fit doors to frame, bevel lock edge of doors 3 mm (1/8 inch) for each 50 mm (2 inches) of door thickness undercut where shown .
D. Clearances between Doors and Frames and Floors:
   1. Fire Rated Doors: Comply with NFPA 80.
      a. Doors with Automatic Bottom Seal: Maximum clearance 10 mm (3/8 inch) at threshold.
      b. Other Door Bottoms: Maximum 3 mm (1/8 inch) clearance at the jambs, heads, and meeting stiles, and a 19 mm (3/4 inch) clearance at bottom, except as otherwise specified.
   2. Door Jambs, Heads, and Meeting Stiles: Maximum 3 mm (1/8 inch).
E. Provide cutouts for glazed and louver openings.
F. Finish surfaces, including both faces, top and bottom and edges of the doors smooth to touch.
G. Identify each door on top edge.
   1. Mark with stamp, brand or other indelible mark, giving manufacturer’s name, door’s trade name, construction of door, date of manufacture and quality.
   2. Mark door or provide separate certification including name of inspection organization.
   3. Identify door manufacturing standard, including glue type.
   4. Identify veneer and quality certification.
   5. Identification of preservative treatment for stile and rail doors.

2.4 FINISHES

A. Field Finished Doors: Seal top and bottom edges of doors with two coats of catalyzed polyurethane or water resistant sealer.

B. Factory Transparent Finish:

1. Factory finish flush wood doors.

a. ANSI/WDMA I.S. 1A Section F-3 Finish System Descriptions for System 5, Conversion Varnish or System 7, Catalyzed Vinyl.

b. Use stain when required to produce finish specified in Section 09 06 00, SCHEDULE FOR FINISHES.

PART 3 - EXECUTION

3.1 PREPARATION

A. Examine and verify substrate suitability for product installation.

1. Verify door frames are properly anchored.

2. Verify door frames are plumb, square, in plane, and within tolerances for door installation.

B. Protect existing construction and completed work from damage.

C. Install astragal on active leaf of pair of smoke doors and one leaf of double egress smoke doors.

3.2 INSTALLATION

A. Install products according to manufacturer's instructions and approved submittal drawings .

1. Install fire rated doors according to NFPA 80.

2. When manufacturer's instructions deviate from specifications, submit proposed resolution for Contracting Officer's Representative consideration.

3.3 PROTECTION

A. After installation, place shipping container over door and tape in place.

1. Do not apply tape to door faces and edges.

B. Provide protective covering over exposed hardware in addition to covering door.

C. Maintain covering in good condition until removal is directed by Contracting Officer's Representative.

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SECTION 08 31 13

ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Access doors and panels installed in walls and ceilings.

1.2 RELATED WORK

A. Section 08 71 00, DOOR HARDWARE: Lock Cylinders.

B. Section 09 91 00, PAINTING: Field Painting.

C. Section 09 06 00, SCHEDULE FOR FINISHES: Finish Color.

D. Section 21 13 13, WET-PIPE SPRINKLER SYSTEMS: Access Doors for Control or Drain Valves.

E. Section 22 40 00, PLUMBING FIXTURES: Access Doors for Plumbing Valves.

F. Section 23 31 00, HVAC DUCTS AND CASINGS: Locations of Access Doors for Ductwork Cleanouts.

1.3 APPLICABLE PUBLICATIONS

A. Comply with references to extent specified in this section.

B. American Welding Society (AWS):

D1.3/D1.3M-2018.....Structural Welding Code - Sheet Steel (6th Edition.

C. ASTM International (ASTM):

A653/A653M-20.....Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Sip Process.

A1008/A1008M-18.....Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.

A666-15.....Annealed or Cold-Worked Austenitic Stainless Steel sheet, Strip, Plate, and Flat Bar.

E119-20.....Fire Test of Building Construction and Materials.

D. National Fire Protection Association (NFPA):

80-2019 Edition.....Fire Doors and Other Opening Protectives.

252-2017 Edition.....Fire Tests of Door Assemblies.

E. National Association of Architectural Metal Manufacturers (NAAMM):

AMP 500-06.....Metal Finishes Manual.

F. UL LLC (UL):

Listed.....Online Certifications Directory.

10B-08 (Edition 10).....Standard for Fire Tests of Door Assemblies.

263-11 (Edition 14).....Fire Tests of Building Construction and Materials.

1.4 SUBMITTALS

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

B. Submittal Drawings:

1. Show size, configuration, and fabrication and installation details.

C. Manufacturer's Literature and Data:

1. Description of each product.
2. Installation instructions.

D. Sustainable Construction Submittals:

1. Recycled Content: Identify post-consumer and pre-consumer recycled content percentage by weight.

1.5 DELIVERY

A. Deliver products in manufacturer's original sealed packaging.

B. Mark packaging, legibly. Indicate manufacturer's name or brand, type, color, production run number, and manufacture date.

C. Before installation, return or dispose of products within distorted, damaged, or opened packaging.

1.6 STORAGE AND HANDLING

A. Store products indoors in dry, weathertight facility.

B. Protect products from damage during handling and construction operations.

1.7 FIELD CONDITIONS

A. Field Measurements: Verify field conditions affecting access door fabrication and installation. Show field measurements on Submittal Drawings.

1. Coordinate field measurement and fabrication schedule to avoid delay.

1.8 WARRANTY

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

PART 2 - PRODUCTS

2.1 MATERIALS

A. Stainless Steel: ASTM A666; Type 302 or Type 304.

2.2 PRODUCTS - GENERAL

A. Basis of Design: Section 09 06 00, SCHEDULE FOR FINISHES.

B. Provide each product from one manufacturer.

C. Sustainable Construction Requirements:

1. Stainless Steel Access Doors Recycled Content: 70 percent total recycled content, minimum.

2.3 ACCESS DOORS, FIRE-RATED

A. Door Construction:

1. Ceiling Access Door Construction: ASTM E119 or UL 263.
2. Wall Access Doors: NFPA 252 or UL 10B.

B. Label: Class B opening according to UL 10B or test by another nationally recognized laboratory. 1 hour fire-rated with maximum temperature rise of 120 degrees C (216 degrees F) .

C. Door Panel: Minimum 0.9 mm (0.0359 inch) thick stainless steel sheet, with mineral-fiber insulation core, insulated sandwich type construction.

D. Frame: Minimum 1.5 mm (0.0598 inch) thick stainless steel sheet, depth and configuration to suit material and construction type where installed.

1. Frame Flange: Provide at units installed in concrete, masonry, or gypsum board.
2. Exposed Joints in Flange: Weld and grind smooth.
3. Provide expanded galvanized metal lath perimeter wings when installed in plaster, except veneer plaster.

E. Provide automatic closing device.

F. Hinge: Continuous stainless steel hinge with stainless steel pin.

G. Lock: Self-latching, mortise type with provision for fitting flush a standard screw-in type lock cylinder.

1. Lock cylinder specified in Section 08 71 00, DOOR HARDWARE.
2. Latch release device operable from inside of door.

H. Anchors for Fire-Rated Access Doors: Comply with requirements of applicable fire test.

2.4 ACCESS DOORS, FLUSH PANEL, NON-RATED

A. Door Panel:

1. 1.5 mm (0.06 inch) thick stainless steel sheet.
2. Reinforce to maintain flat surface.

B. Frame:
1. 1.5 mm (0.06 inch) thick stainless steel sheet, depth and configuration to suit material and construction type where installed.
2. Frame Flange: Provide at units installed in concrete, masonry, and gypsum board.
3. Exposed Joints in Flange: Weld and grind smooth.
4. Provide expanded galvanized metal lath perimeter wings when installed in plaster, except veneer plaster.

C. Hinge:
1. Concealed spring hinge, 175 degrees of opening.
2. Removable hinge pin to allow removal of door panel from frame.

D. Lock:
1. Flush, screwdriver-operated cam lock.
2. Tamper proof screws (spanner head locks) for access panels in Behavioral Health Areas.

2.5 ACCESS DOOR, RECESSED PANEL, NON-RATED

A. Door Panel:
1. 1.2 mm (0.05 inch) thick stainless steel sheet to form a 25 mm (1 inch) deep recessed pan to accommodate installation of acoustical units and other materials where shown in walls and ceiling.
2. Reinforce to prevent sagging.

B. Frame:
1. 1.5 mm (0.06 inch) thick steel sheet of depth and configuration to suit installation in suspension system of ceiling or wall framing.
2. Extend sides of frame to protect edge of acoustical units when door panel is in open position.
3. Provide shims, bushings, clips and other devices necessary for installation.

C. Hinge: Continuous stainless steel hinge with stainless steel pin, or concealed hinge.

D. Lock:
1. Flush screwdriver-operated cam lock.
2. Plastic sleeve or stainless steel grommet to protect hole made in acoustical unit for screwdriver access to lock.

3. Tamper proof screws (spanner head locks) for access panels in Behavioral Health Areas.

2.6 FABRICATION - GENERAL

A. Size: Minimum 600 mm (24 inches) square door unless otherwise shown or required to suit opening in suspension system of ceiling.

B. Component Fabrication: Straight, square, flat and in same plane where required.

1. Exposed Edges: Slightly rounded, without burrs, snags and sharp edges.
2. Exposed Welds: Continuous, ground smooth.
3. Welding: AWS D1.3/D1.3M.

C. Locks and Non-Continuous Hinges: Provide in numbers required to maintain alignment of door panel with frame. For fire-rated doors, provide hinges and locks as required by fire test.

D. Anchoring: Make provisions in frame for anchoring to adjacent construction. Provide anchors in size, number and location on four sides to secure access door to substrate. Provide anchors as required by fire test.

2.7 FINISHES

A. Stainless Steel Exposed Surfaces: NAAMM AMP 500; No.06 Metal Finishes.

2.8 ACCESSORIES

A. Fasteners: Type and size recommended by access door manufacturer, to suit application.

1. Stainless Steel Access Doors: Stainless steel fasteners.
2. Other Access Doors: Stainless steel fasteners.

PART 3 - EXECUTION

3.1 PREPARATION

A. Examine and verify substrate suitability for product installation.

1. Verify access door locations and sizes provide required maintenance access to installed building services components.

B. Protect existing construction and completed work from damage.

3.2 INSTALLATION - GENERAL

A. Install products according to manufacturer's instructions and approved submittal drawings.

1. When manufacturer's instructions deviate from specifications, submit proposed resolution for Contracting Officer's Representative consideration.

B. Install access doors and panels permitting access to service valves, traps, dampers, cleanouts, and other mechanical, electrical and conveyor control items concealed in walls and partitions, and concealed above gypsum board and plaster ceilings.

C. Install fire rated access door according to NFPA 80.

D. Install fire-rated doors in fire-rated partitions and ceilings.

E. Install flush access panels in partitions and in gypsum board and plaster ceilings.

F. Install recessed panel access doors in the following locations:

1. Insert Room Names.

3.3 ACCESS DOOR AND FRAME INSTALLATION

A. Wall Installations: Install access doors in openings with sides vertical.

B. Ceiling Installations: Install access doors parallel to ceiling suspension grid or room partitions.

C. Frames without Flanges: Install frame flush with surrounding finish surfaces.

D. Frames with Flanges: Overlap opening, with face uniformly spaced from finish surface.

E. Recessed Panel Access Doors: Install with face of surrounding materials flush with door panel installed finish.

F. Secure frames to adjacent construction with fasteners.

G. Install type, size and quantity of anchoring device suitable for material surrounding opening to maintain alignment, and resist displacement, during normal use of access door.

H. Field Painting Primed Access Doors: Comply with the requirements of Section 09 91 00, PAINTING.

3.4 ADJUSTMENT

A. Adjust hardware so door panel opens freely.

B. Adjust door when closed so door panel is centered in frame.

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01-01-21

SECTION 08 32 13
SLIDING GLASS DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior, single or double slide, automatic sliding entrances; trackless for individual rooms.
2. Entrances shall be rated as an effective barrier limiting the passage of smoke where noted.

1.2 RELATED WORK

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Section 09 06 00, SCHEDULE FOR FINISHES Door Finish and Color.

C. Section 08 80 00, GLAZING. Glass and Glazing:

D. Section 08 71 00, DOOR HARDWARE: Hardware.

E. Section 08 71 13, AUTOMATIC DOOR OPERATORS: Automatic Door Actuators.

F. Section 09 06 00, SCHEDULE FOR FINISHES: Aluminum Finish and Color.

1.3 COORDINATION

A. Field Measurements: Verify actual dimensions of openings to receive entrances by field measurements before fabrication.

B. Templates: Distribute for doors, frames, and other work specified to be factory prepared for installing sliding entrances.

1.4 APPLICABLE PUBLICATIONS

A. Comply with references to extent specified in this section. Refer to the version year adopted by the Authority Having Jurisdiction or the latest edition.

B. American Welding Society (AWS):
D1.2/D1.2M-2014.....Structural Welding Code - Aluminum

C. ASTM International (ASTM):
B209-14.....Aluminum and Aluminum-Alloy Sheet and Plate
B209M-14.....Aluminum and Aluminum-Alloy Sheet and Plate (Metric)

B221-14.....Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

B221M-13.....Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)

D. National Association of Architectural Metal Manufacturers (NAAMM):

AMP 500-04.....Metal Finishes Manual for Architectural Metal Products

E. National Fenestration Rating Council (NFRC):

500-17.....Determining Fenestration Product Condensation Resistance Values

F. National Fire Protection Association (NFPA):

NFPA 70-20.....National Electric Code

NFPA 105-19.....Standard for the Installation of Smoke Door Assemblies

G. Underwriters Laboratories UL:

UL 1784-20.....Air Leakage Tests for Door Assemblies

1.5 PREINSTALLATION MEETINGS

A. Conduct preinstallation meeting at project site minimum 30 days before beginning Work of this section.

1. Required Participants:
   a. Contracting Officer's Representative.
   b. Architect/Engineer.
   c. Contractor.
   d. Installer.
   e. Manufacturer's field representative.
   f. Other installers responsible for adjacent and intersecting work, including.
2. Meeting Agenda: Distribute agenda to participants minimum 3 days before meeting.
   a. Installation schedule.
   b. Installation sequence.
   c. Preparatory work.
   d. Protection before, during, and after installation.
   e. Installation.
   f. Terminations.
   g. Transitions and connections to other work.

h. Other items affecting successful completion.

3. Document and distribute meeting minutes to participants to record decisions affecting installation.

1.6 SUBMITTALS

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

B. Submittal Drawings: Minimum 1 to 2 (half size) scale.

1. Show size, configuration, and fabrication and installation details.
2. Show anchorage and reinforcement.
3. Show interface and relationship to adjacent work.

C. Manufacturer's Literature and Data:

1. Description of each product.
2. Doors, each type.
3. Entrance and Storefront construction.
4. Installation instructions.
5. Warranty.

D. Samples:

1. Door Corner Section: Minimum 450 mm x 450 mm (18 x 18 inches) for each specified door type, showing head rail and hinge stile, door closer reinforcement, and internal reinforcement.
2. Aluminum Anodized Finish: Provide sample extrusions minimum 150 mm (6 inches) long for each specified color in sets of three showing maximum color range.
3. Aluminum Paint Finish: Provide sample extrusions minimum 150 mm (6 inches) long for each specified color.

E. Sustainable Construction Submittals:

1. Recycled Content: Identify post-consumer and pre-consumer recycled content percentage by weight.

F. Test reports: Certify each product complies with specifications.

G. Certificates: Certify each product complies with specifications.

1. Certify anodized finish thickness.

H. Qualifications: Substantiate qualifications comply with specifications.

1. Manufacturer with project experience list.
2. Installer with project experience list.
3. Welders and welding procedures.

I. Delegated Design Drawings and Calculations: Signed and sealed by responsible design professional.
   1. Show location and magnitude of loads applied to building structural frame.
   2. Identify deviations from details shown on drawings.
J. Operation and Maintenance Data:
   1. Care instructions for each exposed finish product.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications:
   1. Regularly manufactures specified products.
   2. Manufactured specified products with satisfactory service on five similar installations for minimum five years.
      a. Project Experience List: Provide contact names and addresses for completed projects.
B. Installer Qualifications: Product manufacturer. Manufacturer authorized representative.
   1. Regularly installs specified products.
   2. Installed specified products with satisfactory service on five similar installations for minimum five years.
      a. Project Experience List: Provide contact names and addresses for completed projects.
C. Welders and Welding Procedures Qualifications: AWS D1.2/D1.2M.

1.8 DELIVERY, STORAGE AND HANDLING

A. Deliver products in manufacturer's original sealed packaging.
B. Mark packaging, legibly. Indicate manufacturer's name or brand, type, color, production run number, and manufacture date.
C. Before installation, return or dispose of products within distorted, damaged, or opened packaging.
D. Store products indoors in dry, weathertight conditioned facility.
E. Protect products from damage during handling and construction operations.

1.9 WARRANTY

A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction." Warranty Period for One year but not limited to, the following: Structural failure including excessive deflection
   1. Faulty operation of hardware

2. Excessive deterioration/failure of metals, metal finishes, glass and other materials.

B. Manufacturer's Warranty: Warrant painted finish against material and manufacturing defects.

1. Warranty Period: 20 years.

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

A. Entrance Assemblies

1. General: Provide manufacturer's standard entrance assemblies including doors, sidelites, framing, headers, carrier assemblies, roller tracks, pivots, and accessories required for a complete installation. All components are to be from a single source from a single manufacturer.

2. Performance Requirements:

a. Opening Force: Not more than 5-pound force (22.2 N) to fully open door.

b. Air Leakage: Entrance assemblies for smoke control and pressurized rooms shall be listed and labeled for smoke and draft control by qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and having maximum air leakage according to NFPA 105 of ____cfm/sf unless otherwise indicated.

c. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

3. Breakaway Hardware: Release hardware that allows indicated panels to swing out in direction of egress to full 90 degrees from closed door position.

4. Maximum Force to Open Panel: 50-pound force (222 N) Insert value.

5. Release Position: Sliding door fully open. At any point in sliding-door travel.

B. Sliding Entrances:

1. Configuration: As indicated on the drawings.

2. Performance:

Standard assembly Smoke-control and pressurized-entrance assemblies.

a. Alarm Interface: Equip entrance with electromagnet closer that closes door when alarm is triggered.

3. Breakaway Capability: Sliding panels and sidelites, from fully open position.
4. Mounting: Between jambs.
5. Floor Track: Trackless across sliding-door opening and at sidelites (trackless).
6. Stile Design: Medium stile; 3-1/2-inch (90-mm) nominal width.
7. Top Rail Design: 3-1/2-inch (90-mm) nominal height 5-inch (125-mm) nominal height.
8. Bottom Rail Design: 10-inch (255-mm) nominal.
9. Muntin Bars: None.
10. Glazing Stops and Gaskets: Beveled.
11. Glazing: Clear tempered.
    a. Glazing: As specified in Section 088000 "Glazing."
    b. Glazing: Fabricate framing with minimum glazing edge clearances for thickness and type of glazing indicated, according to GANA's "Glazing Manual."
    c. Factory Glazing: Install electrochromic glazing at the factory.
12. Finish framing and door(s) with Class II, clear anodic finish Class I, color anodic finish

2.2 MATERIALS

A. Aluminum:
1. Extrusions: ASTM B221M (ASTM B221).
    a. Framing: Minimum 3 mm (0.125 inch) wall thickness.
    b. Glazing Beads, Moldings, and Trim: Minimum 1.25 mm (0.050 inch) thick.
2. Alloy 6063 temper T5 for doors, door frames, fixed glass sidelites and transoms .

B. Stainless Steel: ASTM A240/A240M; Type 302 or Type 304.

2.3 PRODUCTS - GENERAL

A. Basis of Design: Section 09 06 00, SCHEDULE FOR FINISHES.
B. Provide aluminum framed entrances from one manufacturer and from one production run.
C. Provide aluminum entrances and windows, systems from same manufacturer.
D. Sustainable Construction Requirements:

1. Aluminum Recycled Content: 80 percent total recycled content, minimum.

2.4 FRAMES

A. Framing Members: Extruded aluminum.

B. Stops: Provide integral fixed stops and glass rebates and snap-on removable stops.

C. Provide concealed screws, bolts and other fasteners.

D. Secure cover boxes to frames in back of lock strike cutouts.

2.5 STILE AND RAIL DOORS

A. Stiles and Rails: Extruded aluminum.

1. Thickness: 45 mm (1-3/4 inch).
2. Stiles and Head Rails: 90 mm (3-1/2 inches) wide.
3. Bottom Rails: 250 mm (10 inches) wide.

B. Glass Rebates: Integral with stiles and rails.

C. Glazing Beads: Extruded aluminum, 1.3 mm (0.050 inch) thick. Integral with stiles and rails or applied type, snap-fit secured.

D. Stile and Rail Joints: Welded or interlocking dovetail joints between stiles and rails.

1. Clamp door together through top and bottom rails with 9 mm (3/8 inch) primed steel tie rod extending into stiles and having self-locking nut and washer at both ends.
2. Reinforce stiles and rails to prevent door distortion when tie rods are tightened.
3. Provide compensating spring-type washer under each nut for stress relief.
4. Construct joints to remain rigid and tight when door is operated.

E. Headers: Fabricated from minimum 0.125-inch- (3.2-mm-) thick, extruded aluminum, and extending full width of entrance units to conceal carrier assemblies and roller tracks. Provide hinged or removable access panels for service and adjustment. Secure panels to prevent unauthorized access.

1. Capacity: Capable of supporting doors up to [100 pounds (45 kg) per leaf over spans up to 14 feet (4.3 meter)] <Insert load and span> without intermediate supports.
2. Provide sag rods for spans exceeding 14 feet (4.3 m).

F. Carrier Assemblies and Overhead Roller Tracks: Assembly that allows vertical adjustment; consisting of nylon- or polyoxymethylene (POM)-covered, ball-bearing-center steel wheels operating on a continuous roller track or of ball-bearing-center steel wheels operating on a nylon- or POM-covered, continuous roller track. Support doors from carrier assembly by cantilever and pivot assembly. Provide minimum of two ball-bearing roller wheels and two antirise rollers for each active leaf.

G. Brackets and Reinforcements: High-strength aluminum with nonstaining, nonferrous shims for aligning system components.

H. Fasteners and Accessories: Corrosion-resistant, nonstaining, nonbleeding, flush fasteners and accessories compatible with adjacent materials.

2.6 COLUMN COVERS AND TRIM

A. Column Covers and Trim: Sheet aluminum fabrications shown from sheet aluminum of longest available lengths.

B. Provide concealed fasteners.

C. Provide aluminum stiffeners and supporting members shown on drawings and as required to maintain component integrity and shape.

2.7 DOOR OPERATORS

A. General: Where door operators are specified provide door operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; and for long-term, operation under normal traffic load for type of occupancy indicated and per the requirements of 08 71 13 AUTOMATIC DOOR OPERATORS.

B. Opening and closing actions of doors shall be actuated by controls and safety devices specified and conform to ANSI 156.10. Controls shall cause doors to open instantly when control device is actuated; hold doors in open positions; then, cause doors to close, unless safety device or reactivated control interrupts operation.

2.8 ACTIVATION AND SAFETY DEVICES

A. Touchless Activation Switch: Where scheduled, provide touchless activation switches for primary activation of automatic sliding entrances. Face plates shall be high impact polycarbonate or stainless steel, engraved with waving hand logo and “Wave To Open” text.

1. Switches shall be jamb style, 1 3/4 inch by 4 ½ inch (44 mm x 114 mm), frame mounted hardwired to door operator controls.
2. Units shall incorporate active infra-red to detect all motion in the detection zone. Detection zone shall be adjustable from 1 inch to 28 inch (25 mm to 711 mm).
3. Relay shall be rated at 3 A at 30 VAC/VDC.
4. Relay hold time adjustable from 0 to 60 sec.

B. Combined Activation and Safety Sensors: Combined activation and safety sensors shall, in a single housing, detect motion and presence in accordance with ANSI/BHMA A156.38. Motion shall be detected using K-band microwave technology, presence by active infrared reflection technology.

1. Mounting Height: Up to 11.5 feet (3.5 m) above finish floor
2. Temperature Range: Between -31°F and 131°F (-35°C to 55°C) in all environmental conditions
3. Relays: Form C, 50V at 0.3A for both activation and safety. Hold time of less than 0.5 seconds.
4. Detection Pattern: When detection is made in the activation zone, and the entrance opens, the safety zone shall extend through the threshold on each side; creating an X-pattern. When activation and safety zones are cleared and the entrance closes the sensor will ignore the X-pattern safety zones.
5. Sensor activation shall be secondary to all knowing act activation.

C. Presence Sensor Monitoring: Sliding automatic entrances control system shall include a means to verify the functionality of all active presence sensors in accordance with ANSI/BHMA A156.10. A detected fault shall cause automatic operation to cease until the fault is corrected.

2.9 HARDWARE

A. General: Provide units in sizes and types recommended by entrance and hardware manufacturers for entrances and uses indicated. See Section 08 71 13, AUTOMATIC DOOR OPERATORS. Where exposed fasteners are required use countersunk Phillips flat-head or Allen flat-head machine screws, finish to match adjacent material.

B. Breakaway Feature: Provide release hardware that allows sliding panel and sidelites to swing out in direction of egress to full 90 degrees, only from the fully open position.

1. Latching system shall allow both panels to swing out after disengaging semi-automatic flush bolt from a single release point.
2. When returning panels from breakaway position, panels shall self-latch.

C. Positive Latch: Manufacturer's standard non-keyed, spring loaded, latch and strike that can secure sliding door panels to adjacent panels or jambs. Strike shall mount flush to surface of framing. Latch shall engage by closing action of door.
1. Dead latch hook bolt shall be concealed to prevent snagging.
2. Handle shall be circumferential design without exposed edges or open ends.
3. Handle action shall be linear, unlatching in the direction of slide.

D. Locking Hardware:
1. Locking hardware at interior doors not requiring physical security is not required.
2. Doors with flush concealed vertical rod panic hardware integrated into doors where physical security is required, and free egress is required at all times.
3. Doors with manufacturers’ standard hook bolt lock (keyed both sides) where physical security is required and free egress is not required at all times.
a. At doors with access control devices specified in Division 28 - ELECTRONIC SAFETY AND SECURITY, provide doors with electronic deadbolt locking to prevent doors from manually sliding open.

E. Door Closers: Breakout or swing-out panels with door closers concealed in top rail of door.

F. Automatic Latching System: Provide automatic latching hardware on sliding automatic entrances as follows:
1. System shall include a fail-secure electric strike mounted in the jamb specifically designed for use with the specified positive latch.
2. The automatic sliding entrance(s) shall electrically latch in the closed position preventing door panels from sliding manually.
3. During a power interruption the positive latch can be disengaged allowing doors to slide manually.

G. Control Switch: Provide manufacturer's standard jamb mounted two-position rocker switch to allow for full control of the automatic entrance door.
   1. Automatic
   2. Manual
H. Power Switch: Sliding automatic entrances shall be equipped with a two position on/off rocker switch to control power to the door.
I. Smoke Seal Components: Provide manufactures standard smoke and draft control components as required to meet performance specifications. Components included but are not limited to:
   1. High temperature seals.
   2. Stiles shall be slotted for seal mounting.

2.10 FABRICATION

A. Form metal parts and fit and assemble joints, except joints designed to accommodate movement.
B. Welding:
   1. Make welds without distorting and discoloring exposed surfaces.
   2. Clean and dress welds. Remove welding flux and weld spatter.
C. Prepare and reinforce doors and frames for hardware and accessories.
   1. Coordinate preparation with specified hardware. See Section 08 71 00, DOOR HARDWARE.
   2. Fabricate reinforcement from stainless steel plates.
      a. Hinge and pivot reinforcing: Minimum 4.5 mm (0.179 inch) thick.
      b. Lock Face, Flush Bolts, Concealed Holders, Concealed and Surface Mounted Closers Reinforcing: Minimum 2.6 mm (0.104 inch) thick.
      c. Other Surface Mounted Hardware Reinforcing: Minimum 1.5 mm (0.059 inch) thick.
   3. Where concealed hardware is specified, provide space, cutouts, and reinforcement for installation and secure fastening.
D. Factory assemble doors.

2.11 FINISHES

A. Aluminum Anodized Finish: NAAMM AMP 500.
   1. Clear Anodized Finish: AA-C22A41; Class I Architectural, 0.018 mm (0.7 mil) thick.
   2. Color Anodized Finish: AA-C22A42 or AA-C22A44; Class I Architectural, 0.018 mm (0.7 mil) thick.

3. Clear Anodized Finish: AA-C22A31; Class II Architectural, 0.01 mm (0.4 mil) thick.

2.12 ACCESSORIES

A. Dielectric Tape: Plastic, non-absorptive, with pressure sensitive adhesive; 0.18 to 0.25 mm (7 to 10 mils) thick.

B. Barrier Coating: ASTM D1187/D1187M.

C. Welding Materials: AWS D1.2/D1.2M, type to suit application.

D. Fasteners:

1. Aluminum: ASTM F468, Alloy 2024.
2. Stainless Steel: ASTM F593, Alloy Groups 1, 2 and 3.
3. Install surface mounted hardware using concealed fasteners to greatest extent possible.

E. Anchors: Aluminum or stainless steel; type to suit application.

F. Galvanizing Repair Paint: MPI No. 18.

G. Touch-Up Paint: Match shop finish.

H. Magnetic Hold-Open Devices: Connect magnetic hold-open devices to the building fire alarm/sprinkler system as specified in Division 26 and Division 28 Sections.]

1. Holding force not to exceed 30 pounds for manual door release.

I. Switchable Privacy Glass: Connect switchable privacy glass to electrical power distribution system as specified in Division 26 Sections.

PART 3 - EXECUTION

3.1 PREPARATION

A. Examine and verify substrate suitability for product installation.

1. Coordinate floor closer installation recessed into concrete slabs.
2. Coordinate anchor installation built into masonry and concrete.
3. Mounting Surfaces: General Contractor shall verify all surfaces to be plumb, straight and secure; substrates to be of proper dimension and material.
4. Other trades: General Contract shall advise of any inadequate conditions or equipment.

B. Protect existing construction and completed work from damage.

C. Clean substrates. Remove contaminants capable of affecting subsequently installed product's performance.

D. Apply dielectric tape or barrier coating to aluminum surfaces in contact with dissimilar metals and cementitious materials to minimum 0.7 mm (30 mils) dry film thickness.

3.2 INSTALLATION - GENERAL

A. Project Conditions

1. Field Measurements: Verify actual dimensions of openings to receive entrances by field measurements before fabrication and indicate on shop drawings.

B. Coordination

1. Templates: Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing entrances to comply with indicated requirements.
2. Electrical System Roughing-in: Coordinate layout and installation of automatic entrance door assemblies with connections to power supplies.

C. Install products according to manufacturer's instructions and approved submittal drawings.

1. When manufacturer's instructions deviate from specifications, submit proposed resolution for Contracting Officer's Representative consideration.

D. Install aluminum framed entrances and storefronts plumb and true, in alignment and to lines shown on drawings.

E. Anchor frames to adjoining construction at heads, jambs and sills.

F. Provide concealed aluminum clips to connect adjoining frame sections.

G. Install door hardware and hang doors. See Section 08 71 00, DOOR HARDWARE.

H. Install door operators. See Section 08 71 13, AUTOMATIC DOOR OPERATORS.

I. Adjust doors and hardware uniform clearances and proper operation.

J. Air Leakage: Install entrance assemblies for smoke-control and pressurized rooms according to NFPA 105 and as indicated.

K. Touch up damaged factory finishes.

1. Repair galvanized surfaces with galvanized repair paint.
2. Repair painted surfaces with touch up primer.

L. Tolerances:

1. Variation from Plumb, Level, Warp, and Bow: Maximum 3 mm in 3 meters (1/8 inch in 10 feet).
2. Variation from Plane: Maximum3 mm in 3.65 meter (1/8 inch in 12 feet); 6 mm (1/4 inch) over total length.
3. Variation from Alignment: Maximum 1.5 mm (1/16 inch) in-line offset and maximum3 mm (1/8 inch) corner offset.
4. Variation from Square: Maximum 3 mm (1/8 inch) diagonal measurement differential.

3.3 PROTECTION, CLEANING AND REPAIRING

A. Clean exposed aluminum and glass surfaces. Remove contaminants and stains.

B. Protect aluminum-framed entrances and storefronts from construction operations.

C. Remove protective materials immediately before acceptance.

D. Repair damage.

3.4 ADJUSTING

A. Adjust alignment of entrances and hardware for smooth, safe operation with minimum air infiltration.

B. Verify installation and alignment of all entrance gasketing as required for minimum air infiltration and compliance with specified standards.

3.5 DEMONSTRATION

A. Engage a factory-authorized representative to train Owner's maintenance personnel to adjust, operate, and maintain safe operation of the door.

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03-01-24

SECTION 08 71 00

DOOR HARDWARE

1.1 DESCRIPTION

A. Door hardware and related items necessary for complete installation and operation of doors.

1.2 RELATED WORK

A. Caulking: Section 07 92 00 JOINT SEALANTS.

B. Application of Hardware: Section 08 14 00, WOOD DOORS Section 08 11 13, HOLLOW METAL DOORS AND FRAMES , Section 08 32 13, SLIDING GLASS DOORS, Section 08 71 13.11, AUTOMATIC DOOR OPERATORS.

C. Finishes: Section 09 06 00, SCHEDULE FOR FINISHES.

D. Painting: Section 09 91 00, PAINTING.

E. Card Readers: Section 28 13 00, PHYSICAL ACCESS CONTROL SYSTEMS.

F. Electrical: Division 26, ELECTRICAL.

G. Fire Detection: Section 28 31 00, FIRE DETECTION AND ALARM.

1.3 GENERAL

A. All hardware shall comply with ABAAS, (Architectural Barriers Act Accessibility Standard) unless specified otherwise.

B. Provide rated door hardware assemblies where required by most current version of the International Building Code (IBC).

C. Hardware for Labeled Fire Doors and Exit Doors: Conform to requirements
C. of NFPA 80 for labeled fire doors and to NFPA 101 for exit doors, as
C. well as to other requirements specified. Provide hardware listed by UL,
C. except where heavier materials, large size, or better grades are
C. specified herein under paragraph HARDWARE SETS. In lieu of UL labeling
C. and listing, test reports from a nationally recognized testing agency
C. may be submitted showing that hardware has been tested in accordance
C. with UL test methods and that it conforms to NFPA requirements.

D. Hardware for application on metal and wood doors and frames shall be made to standard templates. Furnish templates to the fabricator of these items in sufficient time so as not to delay the construction.

E. The following items shall be of the same manufacturer, except as otherwise specified:
   1. Mortise locksets.
   2. Hinges for hollow metal and wood doors.

3. Surface applied overhead door closers.
4. Exit devices.
5. Floor closers.

1.4 WARRANTY

A. Automatic door operators shall be subject to the terms of FAR Clause 52.246-21, except that the Warranty period shall be two years in lieu of one year for all items except as noted below:
1. Locks, latchsets, and panic hardware: 5 years.
2. Door closers and continuous hinges: 10 years.

1.5 MAINTENANCE MANUALS

A. In accordance with Section 01 00 00, GENERAL REQUIREMENTS Article titled "INSTRUCTIONS", furnish maintenance manuals and instructions on all door hardware. Provide installation instructions with the submittal documentation.

1.6 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. Submit 6 copies of the schedule per Section 01 33 23. Submit 2 final copies of the final approved schedules to VAMC Locksmith as record copies (VISN Locksmith if the VAMC does not have a locksmith).

B. Hardware Schedule: AHC certified hardware consultant to prepare and submit hardware schedule in the following form:

Hardware Item	Quantity	Size	Reference Publication Type No.	Finish	Mfr. Name and Catalog No.	Key Control Symbols	UL Mark (if fire rated and listed)	ANSI/BHMA Finish Designation

C. Samples and Manufacturers' Literature:
1. Samples: All hardware items (proposed for the project) that have not been previously approved by Builders Hardware Manufacturers

Association shall be submitted for approval. Tag and mark all items with manufacturer's name, catalog number and project number.

2. Samples are not required for hardware listed in the specifications by manufacturer's catalog number, if the contractor proposes to use the manufacturer's product specified.

D. Certificate of Compliance and Test Reports: Submit certificates that hardware conforms to the requirements specified herein. Certificates shall be accompanied by copies of reports as referenced. The testing shall have been conducted either in the manufacturer's plant and certified by an independent testing laboratory or conducted in an independent laboratory, within four years of submittal of reports for approval.

E. Record of opening force measurement for all doors equipped with closers

1.7 DELIVERY AND MARKING

A. Deliver items of hardware to job site in their original containers, complete with necessary appurtenances including screws, keys, and instructions. Tag one of each different item of hardware and deliver to COR for reference purposes. Tag shall identify items by Project Specification number and manufacturer's catalog number. These items shall remain on file in COR's office until all other similar items have been installed in project, at which time the COR will deliver items on file to Contractor for installation in predetermined locations on the project.

1.8 PREINSTALLATION MEETING

A. Convene a preinstallation meeting not less than 30 days before start of installation of door hardware. Require attendance of parties directly affecting work of this section, including Contractor and Installer, Architect, Project Engineer and VA Locksmith, Hardware Consultant, and Hardware Manufacturer’s Representative. Review the following:

1. Inspection of door hardware.
2. Job and surface readiness.
3. Coordination with other work.
4. Protection of hardware surfaces.
5. Substrate surface protection.
6. Installation.
7. Adjusting.

8. Repair.
9. Field quality control.
10. Cleaning.

1.9 INSTRUCTIONS

A. Hardware Set Symbols on Drawings: Except for protective plates, door stops, mutes, thresholds and the like specified herein, hardware requirements for each door are indicated on drawings by symbols. Symbols for hardware sets consist of letters (e.g., "HW") followed by a number. Each number designates a set of hardware items applicable to a door type.

B. Keying: All cylinders shall be keyed into existing _____ Great
B. Grand Master Key System . Provide removable core cylinders that are
B. removable only with a special key or tool without disassembly of knob or
B. lockset. Cylinders shall be 6 7 pin type. Keying information shall be
B. furnished at a later date by the COR.

1.10 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. In text, hardware items are referred to by series, types, etc., listed in such specifications and standards, except as otherwise specified.

B. ASTM International(ASTM):

F883-13.....Padlocks

E2180-18.....Standard Test Method for Determining the Activity of Incorporated Antimicrobial Agent(s) In Polymeric or Hydrophobic Materials

C. American National Standards Institute/Builders Hardware Manufacturers Association (ANSI/BHMA):

A156.1-06.....Butts and Hinges

A156.2-03.....Bored and Pre-assembled Locks and Latches

A156.3-08.....Exit Devices, Coordinators, and Auto Flush Bolts

A156.4-08.....Door Controls (Closers)

A156.5-14.....Cylinders and Input Devices for Locks.

A156.6-05.....Architectural Door Trim

A156.8-05.....Door Controls-Overhead Stops and Holders

A156.11-14.....Cabinet Locks

A156.12-05 .....Interconnected Locks and Latches
A156.13-05.....Mortise Locks and Latches Series 1000
A156.14-07 .....Sliding and Folding Door Hardware
A156.15-06.....Release Devices-Closer Holder, Electromagnetic and Electromechanical
A156.16-08.....Auxiliary Hardware
A156.17-04 .....Self-Closing Hinges and Pivots
A156.18-06.....Materials and Finishes
A156.20-06 .....Strap and Tee Hinges, and Hasps
A156.21-09.....Thresholds
A156.22-05.....Door Gasketing and Edge Seal Systems
A156.23-04.....Electromagnetic Locks
A156.24-03.....Delayed Egress Locking Systems
A156.25-07 .....Electrified Locking Devices
A156.26-06.....Continuous Hinges
A156.28-07 .....Master Keying Systems
A156.29-07 .....Exit Locks and Alarms
A156.30-03 .....High Security Cylinders
A156.31-07 .....Electric Strikes and Frame Mounted Actuators
A156.36-10.....Auxiliary Locks
A250.8-03.....Standard Steel Doors and Frames

D. National Fire Protection Association (NFPA):
80-10.....Fire Doors and Other Opening Protectives
101-09.....Life Safety Code

E. Underwriters Laboratories, Inc. (UL):
Building Materials Directory (2008)

F. Architectural Barriers Act Accessibility Standards (ABAAS)

PART 2 - PRODUCTS

2.1 BUTT HINGES

A. ANSI A156.1. Provide only three-knuckle hinges, except five-knuckle where the required hinge type is not available in a three-knuckle version (e.g., some types of swing-clear hinges). The following types of butt hinges shall be used for the types of doors listed, except where otherwise specified:

1. Interior Doors: Type A8112/A5112 for doors 900 mm (3 feet) wide or less and Type A8111/A5111 for doors over 900 mm (3 feet) wide.

Hinges for doors exposed to high humidity areas (shower rooms, toilet rooms, kitchens, janitor rooms, etc. shall be of stainless steel material.

B. Provide quantity and size of hinges per door leaf as follows:
   1. Doors up to 1210 mm (4 feet) high: 2 hinges.
   2. Doors 1210 mm (4 feet) to 2260 mm (7 feet 5 inches) high: 3 hinges minimum.
   3. Doors greater than 2260 mm (7 feet 5 inches) high: 4 hinges.
   4. Doors up to 900 mm (3 feet) wide, standard weight: 114 mm x 114 mm (4-1/2 inches x 4-1/2 inches) hinges.
   5. Doors over 900 mm (3 feet) to 1065 mm (3 feet 6 inches) wide, standard weight: 127 mm x 114 mm (5 inches x 4-1/2 inches).
   6. Doors over 1065 mm (3 feet 6 inches) to 1210 mm (4 feet), heavy weight: 127 mm x 114 mm (5 inches x 4-1/2 inches).
   7. Provide heavy-weight hinges where specified.
   8. At doors weighing 330 kg (150 pounds) or more, furnish 127 mm (5 inch) high hinges.

C. See Articles "MISCELLANEOUS HARDWARE" and "HARDWARE SETS" for pivots and hinges other than butts specified above and continuous hinges specified below.

2.2 CONTINUOUS HINGES

A. ANSI/BHMA A156.26, Grade 1-600.
   1. Listed under Category N in BHMA's "Certified Product Directory."

B. General: Minimum 0.120-inch- (3.0-mm-) thick, hinge leaves with minimum overall width of 4 inches (102 mm); fabricated to full height of door and frame and to template screw locations; with components finished after milling and drilling are complete

C. Continuous, Barrel-Type Hinges: Hinge with knuckles formed around a Teflon-coated 6.35mm (0.25-inch) minimum diameter pin that extends entire length of hinge.
   1. Base Metal for Exterior Hinges: Stainless steel.
   2. Base Metal for Interior Hinges: Stainless steel Steel.
   3. Base Metal for Hinges for Fire-Rated Assemblies: Stainless steel Steel.
   4. Provide with non-removable pin (hospital tip option) at lockable outswing doors.

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

2.3 DOOR CLOSING DEVICES

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

2.4 OVERHEAD CLOSERS

A. Conform to ANSI A156.4, Grade 1.

B. Closers shall conform to the following:

1. The closer shall have minimum 50 percent adjustable closing force over minimum value for that closer and have adjustable hydraulic back check effective between 60 degrees and 85 degrees of door opening.
2. Where specified, closer shall have hold-open feature.
3. Size Requirements: Provide multi-size closers, sizes 1 through 6, except where multi-size closer is not available for the required application.
4. Material of closer body shall be forged or cast.
5. Arm and brackets for closers shall be steel, malleable iron or high strength ductile cast iron.
6. Where closers are exposed to the exterior or are mounted in rooms that experience high humidity, provide closer body and arm assembly of stainless steel material.
7. Closers shall have full size metal cover; plastic covers will not be accepted.
8. Closers shall have adjustable hydraulic back-check, separate valves for closing and latching speed, adjustable back-check positioning valve, and adjustable delayed action valve.

9. Provide closers with any accessories required for the mounting application, including (but not limited to) drop plates, special soffit plates, spacers for heavy-duty parallel arm fifth screws, bull-nose or other regular arm brackets, longer or shorter arm assemblies, and special factory templating. Provide special arms, drop plates, and templating as needed to allow mounting at doors with overhead stops and/or holders.
10. Closer arms or backcheck valve shall not be used to stop the door from overswing, except in applications where a separate wall, floor, or overhead stop cannot be used.
11. Provide parallel arm closers with heavy duty rigid arm.
12. Where closers are to be installed on the push side of the door, provide parallel arm type except where conditions require use of top jamb arm.
13. Provide all surface closers with the same body attachment screw pattern for ease of replacement and maintenance.
14. All closers shall have a 1 ½" (38mm) minimum piston diameter.

2.5 DOOR STOPS

A. Conform to ANSI A156.16.

B. Provide door stops wherever an opened door or any item of hardware thereon would strike a wall, column, equipment or other parts of building construction. For concrete, masonry or quarry tile construction, use expansion shields for mounting door stops.

C. Where cylindrical locks with turn pieces or pushbuttons occur, equip wall bumpers Type L02251 (rubber pads having concave face) to receive turn piece or button.

D. Provide floor stops (Type L02141 or L02161) in office areas; Type L02121 x 3 screws into floor elsewhere. Wall bumpers, where used, must be installed to impact the trim or the door within the leading half of its width. Floor stops, where used, must be installed within 4-inches of the wall face and impact the door within the leading half of its width.

E. Where drywall partitions occur, use floor stops, Type L02141 or L02161 in office areas, Type L02121 elsewhere.

F. Provide stop Type L02011, as applicable for exterior doors. At outswing doors where stop can be installed in concrete, provide stop mated to

concrete anchor set in 76mm (3-inch) core-drilled hole and filled with quick-setting cement.

G. Omit stops where floor mounted door holders are required and where automatic operated doors occur.

H. Provide appropriate roller bumper for each set of doors (except where closet doors occur) where two doors would interfere with each other in swinging.

I. Provide appropriate door mounted stop on doors in individual toilets where floor or wall mounted stops cannot be used.

J. Provide overhead surface applied stop Type C02541, ANSI A156.8 on patient toilet doors in bedrooms where toilet door could come in contact with the bedroom door.

K. Provide door stops on doors where combination closer magnetic holders are specified, except where wall stops cannot be used or where floor stops cannot be installed within 4-inches of the wall.

L. Where the specified wall or floor stop cannot be used, provide concealed overhead stops (surface-mounted where concealed cannot be used).

2.6 OVERHEAD DOOR STOPS AND HOLDERS

A. Conform to ANSI Standard A156.8. Overhead holders shall be of sizes recommended by holder manufacturer for each width of door. Set overhead holders for 110 degree opening, unless limited by building construction or equipment. Provide Grade 1 overhead concealed slide type: stop-only at rated doors and security doors, hold-open type with exposed hold-open on/off control at all other doors requiring overhead door stops.

2.7 FLOOR DOOR HOLDERS

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

2.8 LOCKS AND LATCHES

A. Conform to ANSI A156.2. Locks and latches for doors 45 mm (1-3/4 inch) thick or over shall have beveled fronts. Lock cylinders shall have not less than six pins seven pins . Cylinders for all locksets shall be removable core type. Cylinders shall be furnished with construction removable cores and construction master keys. Cylinder shall be removable by special key or tool. Construct all cores so that they will be interchangeable into the core housings of all mortise locks, rim locks, cylindrical locks, and any other type lock included in the Great

Grand Master Key System. Disassembly of lever or lockset shall not be required to remove core from lockset. All locksets or latches on double doors with fire label shall have latch bolt with 19 mm (3/4 inch) throw, unless shorter throw allowed by the door manufacturer's fire label. Provide temporary keying device or construction core to allow opening and closing during construction and prior to the installation of final cores.

B. In addition to above requirements, locks and latches shall comply with
B. following requirements:

1. Mortise Lock and Latch Sets: Conform to ANSI/BHMA A156.13. Mortise locksets shall be series 1000, minimum Grade 2. All locksets and latchsets, except on designated doors in Psychiatric (Mental Health) areas, shall have lever handles fabricated from cast stainless steel. Provide sectional (lever x rose) lever design matching [_____]. No substitute lever material shall be accepted. All locks and latchsets shall be furnished with 122.55 mm (4-7/8-inch) curved lip strike and wrought box. At outswing pairs with overlapping astragals, provide flat lip strip with 21mm (7/8-inch) lip-to-center dimension. Lock function F02 shall be furnished with emergency tools/keys for emergency entrance. All lock cases installed on lead lined doors shall be lead lined before applying final hardware finish. Furnish armored fronts for all mortise locks. Where mortise locks are installed in high-humidity locations or where exposed to the exterior on both sides of the opening, provide non-ferrous mortise lock case.
2. Cylindrical Lock and Latch Sets: levers shall meet ADA (Americans with Disabilities Act) requirements. Cylindrical locksets shall be series 4000 Grade I. All locks and latchsets shall be furnished with 122.55 mm (4-7/8-inch) curved lip strike and wrought box. At outswing pairs with overlapping astragals, provide flat lip strip with 21mm (7/8-inch) lip-to-center dimension. Provide lever design to match design selected by Architect or to match existing lever design. Where two turn pieces are specified for lock F76, turn piece on inside knob shall lock and unlock inside knob, and turn piece on outside knob shall unlock outside knob when inside knob is in the locked position. (This function is intended to allow emergency entry into these rooms without an emergency key or any special tool.)

3. Auxiliary locks shall be as specified under hardware sets and conform to ANSI A156.36.

2.9 TOUCHLESS DOOR SWITCHES (TDS)

A. Infrared sensor no-touch switches (12/24V AC/DC Models) with fully wireless (CC-330)

2.10 PROXIMITY CARD READERS (PCR)

A. Touchless door switches with an access control proximity reader in HID,AWID, HID/AWID or EM formats.

2.11 ELECTRIC STRIKES

A. ANSI/ BHMA A156.31 Grade 1.

B. General: Use fail-secure electric strikes at fire-rated doors

2.12 KEYS

A. Stamp all keys with change number and key set symbol. Furnish keys in quantities as follows:

Locks/Keys	**Quantity**
Cylinder locks	2 keys each
Cylinder lock change key blanks	100 each different key way
Master-keyed sets	6 keys each
Grand Master sets	6 keys each
Great Grand Master set	5 keys
Control key	2 keys

2.13 ARMOR PLATES, KICK PLATES, MOP PLATES AND DOOR EDGING

A. Conform to ANSI Standard A156.6.

B. Provide protective plates and door edging as specified below:

1. Kick plates, mop plates and armor plates of metal, Type J100 series.
2. Provide kick plates and mop plates where specified. Kick plates shall be 254 mm (10 inches) or 305 mm (12 inches) high. Mop plates shall be 152 mm (6 inches) high. Both kick and mop plates shall be minimum 1.27 mm (0.050 inches) thick. Provide kick and mop plates beveled on all 4 edges (B4E). On push side of doors where jamb stop extends to floor, make kick plates 38 mm (1-1/2 inches) less than width of door, except pairs of metal doors which shall have plates 25 mm (1 inch) less than width of each door. Extend all other kick and mop plates to within 6 mm (1/4 inch) of each edge of doors. Kick and mop plates

shall butt astragals. For jamb stop requirements, see specification sections pertaining to door frames.

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

2.14 EXIT DEVICES

A. Conform to ANSI Standard A156.3. Exit devices shall be Grade 1; type and function are specified in hardware sets. Provide flush with finished floor strikes for vertical rod exit devices in interior of building. Trim shall have cast satin stainless steel lever handles of design

similar to locksets, unless otherwise specified. Provide key cylinders for keyed operating trim and, where specified, cylinder dogging.

B. Surface vertical rod panics shall only be provided less bottom rod; provide fire pins as required by exit device and door fire labels. Do not provide surface vertical rod panics at exterior doors.

C. Concealed vertical rod panics shall be provided less bottom rod at interior doors, unless lockable or otherwise specified; provide fire pins as required by exit device and door fire labels. Where concealed vertical rod panics are specified at exterior doors, provide with both top and bottom rods.

D. Where removable mullions are specified at pairs with rim panic devices, provide mullion with key-removable feature.

E. At non-rated openings with panic hardware, provide panic hardware with key cylinder dogging feature.

F. Exit devices for fire doors shall comply with Underwriters Laboratories, Inc., requirements for Fire Exit Hardware. Submit proof of compliance.

2.15 FLUSH BOLTS (LEVER EXTENSION)

A. Conform to ANSI A156.16. Flush bolts shall be Type L24081 unless otherwise specified. Furnish proper dustproof strikes conforming to ANSI A156.16, for flush bolts required on lower part of doors.

B. Lever extension manual flush bolts shall only be used at non-fire-rated pairs for rooms only accessed by maintenance personnel.

C. Face plates for cylindrical strikes shall be rectangular and not less than 25 mm by 63 mm (1 inch by 2-1/2 inches).

D. Friction-fit cylindrical dustproof strikes with circular face plate may be used only where metal thresholds occur.

E. Provide extension rods for top bolt where door height exceeds 2184 mm (7 feet 2 inches).

2.16 FLUSH BOLTS (AUTOMATIC)

A. Conform to ANSI A156.3. Dimension of flush bolts shall conform to ANSI A115. Bolts shall conform to Underwriters Laboratories, Inc., requirements for fire door hardware. Flush bolts shall automatically latch and unlatch. Furnish dustproof strikes conforming to ANSI A156.16 for bottom flushbolt. Face plates for dustproof strike shall be rectangular and not less than 38 mm by 90 mm (1-1/2 by 3-1/2 inches).

B. At interior doors, provide auto flush bolts less bottom bolt, unless otherwise specified, except at wood pairs with fire-rating greater than 20 minutes; provide fire pins as required by auto flush bolt and door fire labels.

2.17 DOOR PULLS WITH PLATES

A. Conform to ANSI A156.6. Pull Type J401, 152 mm CTC (6 inches CTC) length by 19 mm (3/4 inches) diameter minimum with plate Type J302, 90 mm by 381 mm (3-1/2 inches by 15 inches), unless otherwise specified. Provide pull with projection of 57.2 mm (2 1/4 inches) minimum and a clearance of 38.1 mm (1 1/2 inches) minimum. Cut plates of door pull plate for cylinders, or turn pieces where required. PUSH PLATES

B. Conform to ANSI A156.6. Metal, Type J302, 203 mm (8 inches) wide by 406.4 mm (16 inches) high. Provide metal Type J302 plates 102 mm (4 inches) wide by 406.4 mm (16 inches) high where push plates are specified for doors with stiles less than 203 mm (8 inches) wide. Cut plates for cylinders, and turn pieces where required.

2.18 COMBINATION PUSH AND PULL PLATES

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

2.19 COORDINATORS

A. Conform to ANSI A156.16. Coordinators, when specified for fire doors, shall comply with Underwriters Laboratories, Inc., requirements for fire door hardware. Coordinator may be omitted on exterior pairs of doors where either door will close independently regardless of the position of the other door. Coordinator may be omitted on interior pairs of non-labeled open where open back strike is used. Open back strike shall not be used on labeled doors. Paint coordinators to match door frames, unless coordinators are plated. Provide bar type coordinators, except where gravity coordinators are required at acoustic pairs. For bar type coordinators, provide filler bars for full width and, as required, brackets for push-side surface mounted closers, overhead stops, and vertical rod panic strikes.

2.20 THRESHOLDS

A. Conform to ANSI A156.21, mill finish extruded aluminum, except as otherwise specified. In existing construction, thresholds shall be installed in a bed of sealant with ¼-20 stainless steel machine screws and expansion shields. In new construction, embed aluminum anchors coated with epoxy in concrete to secure thresholds. Furnish thresholds for the full width of the openings.

B. For thresholds at elevators entrances see other sections of specifications.

C. At exterior doors and any interior doors exposed to moisture, provide threshold with non-slip abrasive finish.

D. Provide with miter returns where threshold extends more than 12 mm (0.5 inch) beyond face of frame.

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

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

2.22 WEATHERSTRIPS (FOR INTERIOR DOORS TO CONTROL AIR LEAKAGE)

A. Conform to ANSI A156.22. Air leakage shall not to exceed 0.50 CFM per foot of crack length (0.000774m^3/s/m).

2.23 FINISHES

A. Exposed surfaces of hardware shall have ANSI A156.18, finishes as specified below. Finishes on all hinges, pivots, closers, thresholds, etc., shall be as specified below under "Miscellaneous Finishes." For field painting (final coat) of ferrous hardware, see Section 09 91 00, PAINTING.

B. 626 or 630: All surfaces on exterior and interior of buildings, except where other finishes are specified.

C. Miscellaneous Finishes:

1. Hinges --interior doors: 652 or 630.
2. Pivots: Match door trim.
3. Door Closers: Factory applied paint finish. Dull or Satin Aluminum color.
4. Thresholds: Mill finish aluminum.
5. Other primed steel hardware: 600.

D. Hardware Finishes for Existing Buildings: U.S. Standard finishes shall match finishes of hardware in (similar) existing spaces except where otherwise specified.

E. Special Finish: Exposed surfaces of hardware for dark bronze anodized

E. aluminum doors shall have oxidized oil rubbed bronze finish (dark

E. bronze) finish on door closers shall closely match doors.

F. Anti-microbial Coating: All hand-operated hardware (levers, pulls, push bars, push plates, paddles, and panic bars) shall be provided with an anti-microbial/anti-fungal coating that has passed ASTM E2180 tests. Coating to consist of ionic silver (Ag+). Silver ions surround bacterial cells, inhibiting growth of bacteria, mold, and mildew by blockading food and respiration supplies.

2.24 BASE METALS

A. Apply specified U.S. Standard finishes on different base metals as following:

Finish	**Base Metal**
652	Steel
626	Brass or bronze
630	Stainless steel

PART 3 - EXECUTION

3.1 HARDWARE HEIGHTS

A. For existing buildings locate hardware on doors at heights to match existing hardware. The Contractor shall visit the site, verify location of existing hardware and submit locations to VA COR for approval.

B. For new buildings locate hardware on doors at heights specified below, with all hand-operated hardware centered within 864 mm (34 inches) to 1200 mm (48 inches), unless otherwise noted:

C. Hardware Heights from Finished Floor:

1. Exit devices centerline of strike (where applicable) 1024 mm (40-5/16 inches).
2. Locksets and latch sets centerline of strike 1024 mm (40-5/16 inches).
3. Deadlocks centerline of strike 1219 mm (48 inches).

4. Hospital arm pull 1168 mm (46 inches) to centerline of bottom supporting bracket.
5. Centerline of door pulls to be 1016 mm (40 inches).
6. Push plates and push-pull shall be 1270 mm (50 inches) to top of plate.
7. Push-pull latch to be 1024 mm (40-5/16 inches) to centerline of strike.
8. Locate other hardware at standard commercial heights. Locate push and pull plates to prevent conflict with other hardware.

3.2 INSTALLATION

A. Closer devices, including those with hold-open features, shall be equipped and mounted to provide maximum door opening permitted by building construction or equipment. Closers shall be mounted on side of door inside rooms, inside stairs, and away from corridors except security bedroom, bathroom and anteroom doors which shall have closer installed parallel arm on exterior side of doors. . At exterior doors, closers shall be mounted on interior side. Where closers are mounted on doors they shall be mounted with hex nuts and bolts; foot shall be fastened to frame with machine screws. Door opening force shall not exceed 22.2 N (5 pounds) maximum in accordance with ABAAS.Measure and adjust opening force for all doors equipped with closers.

B. Hinge Size Requirements:

Door Thickness	**Door Width**	**Hinge Height**
45 mm (1-3/4 inch)	900 mm (3 feet) and less	113 mm (4-1/2 inches)
45 mm (1-3/4 inch)	Over 900 mm (3 feet) but not more than 1200 mm (4 feet)	125 mm (5 inches)
35 mm (1-3/8 inch) (hollow core wood doors)	Not over 1200 mm (4 feet)	113 mm (4-1/2 inches)

C. Hinge leaves shall be sufficiently wide to allow doors to swing clear of
C. door frame trim and surrounding conditions.

D. Where new hinges are specified for new doors in existing frames or existing doors in new frames, sizes of new hinges shall match sizes of

existing hinges; or, contractor may reuse existing hinges provided hinges are restored to satisfactory operating condition as approved by COR. Existing hinges shall not be reused on door openings having new doors and new frames. Coordinate preparation for hinge cut-outs and screw-hole locations on doors and frames.

E. Hinges Required Per Door:

Door Description	**Number butts**
Doors 1500 mm (5 ft) or less in height	2 butts
Doors over 1500 mm (5 ft) high and not over 2280 mm (7 ft 6 in) high	3 butts
Doors over 2280 mm (7 feet 6 inches) high	4 butts
Dutch type doors	4 butts
Doors with spring hinges 1370 mm (4 feet 6 inches) high or less	2 butts
Doors with spring hinges over 1370 mm (4 feet 6 inches)	3 butts

F. Fastenings: Suitable size and type and shall harmonize with hardware as to material and finish. Provide machine screws and lead expansion shields to secure hardware to concrete, ceramic or quarry floor tile, or solid masonry. Fiber or rawl plugs and adhesives are not permitted. All fastenings exposed to weather shall be of nonferrous metal.

G. After locks have been installed; show in presence of COR that keys operate their respective locks in accordance with keying requirements. (All keys, Master Key level and above shall be sent Registered Mail to the Medical Center Director along with the bitting list. Also a copy of the invoice shall be sent to the COR for his records.) Installation of locks which do not meet specified keying requirements shall be considered sufficient justification for rejection and replacement of all locks installed on project.

3.3 FINAL INSPECTION

A. Installer to provide letter to VA Resident/Project Engineer that upon completion, installer has visited the Project and has accomplished the following:

1. Re-adjust hardware.
2. Evaluate maintenance procedures and recommend changes or additions, and instruct VA personnel.

3. Identify items that have deteriorated or failed.
4. Submit written report identifying problems.

3.4 DEMONSTRATION

A. Demonstrate efficacy of mechanical hardware and electrical, and electronic hardware systems, including adjustment and maintenance procedures, to satisfaction of Resident/Project Engineer and VA Locksmith.

3.5 HARDWARE SETS

A. Following sets of hardware correspond to hardware symbols shown on drawings. Only those hardware sets that are shown on drawings will be required. Disregard hardware sets listed in specifications but not shown on drawings.

B. Hardware Consultant working on a project will be responsible for providing additional information regarding these hardware sets. The numbers shown in the following sets come from BHMA standards.

ELECTRIC HARDWARE ABBREVIATIONS LEGEND:
ADO = Automatic Door Operator
EMCH = Electro-Mechanical Closer-Holder
MHO = Magnetic Hold-Open (wall- or floor-mounted)

C. Interior Single Doors

HW-1A

Each Door to Have:	RATED
Hinges	QUANTITY & TYPE AS REQUIRED X HOSPITAL TIPS @ INSWING DOORS
1 Latchset	F01
1 Closer	C02011/C02021 x INSTALL OUTSIDE ROOM
1 Kick Plate	J102
1 Mop Plate (@ Inswing Doors)	J103
1 Floor Stop	L02121 x 3 FASTENERS
1 Threshold	J32300 x 57 MM WIDTH (2-1/4 INCHES)
1 Auto Door Bottom	R0Y346 - HEAVY DUTY
1 Set Seals	R0Y164

BY DIVISION 26.

HW-1Q

Each Door to Have:	ONE HOUR RATED
1 Continuous Hinge	-
1 Latchset	F04
1 Kick Plate	J102
1 Closer (@ rated doors)	C02021-RATED
1 Wall Stop	L02101 CONVEX
1 Threshold	J32300 x 57 MM WIDTH (2-1/4 INCHES)
1 Auto Door Bottom	R0Y346 - HEAVY DUTY
2 Sets Self-Adhesive Seals	R0Y154

HW-4A

Each [ADO] Door to Have:	ONE HOUR RATED
1 Continuous Transfer Hinge	x INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS x 4-THRUWIRE TRANSFER X IN-HINGE ACCESS PANEL
1 Classroom Lock	F05
1 Electric Strike	E09311 (FAIL-SECURE), 24VDC
1 Power Supply	REGULATED, FILTERED, 24VDC, AMPERAGE AS REQUIRED
1 Kick Plate	J102
1 Mop Plate (@ Inswing Doors)	J103 @ TOILET ROOMS ONLY
1 Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE
1 Floor Stop	L02121 x 3 FASTENERS
1 Set Self-Adhesive Seals	R0Y154
2 PCR (Both sides of door)_	

AUTOMATIC DOOR OPERATOR AND CONTROLS BY SECTION 08 71 13, AUTOMATIC DOOR OPERATORS.

POWER TRANSFER FOR RE-ACTIVATION SENSOR WIRING (RE-ACTIVATION SENSORS PROVIDED BY SECTION 08 71 13).

HW-4R

Each [ADO] Door to Have:	RATED
1 Continuous Hinge	x INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS x 4-THRUWIRE TRANSFER X IN-HINGE ACCESS PANEL
1 Classroom Lock	F05
1 Electric Strike	E09311 (FAIL-SECURE), 24VDC
1 Power Supply	REGULATED, FILTERED, 24VDC, AMPERAGE AS REQUIRED
1 Kick Plate	J102
1 Mop Plate (@ Inswing Doors)	J103 @ TOILET ROOMS ONLY
1 Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE
1 Floor Stop	L02121 x 3 FASTENERS
1 Threshold	J32300 x 57 MM WIDTH (2-1/4 INCHES)
1 Auto Door Bottom	R0Y346 - HEAVY DUTY
2 Set Self-Adhesive Seals	R0Y154
1 PCR (Both Sides of Door)	Hand Wave

POWER TRANSFER FOR RE-ACTIVATION SENSOR WIRING (RE-ACTIVATION SENSORS PROVIDED BY SECTION 08 71 13).

HW-5L

Each Door to Have:	NON-RATED
1 Continuous Hinge	x INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS-STAINLESS STEEL
1 Security Storeroom Lock	F13-MOD x RIGID OUTSIDE LEVER x KEY RETRACTS DEADBOLT AND LATCHBOLT-STAINLESS STEEL
1 Weatherstrip/Waterstop	Door Perimeter and bottom
1 Floor Stop	L02121 x 3 FASTENERS
1 Set Self-Adhesive Seals	R0Y154

HW-6F

Each [ADO] Door to Have:	ONE HOUR RATED
1 Continuous Hinge	x INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS x 8-THRUWIRE TRANSFER X IN-HINGE ACCESS PANELS
1 Elec. Exit Device	TYPE 1 F08 LEVER (E04)
1 Key Cylinder	TYPE AS REQUIRED
1 Power Supply	BY EXIT DEVICE MFR. FOR E04 FUNCTION
1 Armor Plate	J101 x 1.275 MM (0.050 INCH) THICKNESS
1 Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE
1 Floor Stop	L02121 x 3 FASTENERS
1 Set Self-Adhesive Seals	R0Y154

1 PCR Hand wave (Both sides of door)

POWER TRANSFER SHARED BY ELECTRIC PANIC AND RE-ACTIVATION SENSOR WIRING (RE-ACTIVATION SENSORS PROVIDED BY SECTION 08 71 13).

AUTO DOOR OPERATORS AND CONTROLS BY SECTION 08 71 13.

HW-6G

Each Door to Have:	NON-RATED
1 Set Frame Seals	R0Y164

Install at existing door.

D. Interior Pairs of Doors

HW-10K

Each [ADO] Pair to Have:	ONE HOUR RATED1 Continuous Transfer
Hinge	x INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS x 8-THRUWIRE TRANSFER X IN-HINGE ACCESS PANEL
1 Continuous Transfer Hinge	x INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS x 4-THRUWIRE TRANSFER X IN-HINGE ACCESS PANEL
1 Set Auto Flush Bolts	TYPE 25 LESS BOTTOM BOLT
1 Classroom Lock	F05
1 Electric Unlatch Strike	E09321 (FAIL-SECURE)
1 Power Supply	REGULATED, FILTERED, 24VDC, AMPERAGE AS REQUIRED
1 Coordinator	TYPE 21A
1 Overlapping Astragal with Self-Adhesive Seal	R0Y634 x R0Y154 x THRU-BOLTS
2 Armor Plates	J101 x 1.275 MM (0.050 INCH) THICKNESS
2 Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE
2 Floor Stops	L02121 x 3 FASTENERS
1 Set Self-Adhesive Seals	R0Y154
1 PIV (Both Sides of Doors)	

AUTOMATIC DOOR OPERATORS AND CONTROLS BY SECTION 08 71 13, AUTOMATIC DOOR OPERATORS.

POWER TRANSFER SHARED BY ELECTRIC STRIKE AND RE-ACTIVATION SENSOR WIRING (RE-ACTIVATION SENSORS PROVIDED BY SECTION 08 71 13).

*AT WOOD PAIRS RATED 45-MINUTES OR MORE, PROVIDE ELECTRIC STRIKE 310-2-3/4 (FOLGER ADAM OR EQUAL) IN LIEU OF SPECIFIC UNLATCH STRIKE.

HW-10L

Each [ADO] Pair to Have:	NON-RATED Continuous Transfer Hinge x INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS x 8-THRUWIRE TRANSFER X IN-HINGE ACCESS PANEL
1 Continuous Transfer Hinge	x INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS x 4-THRUWIRE TRANSFER X IN-HINGE ACCESS PANEL
1 Set Auto Flush Bolts	TYPE 25 LESS BOTTOM BOLT
1 Classroom Lock	F05
1 Electric Unlatch Strike	E09321 (FAIL-SECURE)
1 Power Supply	REGULATED, FILTERED, 24VDC, AMPERAGE AS REQUIRED
1 Coordinator	TYPE 21A
1 Overlapping Astragal with Self-Adhesive Seal	R0Y634 x R0Y154 x THRU-BOLTS
2 Armor Plates	J101 x 1.275 MM (0.050 INCH) THICKNESS
2 Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE
1 Set Frame Seals	R0Y164
1 PIV	

POWER TRANSFER SHARED BY ELECTRIC STRIKE AND RE-ACTIVATION SENSOR WIRING (RE-ACTIVATION SENSORS PROVIDED BY SECTION 08 71 13).

SECURITY HARDWARE ABBREVIATIONS LEGEND:

AC = Access Control Device (Card reader, biometric reader, keypad, etc.)
ADO = Automatic Door Operator
DEML = Delayed Egress Magnetic Lock
DEPH = Delayed Egress Panic Exit Device
DPS = Door Position Switch (Door or Alarm Contact)
EL = Electric Lock or Electric Lever Exit Device
PB = Push-button Combination Lock (stand-alone)
RR = Remote Release Button
ELR = Electric Latch Retraction Exit Device
REX = Request-to-Exit Switch in Latching Device Inside Trim

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01-01-21

SECTION 08 71 13

AUTOMATIC DOOR OPERATORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Automatic operators for swinging doors .

1.2 RELATED WORK

A. Section 08 32 13, SLIDING GLASS DOORS: Aluminum Sliding Door Frames Work.

B. Section 08 71 00, DOOR HARDWARE: Door Hardware.

C. Division 26, ELECTRICAL Electric General Wiring, Connections and Equipment Requirements.

D. Division 28, ELECTRONIC SAFETY AND SECURITY: Access Control Devices.

1.3 APPLICABLE PUBLICATIONS

A. Comply with references to extent specified in this section.

B. ASTM International (ASTM):

1. B209-14 - Aluminum and Aluminum-Alloy Sheet and Plate.
2. A1008/A1008M-20 - Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Baked Hardenable.

C. Builders Hardware Manufacturers Association (BHMA):

1. BHMA A156.10-11 - Power Operated Pedestrian Doors.

D. National Fire Protection Association (NFPA):

1. 101-15 - Life Safety Code.

E. Underwriters Laboratories (UL):

1. 325-13 - Standard for Doors, Drapery, Gate, Louver, and Window Operators and Systems.

1.4 SUBMITTALS

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

B. Submittal Drawings:

1. Show size, configuration, and fabrication and installation details.

C. Manufacturer's Literature and Data:

1. Description of each product.
2. Installation instructions.

3. Warranty.

D. Sustainable Construction Submittals:

1. Recycled Content: Identify post-consumer and pre-consumer recycled content percentage by weight.

E. Test reports: Certify each product complies with specifications.

F. Qualifications: Substantiate qualifications comply with specifications.

1. Manufacturer with project experience list .
2. Installer with project experience list .

G. Operation and Maintenance Data:

1. Care instructions for each exposed finish product.
2. Start-up, maintenance, troubleshooting, emergency, and shut-down instructions for each operational product.

1.5 QUALITY ASSURANCE

A. Manufacturer’s Qualifications:

1. Regularly manufactures specified products.
2. Manufactured specified products with satisfactory service on five similar installations for minimum five years.
   a. Provide contact names and addresses for completed projects when requested by Contracting Officer's Representative.

B. Installer’s Qualifications: Experienced installer, approved by the manufacturer.

1.6 WARRANTY

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

B. Manufacturer's Warranty: Warrant automatic door operators against material and manufacturing defects.

1. Warranty Period: Two years.

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

A. Comply with requirements of BHMA A156.10. Unless otherwise indicated on Drawings, provide operators that move doors from fully closed to fully opened position in three to five seconds maximum time interval, when speed adjustment is at maximum setting.

B. Equipment: Conforming to UL 325. Provide key operated power disconnect wall switch for each door installation.

C. Electrical Wiring, Connections and Equipment: Motors, starters, controls, associated devices, and interconnecting wiring required for installation. Equipment and wiring as specified in Division 26, ELECTRICAL.

2.2 PRODUCTS - GENERAL

A. Basis of Design: Section 09 06 00, SCHEDULE FOR FINISHES.

B. Provide door operators from one manufacturer.

C. Provide one type of operator throughout project.

D. Sustainable Construction Requirements:

1. Steel Recycled Content: 30 percent total recycled content, minimum.
2. Aluminum Recycled Content: 80 percent total recycled content, minimum.

2.3 SWING DOOR OPERATORS

A. General:

1. Type: Institutional type.
2. Size: As recommended by manufacturer for door weight and sizes.

B. Function:

1. Provide operators, enclosed in housing, permitting opening of door by energizing motor and stopped by electrically reducing Voltage and stalling motor against mechanical stop.
2. Door to close by means of spring energy, and closing force controlled by gear system and motor being used as dynamic brake without power,or controlled by hydraulic closer in electro-hydraulic operators.
3. Opening and Closing Speeds: Field adjustable.
4. Operators with checking mechanism providing cushioning action at last part of door travel, in both opening and closing cycle.
5. Operators capable of recycling doors instantaneously to full open position from any point in closing cycle when control switch is activated.
6. When automatic power is interrupted or shut-off, permit doors to easily open manually without damage to automatic operator system.

C. Connect hardware with drive arm attached to door with pin linkage rotating in a self-lubricating bearing. Prevent doors from pivoting on shaft of operator.

D. Operator Housing:

1. ASTM B209, Type 6063-T5 aluminum alloy, 112 mm (4-1/2 inches) wide by 140 mm (5.5 inches) high by 3.2 mm (0.125 inch) thick, aluminum extrusions with enclosed end caps for application to 100 mm (4 inches) and larger frame systems.

E. Power Operator:

1. Completely assembled and sealed unit including gear drive transmission, mechanical spring and bearings, located in aluminum case and filled with special lubricant for extreme temperature conditions. Rubber mounted units with provisions for easy maintenance and replacement, without removing door from pivots or frame.

F. Motors:

1. Provide with interlock to prevent operation when doors are electrically locked from opening.

G. Electrical Control:

1. Self-contained electrical control unit, including necessary transformers, relays, rectifiers, and other electronic components for proper operation and switching of power operator.
2. Connecting Harnesses: Interlocking plugs.

H. Accessories:

1. Metal mounting supports, brackets and other accessories necessary for installation of operators at head of door frames.

I. Microprocessor Controls:

1. Multi-function microprocessor control providing adjustable hold open time (1-30 seconds) with fully adjustable opening speed, LED indications for sensor input signals and operator status and power assist close options. Control capable of receiving activation signals from any device with normally open dry contact output.
2. Hold doors held open by low Voltage applied to the continuous duty motor.
3. Controls:
   a. Adjustable safety circuit that monitors door operation and stops opening direction of door if obstruction is sensed.
   b. Recycle feature that reopens door if obstruction is sensed at any point during closing cycle.

c. Standard three position key switch with functions for ON, OFF, and HOLD OPEN, mounted on operator enclosure, door frame, or wall, as indicated on drawings.

2.4 POWER UNITS

A. Self-contained, electric operated and independent of door operator.

1. Capacity and size of power circuits according to automatic door operator manufacturer's specifications and Division 26 - ELECTRICAL.

2.5 DOOR CONTROLS

A. Control Devices: BHMA A156.10; control opening and closing functions.

B. Open doors when control device is actuated; hold doors in open positions; then, close doors after a set adjustable time period , unless safety device or reactivated control interrupts operation.

C. Manual Controls:

1. Push Plate Wall Switch: Recessed type, stainless steel push plate minimum 100 mm by 100 mm (4 inch by 4 inch), with 13 mm (1/2 inch) high letters "To Operate Door-Push" engraved on face of plate.

D. Motion Detector:

1. Mounting: Surface or concealed.
2. Detection Area: 1500 mm (60 inches) deep and 1500 mm (60 inches) across, plus or minus 150 mm (6 inches).
3. Response Time: 25 milliseconds, maximum.
4. Control Power: 24 Volt DC.
5. Design units to be unaffected by cleaning material, solvents, dust, dirt and outdoor weather conditions.

2.6 SAFETY DEVICES

A. Sliding Doors:

1. Two photoelectric beams mounted at heights of 600 mm (24 inches) and 1200 mm (48 inches) in door frame.
2. Overhead safety presence sensors at door head on both sides of opening.
3. Recycle doors to full open position when beams are interrupted.
4. Motion detector mounted on both sides of door for detection of traffic in both directions.

B. Swing Doors: Install presence sensor on pull side of door to detect any person standing in door swing path and prevent door from opening.

1. Time delay Switches: Adjustable between 3 to 60 seconds and control closing cycle of doors.

C. Install decal signs with "In" or "Do Not Enter" on both faces of each door where shown.

PART 3 - EXECUTION

3.1 PREPARATION

A. Examine and verify substrate suitability for product installation.
   1. Verify door opening is correctly sized and within acceptable tolerances.

B. Protect existing construction and completed work from damage.

3.2 INSTALLATION

A. Install products according to manufacturer's instructions and approved submittal drawings.
   1. When manufacturer's instructions deviate from specifications, submit proposed resolution for Contracting Officer's Representative consideration.

B. Coordinate door installation with other related work.

C. Install manual controls and power disconnect switches recessed or semi-flush mounted in partitions.

D. Secure operator components to adjacent construction with suitable fastenings.

E. Conceal conduits, piping, and electric equipment, in finish work.

F. Install power units in locations shown.
   1. Where units are mounted on walls, provide metal supports or shelves for units.
   2. Ensure equipment, including time delay switches, are accessible for maintenance and adjustment.

G. Ensure operators are adjusted and function properly for type of expected traffic.

H. Synchronize each leaf of pair doors to open and close simultaneously. Permit each door leaf to be opened manually, independent of other door leaf.

I. Install controls at positions shown and ensuring convenience for expected traffic.

J. Wave/Push Plate Wall Switches Mounting Height: 1000 mm (40 inches) maximum, unless otherwise approved by Contracting Officer's Representative.

3.3 DEMONSTRATION AND TRAINING

A. Instruct VA personnel in proper automatic door operator operation and maintenance.

1. Trainer: Manufacturer approved instructor.
2. Training Time: 2 hours minimum.

B. Coordinate instruction to VA personnel with VA Contracting Officer's Representative.

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01-01-21

SECTION 08 80 00
GLAZING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the following:
   1. Glass.
   2. Glazing materials and accessories for both factory and field glazed assemblies.

1.2 RELATED WORK

A. Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS: Sustainable Design Requirements.

B. Section 08 11 13, HOLLOW METAL DOORS AND FRAMES, and Section 08 14 00, WOOD DOORS: Sound resistant doors.

C. Section 08 14 00 INTERIOR WOOD DOORS

D. Section 09 06 00, SCHEDULE FOR FINISHES: Color of spandrel glass, tinted (heat absorbing or light reducing) glass, and reflective (metallic coated) glass.

1.3 LABELS

A. Temporary labels:
   1. Provide temporary label on each light of glass and plastic material identifying manufacturer or brand and glass type, quality and nominal thickness.
   2. Label in accordance with NFRC label requirements.
   3. Temporary labels are to remain intact until glass and plastic material is approved by Contracting Officer Representative (COR).

B. Permanent labels:
   1. Locate in corner for each pane.
   2. Label in accordance with ANSI Z97.1 and SGCC label requirements.
      a. Tempered glass.
      b. Laminated glass or have certificate for panes without permanent label.
      c. Organic coated glass.
   3. Fire rated glazing assemblies: Mark in accordance with IBC.

1.4 PERFORMANCE REQUIREMENTS

A. General: Design glazing system consistent with guidance and practices presented in the GANA Glazing Manual, GANA Laminated Glazing Manual, and GANA Sealant Manual, as applicable to project. Installed glazing is to withstand applied loads, thermal stresses, thermal movements, building movements, permitted tolerances, and combinations of these conditions without failure, including loss or glass breakage attributable to defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; unsafe engagement of the framing system; deflections beyond specified limits; or other defects in construction.

B. Glazing Unit Design: Design glass, including engineering analysis meeting requirements of authorities having jurisdiction. Thicknesses listed are minimum. Coordinate thicknesses with framing system manufacturers.

1.5 SUBMITTALS

A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Sustainable Design Submittals, as described below:

1. Volatile organic compounds per volume as specified in PART 2 - PRODUCTS.

C. Manufacturer's Certificates:

1. Certificate stating that fire-protection and fire-resistive glazing units meet code requirements for fire-resistance-rated assembly and applicable safety glazing requirements.
2. Certificate on solar heat gain coefficient when value is specified.
3. Certificate on "R" value when value is specified.
4. Certificate test reports confirming compliance with specified bullet resistive rating.
5. Certificate that blast resistant glass meets the specified requirements.

D. Manufacturer Warranty.

E. Manufacturer's Literature and Data:

1. Glass, each kind required.
2. Glazing cushion.

3. Sealing compound.

F. Samples:

1. Size: 305 mm by 305 mm (12 inches by 12 inches).

G. Preconstruction Adhesion and Compatibility Test Report: Submit glazing sealant manufacturer’s test report indicating glazing sealants were tested for adhesion to glass and glazing channel substrates and for compatibility with glass and other glazing materials.

1.6 DELIVERY, STORAGE AND HANDLING

A. Delivery: Schedule delivery to coincide with glazing schedules so minimum handling of crates is required. Do not open crates except as required for inspection for shipping damage.

B. Storage: Store cases according to printed instructions on case, in areas least subject to traffic or falling objects. Keep storage area clean and dry.

C. Handling: Unpack cases following printed instructions on case. Stack individual windows on edge leaned slightly against upright supports with separators between each.

D. Protect laminated security glazing units against face and edge damage during entire sequence of fabrication, handling, and delivery to installation location. Provide protective covering on exposed faces of glazing plastics, and mark inside as "INTERIOR FACE" or "PROTECTED FACE":

1. Treat security glazing as fragile merchandise, and packaged and shipped in export wood cases with width end in upright position and blocked together in a mass. Storage and handling to comply with manufacturer's directions and as required to prevent edge damage or other damage to glazing resulting from effects of moisture, condensation, temperature changes, direct exposure to sun, other environmental conditions, and contact with chemical solvents.

2. Protect sealed-air-space insulating glazing units from exposure to abnormal pressure changes, as could result from substantial changes in altitude during delivery by air freight. Provide temporary breather tubes which do not nullify applicable warranties on hermetic seals.

3. Temporary protections: The glass front and polycarbonate back of glazing are to be temporarily protected with compatible, peelable,

heat-resistant film which will be peeled for inspections and re-applied and finally removed after doors and windows are installed at destination. Since many adhesives will attack polycarbonate, the film used on exposed polycarbonate surfaces is to be approved and applied by manufacturer.

4. Edge protection: To cushion and protect glass clad, and polycarbonate edges from contamination or foreign matter, the four (4) edges are to be sealed the depth of glazing with continuous standard-thickness thermoplastic rubber tape. Alternatively, continuous channel shaped extrusion of thermoplastic rubber are to be used, with flanges extending into face sides of glazing.
5. Protect "Constant Temperature" units including every unit where glass sheet is directly laminated to or directly sealed with metal-tube type spacer bar to polycarbonate sheet, from exposures to ambient temperatures outside the range of 16 to 24 degrees C (60 to 75 degrees F), during the fabricating, handling, shipping, storing, installation, and subsequent protection of glazing.

1.7 PROJECT CONDITIONS

A. Field Measurements: Field measure openings before ordering tempered glass products to assure for proper fit of field measured products.

1.8 WARRANTY

A. Construction Warranty: Comply with the FAR clause 52.246-21 “Warranty of Construction”.

B. Manufacturer Warranty: Manufacturer shall warranty their glazing from the date of installation and final acceptance by the Government as follows. Submit manufacturer warranty.

1. Bullet resistive plastic material to remain visibly clear without discoloration for 10 years.
2. Insulating glass units to remain sealed for ten (10) years.
3. Laminated glass units to remain laminated for five (5) years.
4. Polycarbonate to remain clear and ultraviolet light stabilized for five (5) years.
5. Insulating plastic to not have more than 6 percent decrease in light transmission and be ultraviolet light stabilized for ten (10) years.

6. Warrant electrochromic laminated products against lamination defects, such as edge separation or delamination, that materially obstruct vision through the glass for a period of five (5) years.
7. Warrant electrochromic controls against defects in material or workmanship for a period of five (5) years.

1.9 APPLICABLE PUBLICATIONS

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

B. American Architectural Manufacturers Association (AAMA):
800.....Test Methods for Sealants
810.1-77.....Expanded Cellular Glazing Tape

C. American National Standards Institute (ANSI):
Z97.1-14.....Safety Glazing Material Used in Building - Safety Performance Specifications and Methods of Test

D. American Society of Civil Engineers (ASCE):
7-10.....Wind Load Provisions

E. ASTM International (ASTM):
C542-05(2017).....Lock-Strip Gaskets
C716-06(2020).....Installing Lock-Strip Gaskets and Infill Glazing Materials
C794-18.....Adhesion-in-Peel of Elastomeric Joint Sealants
C864-05(2019).....Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers
C920-18.....Elastomeric Joint Sealants
C964-20.....Standard Guide for Lock-Strip Gasket Glazing
C1036-16.....Flat Glass
C1048-18.....Heat-Treated Flat Glass-Kind HS, Kind FT Coated and Uncoated Glass.
C1172-19.....Laminated Architectural Flat Glass
C1349-17.....Standard Specification for Architectural Flat Glass Clad Polycarbonate
C1376-15.....Pyrolytic and Vacuum Deposition Coatings on Flat Glass

D635-18.....Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastic in a Horizontal Position

D4802-16.....Poly (Methyl Methacrylate) Acrylic Plastic Sheet

E84-20.....Surface Burning Characteristics of Building Materials

E119-20.....Standard Test Methods for Fire Test of Building Construction and Material

E1300-16.....Load Resistance of Glass in Buildings

E1886-19.....Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials

E1996-17.....Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes

E2141-14.....Test Methods for Assessing the Durability of Absorptive Electrochromic Coatings on Sealed Insulating Glass Units

E2190-19.....Insulating Glass Unit

E2240-06.....Test Method for Assessing the Current-Voltage Cycling Stability at 90 Degree C (194 Degree F) of Absorptive Electrochromic Coatings on Sealed Insulating Glass Units

E2241-06.....Test Method for Assessing the Current-Voltage Cycling Stability at Room Temperature of Absorptive Electrochromic Coatings on Sealed Insulating Glass Units

E2354-10.....Assessing the Durability of Absorptive Electrochromic Coatings within Sealed Insulating Glass Units

E2355-10.....Test Method for Measuring the Visible Light Transmission Uniformity of an Absorptive Electrochromic Coating on a Glazing Surface

F1233-08(2019).....Standard Test Method for Security Glazing Materials and Systems

F1642/F1642M-17.....Test Method for Glazing and Glazing Systems Subject to Airblast Loadings

F. Code of Federal Regulations (CFR):

16 CFR 1201-10.....Safety Standard for Architectural Glazing Materials

G. Glass Association of North America (GANA):

2010 Edition.....GANA Glazing Manual

2008 Edition.....GANA Sealant Manual

2009 Edition.....GANA Laminated Glazing Reference Manual

2010 Edition.....GANA Protective Glazing Reference Manual

H. International Code Council (ICC):

IBC.....International Building Code

I. Insulating Glass Certification Council (IGCC)

J. Insulating Glass Manufacturer Alliance (IGMA):

TB-3001-13.....Guidelines for Sloped Glazing

TM-3000.....North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use

K. Intertek Testing Services - Warnock Hersey (ITS-WHI)

L. National Fire Protection Association (NFPA):

80-16.....Fire Doors and Windows

252-12.....Fire Tests of Door Assemblies

257-12.....Standard on Fire Test for Window and Glass Block Assemblies

M. National Fenestration Rating Council (NFRC)

N. Safety Glazing Certification Council (SGCC) 2012:

Certified Products Directory (Issued Semi-Annually).

O. Underwriters Laboratories, Inc. (UL):

9-08(R2009).....Fire Tests of Window Assemblies

263-14.....Fire Tests of Building Construction and Materials

752-11.....Bullet-Resisting Equipment.

P. Department of Veterans Affairs:

Q. Physical Security Design Manual for VA Mission Critical Protected Facilities January 2015

R. Architectural Design Manual for VA Facilities (VASDM)

S. Environmental Protection Agency (EPA):

40 CFR 59(2014).....National Volatile Organic Compound Emission Standards for Consumer and Commercial Products

PART 2 - PRODUCT

2.1 GLASS

A. Provide minimum thickness stated and as additionally required to meet performance requirements.

1. Provide minimum 6 mm (1/4 inch) thick glass units unless otherwise indicated.

B. Obtain glass units from single source from single manufacturer for each glass type.

C. Clear Glass:

1. ASTM C1036, Type I, Class 1, Quality q3 .

2.2 HEAT-TREATED GLASS

A. Roller Wave Limits for Heat-Treated Glass: Orient all roller wave distortion parallel to bottom surface of glazing, and provide units complying with the following limitations:

1. Measurement Parallel to Line: Maximum peak to valley 0.203 mm (0.008 inch).

2. Measurement Perpendicular to Line: Maximum 0.0254 mm (0.001 inch).

3. Bow/Warp: Maximum 50 percent of bow and warp allowed by ASTM C1048.

B. Clear Heat Strengthened Glass:

1. ASTM C1048, Kind HS, Condition A, Type I, Class 1, Quality q3.

2.3 FIRE PROTECTION AND FIRE RESISTANCE GLAZING

A. Fire-Protection-Rated Glazing: Glazing units tested for use in fire door assemblies or fire windows, UL, ITS-WHI or equivalent listed and labeled by testing agency in accordance with IBC, for fire-protection ratings as indicated on construction documents scheduled , based upon positive-pressure testing per NFPA 257 or UL 9, and complying with NFPA 80.

1. Hose-Stream Test: Units must comply, except units having fire-protection rating of 20 minutes.
2. Temperature Rise Limitation: Units over 0.065 square meter (100 square inch) must comply with 232 deg. C (450 degress F) limitation.
3. Labeling: Permanently label fire-protection-rated glazing units in accordance with IBC.
4. Safety Glazing: Comply with 16 CFR 1201, Category II.
5. Fire-Protection-Rated Tempered Glass: For 20-minute fire-protection-rated door assemblies, of thickness scheduled.

2.4 GLAZING ACCESSORIES

A. As required to supplement the accessories provided with the items to be glazed and to provide a complete installation. Ferrous metal accessories exposed in the finished work are to have a finish that will not corrode or stain while in service. Fire rated glazing to be installed with glazing accessories in accordance with the manufacturer’s installation instructions.

B. Setting Blocks: ASTM C864:
   1. Silicone type.
   2. Channel shape; having 6 mm (1/4 inch) internal depth.
   3. Shore A hardness of 80 to 90 Durometer.
   4. Block lengths: 50 mm (2 inches) except 100 to 150 mm (4 to 6 inches) for insulating glass.
   5. Block width: Approximately 1.6 mm (1/16 inch) less than the full width of the rabbet.
   6. Block thickness: Minimum 4.8 mm (3/16 inch). Thickness sized for rabbet depth as required.

C. Spacers: ASTM C864:
   1. Channel shape having a 6 mm (1/4 inch) internal depth.
   2. Flanges not less 2.4 mm (3/32 inch) thick and web 3 mm (1/8 inch) thick.
   3. Lengths: 25 to 76 mm (1 to 3 inches).
   4. Shore A hardness of 40 to 50 Durometer.

D. Glazing Tapes:
   1. Semi-solid polymeric based closed cell material exhibiting pressure-sensitive adhesion and withstanding exposure to sunlight, moisture, heat, cold, and aging.

2. Shape, size and degree of softness and strength suitable for use in glazing application to prevent water infiltration.
3. Complying with AAMA 800 for the following types:
   a. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
   b. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

E. Spring Steel Spacer: Galvanized steel wire or strip designed to position glazing in channel or rabbeted sash with stops.

F. Glazing Gaskets: ASTM C864:
1. Firm dense wedge shape for locking in sash.
2. Soft, closed cell with locking key for sash key.
3. Flanges may terminate above the glazing-beads or terminate flush with top of beads.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:
1. Examine openings for glass and glazing units; determine they are proper size; plumb; square; and level before installation is started.
2. Verify that glazing openings conform with details, dimensions and tolerances indicated on manufacturer is approved shop drawings.

B. Review for conditions which may adversely affect glass and glazing unit installation, prior to commencement of installation. Do not proceed with installation until unsatisfactory conditions have been corrected.

C. Verify that wash down of adjacent masonry is completed prior to erection of glass and glazing units.

3.2 PREPARATION

A. For sealant glazing, prepare glazing surfaces in accordance with GANA Sealant Manual.

B. Determine glazing unit size and edge clearances by measuring the actual unit to receive the glazing.

C. Shop fabricate and cut glass with smooth, straight edges of full size required by openings to provide GANA recommended edge clearances.

D. Verify that components used are compatible.

E. Clean and dry glazing surfaces.

F. Prime surfaces scheduled to receive sealants, as determined by preconstruction sealant-substrate testing.

3.3 INSTALLATION – GENERAL

A. Install in accordance with GANA Glazing Manual, GANA Sealant Manual, IGMA TB-3001, and IGMA TM-3000 unless specified otherwise.

B. Glaze in accordance with recommendations of glazing and framing manufacturers, and as required to meet the Performance Test Requirements specified in other applicable sections of specifications.

C. Set glazing without bending, twisting, or forcing of units.

D. Do not allow glass to rest on or contact any framing member.

E. Glaze doors and operable sash, in a securely fixed or closed and locked position, until sealant, glazing compound, or putty has thoroughly set.

F. Tempered Glass: Install with roller distortions in horizontal position unless otherwise directed.

G. Fire Protective and Fire Resistance Glass:

1. Wire Glass: Glaze in accordance with NFPA 80.
2. Other fire protective and fire resistant glass: Glaze in accordance with manufacturer’s installation instructions and NFPA 80.

3.4 REPLACEMENT AND CLEANING

A. Clean new glass surfaces removing temporary labels, paint spots, and defacement after approval by COR.

B. Replace cracked, broken, and imperfect glass, or glass which has been installed improperly.

C. Leave glass, putty, and other setting material in clean, whole, and acceptable condition.

3.5 PROTECTION

A. Protect finished surfaces from damage during erection, and after

A. completion of work. Strippable plastic coatings on colored anodized

A. finish are not acceptable.

3.6 MONOLITHIC GLASS SCHEDULE

A. Glass Type MG# : Clear fully tempered float glass.

1. Unit Thickness: 6 mm (0.23 inch).
2. Safety glazing label required.

B. Glass Type MG# : Ultra-clear (low-iron) fully tempered float glass.

1. Unit Thickness: 6 mm (0.23 inch).
2. Safety glazing label required.

3.7 FIRE-PROTECTIVE AND FIRE-RESISTANCE GLAZING SCHEDULE

A. Glass Type FR# : Fire-protection-rated tempered glass.

1. Thickness: 6 mm (0.23 inch) 10 mm (0.39 inch) 12 mm (0.47 inch).
2. Rating: 20 minutes.
3. Application: Fire-protection-rated door assemblies with openings not over 0.65 square meter (100 square inch).

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01-01-21

SECTION 09 05 16

SUBSURFACE PREPARATION FOR FLOOR FINISHES

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies subsurface preparation requirements for areas to

B. receive the installation of applied and resinous flooring. This section includes removal of existing floor coverings, testing concrete for moisture and pH, remedial floor coating for concrete floor slabs having unsatisfactory moisture or pH conditions, floor leveling and repair as required.

1.2 RELATED WORK

A. Section 07 92 00, JOINT SEALANTS.

B. Section 09 65 16, RESILIENT SHEET FLOORING

1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA and TEST DATA.

B. Written approval confirming product compatibility with subfloor material manufacturer and the flooring manufacturer

C. Product Data:

1. Moisture remediation system
2. Underlayment Primer
3. Cementitious Self-Leveling Underlayment
4. Cementitious Trowel-Applied Underlayment (Not suitable for resinous floor finishes)

D. Test Data:

1. Moisture test and pH results performed by a qualified independent testing agency or warranty holding manufacturer’s technical representative.

1.4 DELIVERY AND STORAGE

A. Deliver materials in containers with labels legible and intact and grade-seals unbroken.

B. Store material to prevent damage or contamination.

1.5 APPLICABLE PUBLICATIONS

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

B. ASTM International(ASTM):

D638-14(2014).....Standard Test Method for Tensile Properties of Plastics

D4259-18(2019).....Standard Practice for Preparation of Concrete by Abrasion Prior to Coating Application.

C109/C109M-20b(2020)....Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens

7234-19(2020).....Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers

E96/E96M-16(2016).....Standard Test Methods for Water Vapor Transmission of Materials

F710-1e1(2020).....Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring

F1869-16a.....Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

F2170-19a(2020).....Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes

C348-20(2020).....Standard Test Method for Flexural Strength of Hydraulic-Cement Mortars

C191-19(2020).....Standard Test Method for Time of Setting of Hydraulic Cement by Vicat Needle

PART 2 - PRODUCTS

2.1 MOISTURE REMEDIATION COATING

A. System Descriptions:

1. High-solids, epoxy system designed to suppress excess moisture in concrete prior to an overlayment. For use under resinous products, VCT, tile and carpet where issues caused by moisture vapor are a concern.

B. Products: Subject to compliance with applicable fire, health, environmental, and safety requirements for storage, handling, installation, and clean up.

C. System Components: Verify specific requirements as systems vary by manufacturer. Verify build up layers and installation method. Verify compatibility with substrate. Use manufacturer's standard components, compatible with each other and as follows:

1. Liquid applied coating:
   a. Resin: epoxy.
   b. Formulation Description: Multiple component high solids.
   c. Application: Per manufacturer's written installation requirements.
   d. Thickness: minimum 10 mils

D. Material Vapor Permeance: Application shall achieve a permeance rating of less than 0.1 perm in accordance with ASTM E96/E96M.

E. Maximum RH requirement: 100% testing in accordance with ASTM F2170.

2.2 CEMENTITIOUS SELF-LEVELING UNDERLAYMENT

Property	Test	Value
Tensile Strength	ASTM D638	4,400 psi
Volatile Organic Compound Limits (V.O.C.)	SCAMD Rule 1113 (Ammended 02/05/2016)	25 grams per liter
Permeance	ASTM E96	0.1 perms
Tensile Modulus	ASTM D638	$1.9X10^5$psi
Percent Elongation	ASTM D638	12%
Cure Rate	Per manufacture's Data	4 hours Tack free with 24hr recoat window
Bond Strength	ASTM D7234	100% bond to concrete failure

A. System Descriptions:

1. High performance self-leveling underlayment resurfacer. Single component, self-leveling, cementitious material designed for easy application as an underlayment for all types of flooring materials. It is used for substrate repair and leveling.

B. Products: Subject to compliance with applicable fire, health, environmental, and safety requirements for storage, handling, installation, and clean up. Gypsum-based products are unacceptable.

C. System Characteristics:

1. Wearing Surface: smooth
2. Thickness: Per architectural drawings, ranging from feathered edge to 1”, per application. Applications greater than 1” require additional 3/8” aggregate to mix or as recommended by manufacturer.

D. Underlayment shall be calcium aluminate cement-based, containing Portland cement. Gypsum-based products are unacceptable.

E. Compressive Strength: Minimum 4100 psi in 28 days in accordance with ASTM C109/C109M.

F. Flexural Strength: Minimum 1000 psi in 28 days in accordance with ASTM C348

G. Dry Time: Underlayment shall receive the application of moisture insensitive tile in 6 hours, floor coverings in 16 hours, and resinous flooring in 3-7 days.

H. Primer: compatible and as recommended by manufacturer for use over intended substrate

I. System Components: Manufacturer's standard components that are compatible with each other and as follows:

1. Primer:
   a. Resin: copolymer
   b. Formulation Description: single component ready to use.
   c. Application Method: Squeegee and medium nap roller.
   d. All puddles shall be removed, and material shall be allowed to dry, 1-2 hours at 70F/21C.
   e. Number of Coats: (1) one.
2. Grout Resurfacing Base:
   a. Formulation Description: Single component, cementitious self-leveling high-early and high-ultimate strength grout.
   b. Application Method: colloidal mix pump, cam rake, spike roll.

1) Thickness of Coats: Per architectural scope, 1” lifts.

2) Number of Coats: More than one if needed.

c. Aggregates: for applications greater than 1inch, require additional 3/8” aggregate to mix.

J.

Property	Test	Value
Compressive Strength	ASTM C109/C109M	2,200 psi @ 24 hrs 3,000 psi @ 7 days
Initial set time Final Set time	ASTM C191	30-45 min. 1 to 1.5 hours
Bond Strength	ASTM D7234	100% bond to concrete failure

2.3 CEMENTITIOUS TROWEL-APPLIED UNDERLAYMENT(NOT SUITABLE FOR RESINOUS FLOOR FINISHES)

A. Underlayment shall be calcium aluminate cement-based, containing Portland cement. Gypsum-based products are unacceptable.

B. Compressive Strength: Minimum 4000 psi in 28 days

C. Trowel-applied underlayment shall not contain silica quartz (sand).

D. Dry Time: Underlayment shall receive the application of floor covering in 15-20 minutes.

PART 3 - EXECUTION

3.1 ENVIRONMENTAL REQUIREMENTS

A. Maintain ambient temperature of work areas at not less than 16 degree C (60 degrees F), without interruption, for not less than 24 hours before testing and not less than three days after testing.

B. Maintain higher temperatures for a longer period of time where required by manufacturer's recommendation.

C. Do not install materials when the temperatures of the substrate or materials are not within 60-85 degrees F/ 16-30 degrees C.

3.2 SURFACE PREPARATION

A. Existing concrete slabs with existing floor coverings:

1. Conduct visual observation of existing floor covering for adhesion, water damage, alkaline deposits, and other defects.

2. Remove existing floor covering and adhesives. Comply with local, state and federal regulations and the RFCI Recommended Work

Practices for Removal of Resilient Floor Coverings, as applicable to the floor covering being removed.

B. Concrete shall meet the requirements of ASTM F710 and be sound, solid, clean, and free of all oil, grease, dirt, curing compounds, and any substance that might act as a bond-breaker before application. As required prepare slab by mechanical methods. No chemicals or solvents shall be used.

C. General: Prepare and clean substrates according to flooring manufacturer's written instructions for substrate indicated.

D. Prepare concrete substrates per ASTM D4259 as follows:
   1. Dry abrasive blasting.
   2. Wet abrasive blasting.
   3. Vacuum-assisted abrasive blasting.
   4. Centrifugal-shot abrasive blasting.
   5. Comply with manufacturer's written instructions.

E. Repair damaged and deteriorated concrete according to flooring manufacturer's written recommendations.

F. Verify that concrete substrates are dry.

G. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with application only after substrates have maximum moisture-vapor-emission rate of per flooring manufactures formal and project specific written recommendation.

H. Perform in situ probe test, ASTM F2170. Proceed with application only after substrates do not exceed a maximum potential equilibrium relative humidity per flooring manufacture’s formal and project specific written recommendation.

I. Provide a written report showing test placement and results.

J. Prepare joints in accordance with Section 07 92 00, JOINT SEALANTS and material manufacturer’s instructions.

K. Alkalinity: Measure surface pH in accordance with procedures provided in ASTM F710 or as outlined by qualified testing agency or flooring manufacturer’s technical representative.

L. Tolerances: Subsurface shall meet the flatness and levelness tolerance specified on drawings or recommended by the floor finish manufacturer. Tolerance shall also not to exceed 1/4” deviation in 10’. As required, install underlayment to achieve required tolerance.

M. Other Subsurface: For all other subsurface conditions, such as wood or metal, contact the floor finish or underlayment manufacturer, as appropriate, for proper preparation practices.

3.3 MOISTURE REMEDIATION COATING

A. Where results of relative humidity testing (ASTM F2170) exceed the requirements of the specified flooring manufacturer, apply remedial coating as specified to correct excessive moisture condition.

B. Prior to remedial floor coating installation mechanically prepare the concrete surface to provide a concrete surface profile in accordance with ASTM D4259.

C. Mix and apply moisture remediation coating in accordance with manufacturer’s instructions.

3.4 CEMENTITOUS UNDERLAYMENT

A. Install cementitious self-leveling underlayment as required to correct surface defects, floor flatness or levelness corrections to meet the tolerance requirements as or detailed on drawings, address non-moving cracks or joints, provide a smooth surface for the installation of floor covering, or meet elevation requirements detailed on drawings.

B. Mix and apply in accordance with manufacturer's instructions.

3.5 PROTECTION

A. Prior to the installation of the finish flooring, the surface of the underlayment should be protected from abuse by other trades by the use of plywood, tempered hardwood, or other suitable protection course

3.6 FIELD QUALITY CONTROL

A. Where specified, field sampling of products shall be conducted by a qualified, independent testing facility.

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SECTION 09 06 00
SCHEDULE FOR FINISHES

PART 1 - GENERAL

1.1 DESCRIPTION

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

1.2 MANUFACTURERS

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

1.3 SUBMITALS

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

1. DIGITAL COLOR PHOTOS-INTERIOR VIEWS:

Room Number and Name	Item/View to be Photographed

1.4 APPLICABLE PUBLICATIONS

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

B. MASTER PAINTING INSTITUTE: (MPI)

6/1/2019.....Architectural Painting Specification Manual

PART 2 - PRODUCTS

2.1 DIGITAL COLOR PHOTOS

A. Size 24 x 35 mm.

B. Labeled for:

1. Building name and Number.
2. Room Name and Number.

2.2 DIVISION 07 - THERMAL AND MOISTURE PROTECTION

A. SECTION 07 54 23, THERMOPLASTIC POLYOLEFIN (TPO) ROOFING

Finish	Manufacturer	Mfg. Color Name/No.

2.3 DIVISION 08 - OPENINGS

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

1. Paint both sides of door and frames same color including ferrous metal louvers, and hardware attached to door

Component	Color of Paint Type and Gloss
Door	
Frame	

Window frame	

B. SECTION 08 14 00, INTERIOR WOOD DOORS

Component	Finish/Color
Doors	
Frames	

C. SECTION 08 31 13, ACCESS DOORS AND FRAMES

Material	Finish/Color
Stainless steel	

D. SECTION 08 32 13, SLIDING GLASS DOORS

Material	Finish	Manufacturer	Manufacturer Color Name/No.
Aluminum			
Glass			

E. SECTION 08 71 00, BUILDERS HARDWARE

Item	Material	Finish
Hinges		
Door Closers		
Closer/ Holder		
Floor Stops		
Door Holders		
Lock/ Latches		
Armor Plates	Metal	STAINLESS STEEL-TYPE 304, BRUSHED
Kick Mop Plates	Metal	
Door Edging		
Exit Device		
Flush Bolts		
Coordinators		
Threshold		

F. SECTION 08 80 00, GLAZING

Glazing Type	Manufacturer	Mfg. Color Name/No.
G-6		
G-7		
G-8		

2.4 DIVISION 09 - FINISHES

A. SECTION 09 30 13, CERAMIC/PORCELAIN TILING

1. CERAMIC MOSAIC TILE (FT)

Color	Size	Shape	Pattern	Manufacturer	Mfg. Color Name/No.

2. SECTION 09 30 13, CERAMIC/PORCELAIN TILING

Finish ode	Manufacturer	Mfg. Color Name/No

B. SECTION 09 51 00, ACOUSTICAL CEILINGS

Finish Code	Component	Color Pattern	Manufacturer	Mfg Name/No.
	Exposed Suspension System	White	Armstrong	
AT	Type III	White	Armstrong	1935

C. SECTION 09 65 16, [RESILIENT SHEET FLOORING], HEAT WELDED SEAMS (WSF)

Finish Code	Pattern name	Manufacturer	Mfg. Color Name/No.
SV1	Aria	Tarkett	

1. SECTION 09 65 16, [RESILIENT SHEET FLOORING], WELDING RODS (WSF)

Finish code	Manufacturer	Mfg. Color Name/No.
	Tarkett	To match SV1

2. SECTION 09 65 16, [RESILIENT SHEET FLOORING], CAP STRIPS (WSF)

Finish Code	Manufacturer	Mfg. Color Name/No.
	Tarkett	To Match SV1

D. SECTION 09 65 13, RESILIENT BASE AND ACCESSORIES

Finish Code	Item	Height	Manufacturer	Mfg Name/No.
RB1	Rubber Base (RB)	6 inch	Johnsonite	

E. SECTION 09 96 59, RESINOUS SPECIALTY GLAZED COATING SYSTEMS FOR WALLS, CEILINGS WALLBOARD AND BLOCK CMU(RES-W1 & RES-W2)

Finish code	Manufacturer	Mfg. Color Name/No.

1. MPI Gloss and Sheen Standards

		Gloss @60	Sheen @85
Gloss Level 1	a traditional matte finish-flat	max 5 units, and	max 10 units
Gloss Level 2	a high side sheen flat-"a velvet-like" finish	max 10 units, and	10-35 units
Gloss Level 3	a traditional "egg-shell like" finish	10-25 units, and	10-35 units
Gloss Level 4 min. 35 units		a "satin-like" finish	20-35 units, and
Gloss Level 5	a traditional semi-gloss	35-70 units	
Gloss Level 6	a traditional gloss	70-85 units	
Gloss level 7		a high gloss more than 85 units	

2. Paint code	Gloss	Manufacturer	Mfg. Color Name/No.
P1			
P2	5		
P3			
P			
P			
P			

P			
P			
P			
3. Stain Code (S)	Gloss and Transparency	Manufacturer	Mfg. Color Name/No.
	Semi		
S			
S			
S	Opaque		
S			
S			
4. Clear coatings Code(CC)	Gloss	Manufacturer	Mfg. Color Name/No.
CC			
CC			

2.5 DIVISION 10 - SPECIALTIES

A. SECTION 10 26 00, WALL AND DOOR PROTECTION

Item	Material	Manufacturer	Mfg. Color Name/No.
Corner Guards			
Wall Guards and Handrail			
Wall Guard			
Door Frame Protection			

B. SECTION 10 28 00, TOILET, BATH AND LAUNDRY ACCESSORIES / SECTION 10 14 00, SIGNAGE

Room No. and Name	Item	Finish	Manufacturer	Mfg. Color Name/No.

	Mop racks			
	Package Transfer Box			

C. SECTION 10 44 13, FIRE EXTNGUISHER CABINETS

Component	Material	Finish

D. SECTION 10 28 00, TOILET, BATH AND LAUNDRY ACCESSORIES

Item	Material	Manufacturer	Mfg. Color Name/No.

2.6 DIVISION 12- FURNISHINGS

A. SECTION 12 31 00, MANUFACTURED METAL CASEWORK

Item/ Type	Finish	Manufacturer	Mfg. Color Name/No.
1. SHELVES			
4			
4 A			
2. CABINETS			

1 A			
1 B			
1 G			
8 A			
8 B			
3. COUNTERS			
1 F			
1 K			

PART 3 - EXECUTION

3.1 FINISH SCHEDULES & MISCELLANEOUS ABBREVIATIONS

FINISH SCHEDULE & MISCELLANEOUS ABBREVIATIONS	
Term	Abbreviation
Acoustical Ceiling	AT
Anodized Aluminum Colored	AAC
Anodized Aluminum Natural Finish	AA
Baked On Enamel	BE
Concrete	C
Concrete Masonry Unit	CMU
Divider Strips Marble	DS MB
Epoxy Coating	EC
Epoxy Resin Flooring	ERF
Existing	E
Exposed Divider Strips	EXP
Exterior	EXT
Exterior Finish System	EFS
Exterior Paint	EXT-P
Fabric Wallcovering	WF
Facing Tile	SCT
Feature Strips	FS
Floor Mats & Frames	FM
Floor Tile, Mosaic	FT

Fluorocarbon	FC
Glazed Face CMU	GCMU
Glazed Structural Facing Tile	SFTU
Gypsum Wallboard	GWB
Marble	MB
Material	MAT
Mortar	M
Multi-Color Coating	MC
Paint	P
Plaster	PL
Plaster High Strength	HSPL
Plaster Keene Cement	KC
Plastic Laminate	HPDL
Rubber Base	RB

Rubber Tile Flooring	RT
Spandrel Glass	SLG
Stain	ST
Stone Flooring	SF
Structural Clay	SC
Suspension Decorative Grids Grids	SDG
Terrazzo Portland Cement	PCT
Terrazzo Tile	TT
Terrazzo, Thin Set	
Thin set Terrazzo	TST
Wood	WD

3.2 FINSIH SCHEDULE SYMBOLS

Symbol Definition

** Same finish as adjoining walls

- No color required

E Existing

XX To match existing

EFTR Existing finish to remain

RM Remove

3.3 ROOM FINISH SCHEDULE

A. Match adjoining or existing similar surfaces colors, textures or patterns where disturbed or damaged by alterations or new work when not scheduled.

B. ROOM FINISH SCHEDULE

Room No. and Name		FLOOR			BASE		WALL		WAINSCOT		CEILING		REMARKS
		MAT	FC		MAT	FCC	MAT	FCC	MAT	FC	MAT	FCC	
	EXIST			N									
				E									
				S									
				W									
				C									
	NEW			N									
				E									
				S									
				W									
				C									
	EXIST			N									
				E									
				S									
				W									
				C									
				N									

	NEW			E								
				S								
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				C								
	EXIST			N								
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	NEW			N								
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				S								
				W								
				C								

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06-01-18

SECTION 09 22 16
NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies steel studs wall systems, shaft wall systems, ceiling or soffit suspended or furred framing, wall furring, fasteners, and accessories for the screw attachment of gypsum board, plaster bases or other building boards.

1.2 RELATED WORK

A. Ceiling suspension systems for acoustical tile or panels and lay in gypsum board panels: Section 09 51 00, ACOUSTICAL CEILINGS, Section 09 29 00, GYPSUM BOARD.

1.3 TERMINOLOGY

A. Description of terms shall be in accordance with ASTM C754, ASTM C11, ASTM C841 and as specified.

B. Underside of Structure Overhead: In spaces where steel trusses or bar joists are shown, the underside of structure overhead shall be the underside of the floor or roof construction supported by beams, trusses, or bar joists. In interstitial spaces with walk-on floors the underside of the walk-on floor is the underside of structure overhead.

C. Thickness of steel specified is the minimum bare (uncoated) steel thickness.

1.4 SUBMITTALS

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

B. Manufacturer's Literature and Data:

1. Studs, runners and accessories.
2. Hanger inserts.
3. Channels (Rolled steel).
4. Furring channels.
5. Screws, clips and other fasteners.

C. Shop Drawings:

1. Typical ceiling suspension system.
2. Typical metal stud and furring construction system including details around openings and corner details.

3. Typical shaft wall assembly
4. Typical fire rated assembly and column fireproofing showing details of construction same as that used in fire rating test.

D. Test Results: Fire rating test designation, each fire rating required for each assembly.

1.5 DELIVERY, IDENTIFICATION, HANDLING AND STORAGE

A. In accordance with the requirements of ASTM C754.

1.6 APPLICABLE PUBLICATIONS

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

B. American Society For Testing And Materials (ASTM)

A641-09.....Zinc-Coated (Galvanized) Carbon Steel Wire

A653/653M-11.....Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.

C11-10.....Terminology Relating to Gypsum and Related Building Materials and Systems

C635-07.....Manufacture, Performance, and Testing of Metal Suspension System for Acoustical Tile and Lay-in Panel Ceilings

C636-08.....Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels

C645-09.....Non-Structural Steel Framing Members

C754-11.....Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products

C841-03(R2008).....Installation of Interior Lathing and Furring

C954-10.....Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness

E580-11.....Application of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Requiring Moderate Seismic Restraint.

PART 2 - PRODUCTS

2.1 PROTECTIVE COATING

A. Galvanize steel studs, runners (track), rigid (hat section) furring channels, "Z" shaped furring channels, and resilient furring channels, with coating designation of G90 or equivalent.

2.2 STEEL STUDS AND RUNNERS (TRACK)

A. ASTM C645, modified for thickness specified and sizes as shown.
   1. Use C 645 steel, 0.75 mm (0.0296-inch) minimum base-metal (30 mil).
   2. Runners same thickness as studs.
   3. Exception: Members that can show certified third party testing with gypsum board in accordance with ICC ES AC86 (Approved May 2012) need not meet the minimum thickness limitation or minimum section properties set forth in ASTM C 645. The submission of an evaluation report is acceptable to show conformance to this requirement. Use C 645 steel, 0.48mm (0.019 inch) minimum base-metal (19 mil).

B. Provide not less than two cutouts in web of each stud, approximately 300 mm (12 inches) from each end, and intermediate cutouts on approximately 600 mm (24-inch) centers.

C. Doubled studs for openings and studs for supporting concrete backer-board.

D. Studs 3600 mm (12 feet) or less in length shall be in one piece.

2.3 FURRING CHANNELS

A. Rigid furring channels (hat shape): ASTM C645.

B. Resilient furring channels:
   1. Not less than 0.45 mm (0.0179-inch) thick bare metal.
   2. Semi-hat shape, only one flange for anchorage with channel web leg slotted on anchorage side, channel web leg on other side stiffens fastener surface but shall not contact anchorage surface other channel leg is attached to.

C. "Z" Furring Channels:
   1. Not less than 0.45 mm (0.0179-inch)-thick base metal, with 32 mm (1-1/4 inch) and 19 mm (3/4-inch) flanges.
   2. Web furring depth to suit thickness of insulation.

D. Rolled Steel Channels: ASTM C754, cold rolled; or, ASTM C841, cold rolled.

2.4 FASTENERS, CLIPS, AND OTHER METAL ACCESSORIES

A. ASTM C754, except as otherwise specified.

B. For fire rated construction: Type and size same as used in fire rating test.

C. Fasteners for steel studs thicker than 0.84 mm (0.033-inch) thick. Use ASTM C954 steel drill screws of size and type recommended by the manufacturer of the material being fastened.

D. Clips: ASTM C841 (paragraph 6.11), manufacturer's standard items. Clips used in lieu of tie wire shall have holding power equivalent to that provided by the tie wire for the specific application.

E. Concrete ceiling hanger inserts (anchorage for hanger wire and hanger straps): Steel, zinc-coated (galvanized), manufacturers standard items, designed to support twice the hanger loads imposed and the type of hanger used.

F. Tie Wire and Hanger Wire:

1. ASTM A641, soft temper, Class 1 coating.
2. Gage (diameter) as specified in ASTM C754 or ASTM C841.

G. Attachments for Wall Furring:

1. Manufacturers standard items fabricated from zinc-coated (galvanized) steel sheet.

H. Power Actuated Fasteners: Type and size as recommended by the manufacturer of the material being fastened.

2.5 SUSPENDED CEILING SYSTEM FOR GYPSUM BOARD (OPTION)

A. Conform to ASTM C635, heavy duty, with not less than 35 mm (1-3/8 inch) wide knurled capped flange face designed for screw attachment of gypsum board.

B. Wall track channel with 35 mm (1-3/8 inch) wide flange.

PART 3 - EXECUTION

3.1 INSTALLATION CRITERIA

A. Where fire rated construction is required for walls, partitions, columns, beams and floor-ceiling assemblies, the construction shall be same as that used in fire rating test.

B. Construction requirements for fire rated assemblies and materials shall be as shown and specified, the provisions of the Scope paragraph (1.2) of ASTM C754 and ASTM C841 regarding details of construction shall not apply.

3.2 INSTALLING STUDS

A. Install studs in accordance with ASTM C754, except as otherwise shown or specified.

B. Space studs not more than 610 mm (24 inches) on center.

C. Cut studs 6 mm to 9 mm (1/4 to 3/8-inch) less than floor to underside of structure overhead when extended to underside of structure overhead.

D. Where studs are shown to terminate above suspended ceilings, provide bracing as shown or extend studs to underside of structure overhead.

E. Extend studs to underside of structure overhead for fire, rated partitions, smoke partitions, shafts, and sound rated partitions and insulated exterior wall furring.

F. Openings:

1. Frame jambs of openings in stud partitions and furring with two studs placed back-to-back or as shown.
2. Fasten back-to-back studs together with 9 mm (3/8-inch) long Type S pan head screws at not less than 600 mm (two feet) on center, staggered along webs.
3. Studs fastened flange to flange shall have splice plates on both sides approximately 50 X 75 mm (2 by 3 inches) screwed to each stud with two screws in each stud. Locate splice plates at 600 mm (24 inches) on center between runner tracks.

G. Fastening Studs:

1. Fasten studs located adjacent to partition intersections, corners and studs at jambs of openings to flange of runner tracks with two screws through each end of each stud and flange of runner.
2. Do not fasten studs to top runner track when studs extend to underside of structure overhead.

H. Chase Wall Partitions:

1. Locate cross braces for chase wall partitions to permit the installation of pipes, conduits, carriers and similar items.
2. Use studs or runners as cross bracing not less than 63 mm (2-1/2 inches wide).

I. Form building seismic or expansion joints with double studs back to back spaced 75 mm (three inches) apart plus the width of the seismic or expansion joint.

J. Form control joint, with double studs spaced 13 mm (1/2-inch) apart.

3.3 INSTALLING WALL FURRING FOR FINISH APPLIED TO ONE SIDE ONLY

A. In accordance with ASTM C754, or ASTM C841 except as otherwise specified or shown.

B. Wall furring-Stud System:

1. Framed with 63 mm (2-1/2 inch) or narrower studs, 600 mm (24 inches) on center.
2. Brace as specified in ASTM C754 for Wall Furring-Stud System or brace with sections or runners or studs placed horizontally at not less than three foot vertical intervals on side without finish.
3. Securely fasten braces to each stud with two Type S pan head screws at each bearing.

C. Direct attachment to masonry or concrete; rigid channels or "Z" channels:

1. Install rigid (hat section) furring channels at 600 mm (24 inches) on center, horizontally or vertically.
2. Install "Z" furring channels vertically spaced not more than 600 mm (24 inches) on center.
3. At corners where rigid furring channels are positioned horizontally, provide mitered joints in furring channels.
4. Ends of spliced furring channels shall be nested not less than 200 mm (8 inches).
5. Fasten furring channels to walls with power-actuated drive pins or hardened steel concrete nails. Where channels are spliced, provide two fasteners in each flange.
6. Locate furring channels at interior and exterior corners in accordance with wall finish material manufacturers printed erection instructions. Locate "Z" channels within 100 mm (4 inches) of corner.

D. Installing Wall Furring-Bracket System: Space furring channels not more than 400 mm (16 inches) on center.

3.4 INSTALLING SUPPORTS REQUIRED BY OTHER TRADES

A. Provide for attachment and support of electrical outlets, plumbing, laboratory or heating fixtures, recessed type plumbing fixture accessories, access panel frames, wall bumpers, wood seats, toilet stall partitions, dressing booth partitions, urinal screens, chalkboards, tackboards, wall-hung casework, handrail brackets,

recessed fire extinguisher cabinets and other items like auto door buttons and auto door operators supported by stud construction.

B. Provide additional studs where required. Install metal backing plates, or special metal shapes as required, securely fastened to metal studs.

3.5 INSTALLING FURRED AND SUSPENDED CEILINGS OR SOFFITS

A. Install furred and suspended ceilings or soffits in accordance with ASTM C754 or ASTM C841 except as otherwise specified or shown for screw attached gypsum board ceilings and for plaster ceilings or soffits.
   1. Space framing at 400 mm (16-inch) centers for metal lath anchorage.
   2. Space framing at 600 mm (24-inch) centers for gypsum board anchorage.

B. Concrete slabs on steel decking composite construction:
   1. Use pull down tabs when available.
   2. Use power activated fasteners when direct attachment to structural framing can not be accomplished.

C. Where bar joists or beams are more than 1200 mm (48 inches) apart, provide intermediate hangers so that spacing between supports does not exceed 1200 mm (48 inches). Use clips, bolts, or wire ties for direct attachment to steel framing.

D. Existing concrete construction exposed or concrete on steel decking:
   1. Use power actuated fasteners either eye pin, threaded studs or drive pins for type of hanger attachment required.
   2. Install fasteners at approximate mid height of concrete beams or joists. Do not install in bottom of beams or joists.

E. Steel decking without concrete topping:
   1. Do not fasten to steel decking 0.76 mm (0.0299-inch) or thinner.
   2. Toggle bolt to decking 0.9 mm (0.0359-inch) or thicker only where anchorage to steel framing is not possible.

F. Installing suspended ceiling system for gypsum board (ASTM C635 Option):
   1. Install only for ceilings to receive screw attached gypsum board.
   2. Install in accordance with ASTM C636.
      a. Install main runners spaced 1200 mm (48 inches) on center.
      b. Install 1200 mm (four foot) tees not over 600 mm (24 inches) on center; locate for edge support of gypsum board.
      c. Install wall track channel at perimeter.

G. Installing Ceiling Bracing System:

1. Construct bracing of 38 mm (1-1/2 inch) channels for lengths up to 2400 mm (8 feet) and 50 mm (2 inch) channels for lengths over 2400 mm (8 feet) with ends bent to form surfaces for anchorage to carrying channels and overhead construction. Lap channels not less than 600 mm (2 feet) at midpoint back-to-back. Screw or bolt lap together with two fasteners.
2. Install bracing at an approximate 45-degree angle to carrying channels and structure overhead; secure as specified to structure overhead with two fasteners and to carrying channels with two fasteners or wire ties.
3. Brace suspended ceiling or soffit framing in seismic areas in accordance with ASTM E580.

3.7 TOLERANCES

A. Fastening surface for application of subsequent materials shall not vary more than 3 mm (1/8-inch) from the layout line.

B. Plumb and align vertical members within 3 mm (1/8-inch.)

C. Level or align ceilings within 3 mm (1/8-inch.)

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04-01-20

SECTION 09 29 00
GYPSUM BOARD

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies installation and finishing of gypsum board.

1.2 RELATED WORK

A. Installation of steel framing members for walls, partitions, furring, soffits, and ceilings: Section 09 22 16, NON-STRUCTURAL METAL FRAMING.

B. Sound deadening board: Section 07 21 13, THERMAL INSULATION.

C. Acoustical Sealants: Section 07 92 00, JOINT SEALANTS.

D. Lay in gypsum board ceiling panels: Section 09 51 00, ACOUSTICAL CEILING.

1.3 TERMINOLOGY

A. Definitions and description of terms shall be in accordance with ASTM C11, C840, and as specified.

B. Underside of Structure Overhead: In spaces where steel beams, trusses or bar joists or concrete beams are encountered or shown, the underside of structure overhead shall be the underside of the floor or roof construction supported by the trusses, beams or bar joists.

C. "Yoked": Gypsum board cut out for opening with no joint at the opening (along door jamb or above the door).

1.4 SUBMITTALS

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

B. Manufacturer's Literature and Data:

1. Cornerbead and edge trim.
2. Finishing materials.
3. Laminating adhesive.
4. Gypsum board, each type.

C. Shop Drawings:

1. Typical gypsum board installation, showing corner details, edge trim details and the like.
2. Typical sound rated assembly, showing treatment at perimeter of partitions and penetrations at gypsum board.
3. Typical wall assembly.

4. Typical fire rated assembly and column fireproofing, indicating details of construction same as that used in fire rating test.

D. Samples:

1. Cornerbead.
2. Edge trim.
3. Control joints.

E. Test Results:

1. Fire rating test, each fire rating required for each assembly.
2. Sound rating test.

F. Certificates: Certify that gypsum board types, gypsum backing board types, cementitious backer units, and joint treating materials do not contain asbestos material.

1.5 DELIVERY, IDENTIFICATION, HANDLING AND STORAGE

A. In accordance with the requirements of ASTM C840.

1.6 ENVIRONMENTAL CONDITIONS

A. In accordance with the requirements of ASTM C840.

1.7 APPLICABLE PUBLICATIONS

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

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

C11-15.....Terminology Relating to Gypsum and Related Building Materials and Systems

C475-15.....Joint Compound and Joint Tape for Finishing Gypsum Board

C840-13.....Application and Finishing of Gypsum Board

C919-12.....Sealants in Acoustical Applications

C954-15.....Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases to Steel Stud from 0.033 in. (0.84mm) to 0.112 in. (2.84mm) in thickness

C1002-14.....Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs

C1047-14.....Accessories for Gypsum Wallboard and Gypsum Veneer Base

C1177-13.....Glass Mat Gypsum Substrate for Use as Sheathing

C1178/C1178M-18.....Specification for Coated Glass Mat Water Resistant Backing Panel

C1658-13.....Glass Mat Gypsum Panels

C1396-14.....Gypsum Board

C. Underwriters Laboratories Inc. (UL):

Latest Edition.....Fire Resistance Directory

D. Inchcape Testing Services (ITS):

Latest Editions.....Certification Listings

PART 2 - PRODUCTS

2.1 GYPSUM BOARD

A. Gypsum Board: ASTM C1396, Type X, 16 mm (5/8 inch) thick unless shown otherwise.

2.2 GYPSUM SHEATHING BOARD

A. ASTM C1396, Type X, water-resistant core, 16 mm (5/8 inch) thick.

B. ASTM C1177, Type X.

2.3 ACCESSORIES

A. ASTM C1047, except form of 0.39 mm (0.015 inch) thick zinc coated steel sheet or rigid PVC plastic.

B. Flanges not less than 22 mm (7/8 inch) wide with punchouts or deformations as required to provide compound bond.

2.4 FASTENERS

A. ASTM C1002 and ASTM C840, except as otherwise specified.

B. ASTM C954, for steel studs thicker than 0.04 mm (0.33 inch).

C. Select screws of size and type recommended by the manufacturer of the material being fastened.

D. For fire rated construction, type and size same as used in fire rating test.

E. Clips: Zinc-coated (galvanized) steel; gypsum board manufacturer's standard items.

2.5 FINISHING MATERIALS AND LAMINATING ADHESIVE

A. ASTM C475 and ASTM C840. Free of antifreeze, vinyl adhesives, preservatives, biocides and other VOC. Adhesive shall contain a maximum VOC content of 50 g/l.

PART 3 - EXECUTION

3.1 GYPSUM BOARD HEIGHTS

A. Extend all layers of gypsum board from floor to underside of structure overhead on following partitions and furring:
   1. Two sides of partitions:
      a. Fire rated partitions.
      b. Smoke partitions.
      c. Sound rated partitions.
      d. Full height partitions shown (FHP).
      e. Corridor partitions.
   2. One side of partitions or furring:
      a. Inside of exterior wall furring or stud construction.
      b. Room side of room without suspended ceilings.
      c. Furring for pipes and duct shafts, except where fire rated shaft wall construction is shown.
   3. Extend all layers of gypsum board construction used for fireproofing of columns from floor to underside of structure overhead, unless shown otherwise.

B. In locations other than those specified, extend gypsum board from floor to heights as follows:
   1. Not less than 100 mm (6 inches) above suspended acoustical ceilings.
   2. At ceiling of suspended gypsum board ceilings.
   3. At existing ceilings.

3.2 INSTALLING GYPSUM BOARD

A. Coordinate installation of gypsum board with other trades and related work.

B. Install gypsum board in accordance with ASTM C840, except as otherwise specified.

C. Moisture and Mold-Resistant Assemblies: Provide and install moisture and mold-resistant glass mat gypsum wallboard products with moisture-resistant surfaces complying with ASTM C1658 where shown and in locations which might be subject to moisture exposure during construction.

D. Use gypsum boards in maximum practical lengths to minimize number of end joints.

E. Bring gypsum board into contact, but do not force into place.

F. Ceilings:
   1. For single-ply construction, use perpendicular application.
   2. For two-ply assembles:
      a. Use perpendicular application.
      b. Apply face ply of gypsum board so that joints of face ply do not occur at joints of base ply with joints over framing members.

G. Walls (Except Shaft Walls):
   1. When gypsum board is installed parallel to framing members, space fasteners 300 mm (12 inches) on center in field of the board, and 200 mm (8 inches) on center along edges.
   2. When gypsum board is installed perpendicular to framing members, space fasteners 300 mm (12 inches) on center in field and along edges.
   3. Stagger screws on abutting edges or ends.
   4. For single-ply construction, apply gypsum board with long dimension either parallel or perpendicular to framing members as required to minimize number of joints except gypsum board shall be applied vertically over "Z" furring channels.
   5. For two-ply gypsum board assemblies, apply base ply of gypsum board to assure minimum number of joints in face layer. Apply face ply of wallboard to base ply so that joints of face ply do not occur at joints of base ply with joints over framing members.
   6. For three-ply gypsum board assemblies, apply plies in same manner as for two-ply assemblies, except that heads of fasteners need only be driven flush with surface for first and second plies. Apply third ply of wallboard in same manner as second ply of two-ply assembly, except use fasteners of sufficient length enough to have the same penetration into framing members as required for two-ply assemblies.
   7. No offset in exposed face of walls and partitions will be permitted because of single-ply and two-ply or three-ply application requirements.
   8. Installing Two Layer Assembly Over Sound Deadening Board:
      a. Apply face layer of wallboard vertically with joints staggered from joints in sound deadening board over framing members.

b. Fasten face layer with screw, of sufficient length to secure to framing, spaced 300 mm (12 inches) on center around perimeter, and 400 mm (16 inches) on center in the field.

9. Control Joints ASTM C840 and as follows:
   a. Locate at both side jambs of openings if gypsum board is not "yoked". Use one system throughout.
   b. Space joints at 30 feet (9000 mm) maximum. Not required for wall lengths less than 9000 mm (30 feet).
   c. Extend control joints the full height of the wall or length of soffit/ceiling membrane.

H. Acoustical or Sound Rated Partitions, Fire and Smoke Partitions:
   1. Cut gypsum board for a space approximately 3 mm to 6 mm (1/8 to 1/4 inch) wide around partition perimeter.
   2. Coordinate for application of caulking or sealants to space prior to taping and finishing.
   3. For sound rated partitions, use sealing compound (ASTM C919) to fill the annular spaces between all receptacle boxes and the partition finish material through which the boxes protrude to seal all holes and/or openings on the back and sides of the boxes. STC minimum values as shown.

I. Electrical and Telecommunications Boxes:
   1. Seal annular spaces between electrical and telecommunications receptacle boxes and gypsum board partitions.

J. Accessories:
   1. Set accessories plumb, level and true to line, neatly mitered at corners and intersections, and securely attach to supporting surfaces as specified.
   2. Install in one piece, without the limits of the longest commercially available lengths.
   3. Corner Beads:
      a. Install at all vertical and horizontal external corners and where shown.
      b. Use screws only. Do not use crimping tool.
   4. Edge Trim (casings Beads):
      a. At both sides of expansion and control joints unless shown otherwise.

b. Where gypsum board terminates against dissimilar materials and at perimeter of openings, except where covered by flanges, casings or permanently built-in equipment.

c. Where gypsum board surfaces of non-load bearing assemblies about load bearing members.

d. Where shown.

3.3 INSTALLING GYPSUM SHEATHING

A. Install in accordance with ASTM C840, except as otherwise specified or shown.

B. Use screws of sufficient length to secure sheathing to framing.

C. Space screws 9 mm (3/8 inch) from ends and edges of sheathing and 200 mm (8 inches) on center. Space screws a maximum of 200 mm (8 inches) on center on intermediate framing members.

D. Apply 600 mm by 2400 mm (2 foot by 8 foot) sheathing boards horizontally with tongue edge up.

E. Apply 1200 mm by 2400 mm or 2700 mm (4 ft. by 8 ft. or 9 foot) gypsum sheathing boards vertically with edges over framing.

3.4 FINISHING OF GYPSUM BOARD

A. Finish joints, edges, corners, and fastener heads in accordance with ASTM C840. Use Level 4 finish for al finished areas open to public view.

B. Before proceeding with installation of finishing materials, assure the following:

1. Gypsum board is fastened and held close to framing or furring.
2. Fastening heads in gypsum board are slightly below surface in dimple formed by driving tool.

C. Finish joints, fasteners, and all openings, including openings around penetrations, on that part of the gypsum board extending above suspended ceilings to seal surface of non decorated smoke barrier, fire rated and sound rated and sound rated gypsum board construction. After the installation of hanger rods, hanger wires, supports, equipment, conduits, piping and similar work, seal remaining openings and maintain the integrity of the smoke barrier, fire rated and sound rated construction/ Sanding is not required of non decorated surfaces.

3.5 REPAIRS

A. After taping and finishing has been completed, and before decoration, repair all damaged and defective work, including nondecorated surfaces.

B. Patch holes or openings 13 mm (1/2 inch) or less in diameter, or equivalent size, with a setting type finishing compound or patching plaster.

C. Repair holes or openings over 13 mm (1/2 inch) diameter, or equivalent size, with 16 mm (5/8 inch) thick gypsum board secured in such a manner as to provide solid substrate equivalent to undamaged surface.

D. Tape and refinish scratched, abraded or damaged finish surfaces including cracks and joints in non decorated surface to provide smoke tight construction fire protection equivalent to the fire rated construction and STC equivalent to the sound rated construction .

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SECTION 09 30 13

CERAMIC/PORCELAIN TILING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies interior ceramic, porcelain tile, marble thresholds and waterproofing membranes for thin-set applications, crack isolation membranes, and tile backer board.

1.2 RELATED WORK

A. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS: Sustainable Design Requirements.

B. Section 07 92 00, JOINT SEALANTS: Sealing of Joints.

C. Section 09 06 00, SCHEDULE FOR FINISHES: Color, Texture, Pattern, and Size of Field Tile and Trim Shapes, and Color of Grout Specified.

1.3 SUBMITTALS

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

B. Sustainable Design Submittals as described below:

1. Volatile organic compounds per volume as specified in PART 2 - PRODUCTS.

C. Samples:

1. Base tile, each type, each color, each size.
2. Mosaic floor tile panels, 228 by 228 mm (9 by 9 inches), each type, color, size and pattern.
3. Porcelain tile, each type, color, patterns and size.
4. Wall (or wainscot) tile, each color, size and pattern.
5. Trim shapes, bullnose cap and cove including bullnose cap and base pieces at internal and external corners of vertical surfaces, each type, color, and size.

D. Product Data:

1. Ceramic and porcelain tile, marked to show each type, size, and shape required.
2. Chemical resistant mortar and grout (epoxy and furan).
3. Cementitious backer unit.
4. Dry-set portland cement mortar and grout.
5. Divider strip.

6. Elastomeric membrane and bond coat.
7. Reinforcing tape.
8. Leveling compound.
9. Latex-portland cement mortar and grout.
10. Commercial portland cement grout.
11. Organic adhesive.
12. Slip resistant tile.
13. Waterproofing isolation membrane.
14. Fasteners.

E. Certification:

1. Master grade certificate, ANSI A137.1.
2. Manufacturer's certificates indicating that the following materials comply with specification requirements:
   a. Chemical resistant mortar and grout (epoxy and furan).
   b. Modified epoxy emulsion.
   c. Commercial portland cement grout.
   d. Cementitious backer unit.
   e. Dry-set portland cement mortar and grout.
   f. Elastomeric membrane and bond coat.
   g. Reinforcing tape.
   h. Latex-portland cement mortar and grout.
   i. Leveling compound.
   j. Organic adhesive.
   k. Waterproof isolation membrane.
   l. Factory back mounted tile documentation for suitability for application in wet area.

F. Installer Qualifications:

1. Submit letter stating installer’s experience.

1.4 DELIVERY AND STORAGE

A. Deliver materials in containers with labels legible and intact and grade-seals unbroken.

B. Store material to prevent damage or contamination.

1.5 QUALITY ASSURANCE

A. Installers to be from a company specializing in performing installation of products specified and have a minimum of three (3) years’ experience.

B. Each type and color of tile to be provided from a single source.

C. Each type and color of mortar, adhesive, and grout to be provided from the same source.

1.6 WARRANTY

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

1.7 APPLICABLE PUBLICATIONS

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

B. American National Standards Institute (ANSI):

A10.20-06(R2016).....Safe Operating Practices for Tile, Terrazzo and Marble Work

A108/A118/A136.1:2019...Installation of Ceramic Tile

A108.01-18.....Subsurfaces and Preparations by Other Trades

A108.02-19.....Materials, Environmental, and Workmanship

A108.1A-17.....Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar

A108.1B-17.....Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex-Portland Cement Mortar

A108.1C-17.....Contractors Option; Installation of Ceramic Tile in the Wet-Set method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex-Portland Cement Mortar

A108.4-09.....Ceramic Tile with Organic Adhesives or Water Cleanable Tile-Setting Epoxy Adhesive

A108.5-10 .....Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar

A108.6-10.....Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy

A108.8-10.....Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout

A108.9-10.....Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout

A108.10-17.....Grout in Tilework
A108.11-18.....Interior Installation of Cementitious Backer Units
A108.12-10.....Installation of Ceramic Tile with EGP (Exterior Glue Plywood) Latex-Portland Cement Mortar
A108.13-16.....Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone
A108.14-10.....Paper-Faced Glass Mosaic Tile
A108.15-19.....Alternate Method: Paper-Faced Glass Mosaic Tile
A108.17-16.....Crack Isolation Membranes for Thin-Set Ceramic Tile and Dimension Stone
A118.1-19.....Dry-Set Portland Cement Mortar
A118.3-13.....Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy and Water Cleanable Tile-Setting Epoxy Adhesive
A118.4-19.....Modified Dry-Set Cement Mortar
A118.5-16.....Chemical Resistant Furan Mortars and Grouts
A118.6-19.....Standard Cement Grouts for Tile Installation
A118.7-1.....High Performance Cement Grouts for Tile Installation
A118.8-16.....Modified Epoxy Emulsion Mortar/ Grout
A118.9-19.....Cementitious Backer Units
A118.10-14.....Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation
A118.11-17.....EGP (Exterior Glue Plywood) Modified Dry-set Mortar
A118.12-14.....Crack Isolation Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation
A118.13-14.....Bonded Sound Reduction Membranes for Thin-Set Ceramic Tile Installation
A118.15-19.....Improved Modified Dry-Set Cement Mortar
A136.1-13.....Organic Adhesives for Installation of Ceramic Tile
A137.1-17.....American National Standard Specifications for Ceramic Tile

C. ASTM International (ASTM):

A666-15.....Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar

A1064/A1064M-18a.....Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

C109/C109M-20b.....Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2 inch. or [50-mm] Cube Specimens)

C241/C241M-15e1.....Abrasion Resistance of Stone Subjected to Foot Traffic

C348-20.....Standard Test Method for Flexural Strength of Hydraulic-Cement Mortars

C627-18.....Evaluating Ceramic Floor Tile Installation Systems Using the Robinson-Type Floor Tester

C954-18.....Steel Drill Screws for the Application of Gypsum Board on Metal Plaster Base to Steel Studs from 0.033 in (0.84 mm) to 0.112 in (2.84 mm) in thickness

C979/C979M-16.....Pigments for Integrally Colored Concrete

C1002-18.....Steel Self-Piercing Tapping Screws for the Application of Panel Products

C1027-19.....Test Method for Determining Visible Abrasion Resistance of Glazed Ceramic Tile

C1127/C1127M-15.....Standard Guide for Use of High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane with an Integral Wearing Surface

C1178/C1178M-18.....Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel

C1325-19.....Non-Asbestos Fiber-Mat Reinforced Cementitious Backer Units

C1353/C1353M-20e1.....Abrasion Resistance of Dimension Stone Subjected to Foot Traffic Using a Rotary Platform, Double-Head Abraser

D1204-14(2020).....Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature

D2240-15e1.....Test Method for Rubber Property - Durometer Hardness

D2497-07(2018).....Tolerances for Manufactured Organic-Base Filament Single Yarns

D3045-2018.....Heat Aging of Plastics Without Load

D4397-16.....Standard Specification for Polyethylene Sheeting for Construction, Industrial and Agricultural Applications

D5109-12(Withdrawn2020).Standard Test Methods for Copper-Clad Thermosetting Laminates for Printed Wiring Boards (recommend deletion)

D. Code of Federal Regulation (CFR):

40 CFR 59.....Determination of Volatile Matter Content, Water Content, Density Volume Solids, and Weight Solids of Surface Coating

E. Marble Institute of America (MIA)/ Building Stone Institute (BSI):

Dimension Stone Design Manual VIII-2016

F. Tile Council of North America, Inc. (TCNA):

Handbook for Ceramic Tile Installation (2020)G. TCNA DCOF AcuTest-2012,Dynamic Coefficient of Friction Test

PART 2 - PRODUCTS

2.1 TILE

A. Comply with ANSI A137.1, Standard Grade, except as modified:

1. Inspection procedures listed under the Appendix of ANSI A137.1.
2. Abrasion Resistance Classification:
   a. Tested in accordance with values listed in Table 1, ASTM C1027.
   b. Class V, 12000 revolutions for floors in Corridors, Kitchens, Storage including Refrigerated Rooms
   c. Class IV, 6000 revolutions for remaining areas.
3. Slip Resistant Tile for Floors:
   a. Coefficient of friction, when tested in accordance with ANSI A137.1 and measured per the TCNA DCOF AcuTest.
      1) Equal to or greater than .42 for level interior tile floors that will be walked on when wet.
   b. Tile Having Abrasive Grains:

1) Unglazed Ceramic Mosaic Tile: Abrasive grains throughout body of the tile.

c. Porcelain Paver Tile: Matte surface finish with raised ridges spaced uniformly over tile surface .

4. Mosaic tile may be mounted or joined by a resinous bonding material along tile edges.

5. Back mounted tiles in manual cart wash. Provide certification that the factory mounted tile has been used successfully in service at three (3) projects and is suitable for wet locations.

6. Factory Blending: For tile with color variations, within the ranges selected during sample submittals blend tile in the factory and package so tile units taken from one (1) package show the same range in colors as those taken from other packages and match approved samples.

7. Factory-Applied Temporary Protective Coating:

a. Protect exposed face surfaces (top surface) of tile against adherence of mortar and grout by pre-coating with a continuous film of hot applied petroleum paraffin wax.

b. Do not coat unexposed tile surfaces.

c. Pre-wax tiles set or grouted with furan or epoxy or latex modified mortars .

B. Unglazed Ceramic Mosaic Tile: Nominal 6 mm (1/4 inch) thick with cushion edges.

C. Glazed Wall Tile: Cushion edges, glazing.

D. Trim Shapes:

1. Conform to applicable requirements of adjoining floor and wall tile.

2. Use slip resistant trim shapes for horizontal surfaces of showers congregate baths, natatorium, hydrotherapy, therapeutic pool, overflow ledges, recessed steps, shower curbs, drying area curbs, and seats.

3. Use trim shapes sizes conforming to size of adjoining field wall tile including existing spaces unless detailed on construction documents or specified otherwise.

4. Internal and External Corners:

a. Square internal and external corner joints are not acceptable.

b. External corners including edges: Use bullnose shapes.

c. Internal corners: Use cove shapes.

d. Base to floor internal corners: Use special shapes providing integral cove vertical and horizontal joint.

e. Base to floor external corners: Use special shapes providing bullnose vertical edge with integral cove horizontal joint. Use stop at bottom of openings having bullnose return to wall.

f. Wall top edge internal corners: Use special shapes providing integral cove vertical joint with bullnose top edge.

g. Wall top edge external corners: Use special shapes providing bullnose vertical and horizontal joint edge.

h. For unglazed ceramic mosaic and glazed wall tile installed in portland cement mortar setting bed, use cove and bullnose shapes as applicable. When ceramic mosaic wall and base tile is required, use C Series cove and bullnose shapes.

i. For unglazed ceramic mosaic and glazed wall tile installed in dry-set portland cement mortar, latex-portland cement mortar, and organic adhesive (thin set methods), use cove and surface bullnose shapes as applicable.

j. Provide cove and bullnose shapes where indicated in construction documents, and required to complete tile work.

2.2 BACKER UNITS

A. Cementitious Backer Units:

1. Use in showers or wet areas.
2. Conform to ASTM C1325; Type A.
3. Use in maximum lengths available to minimize end to end butt joints.

B. Glass Mat Water Resistant Backing Board:

1. Use in showers or wet areas.
2. Conform to ASTM C1178/C1178M.
3. Use in maximum lengths available to minimize end to end butt joints.

2.3 JOINT MATERIALS FOR CEMENTITIOUS BACKER UNITS

A. Reinforcing Tape: Vinyl coated woven glass fiber mesh tape, open weave, 50 mm (2 inches) wide. Tape with pressure sensitive adhesive backing will not be permitted.

B. Tape Embedding Material: Latex-portland cement mortar complying with ANSI A108.01.

C. Joint material, including reinforcing tape, and tape embedding material, are to be as specifically recommended by the backer unit manufacturer.

2.4 FASTENERS

A. Screws for Cementitious Backer Units.
   1. Standard screws for gypsum board are not acceptable.
   2. Minimum 11 mm (7/16 inch) diameter head, corrosion resistant coated, with washers.
   3. ASTM C954 for steel 1 mm (0.033 inch) thick.
   4. ASTM C1002 for steel framing less than 0.0329 inch thick.

B. Washers: Galvanized steel, 13 mm (1/2 inch) minimum diameter.

2.5 SETTING MATERIALS OR BOND COATS

A. Conform to TCNA Handbook for Ceramic Tile Installation.

B. Portland Cement Mortar: ANSI A108.02.

C. Latex-Portland Cement Mortar: ANSI A118.4.
   1. For wall applications, provide non-sagging, latex-portland cement mortar complying with ANSI A118.4.
   2. Prepackaged Dry-Mortar Mix: Factory-prepared mixture of portland cement; dry, redispersible, ethylene vinyl acetate additive; and other ingredients to which only water needs to be added at Project site.

D. Dry-Set Portland Cement Mortar: ANSI A118.1. For wall applications, provide non-sagging, latex-portland cement mortar complying with ANSI A118.1.

E. Organic Adhesives: ANSI A136.1, Type 1.

F. Chemical-Resistant Bond Coat:
   1. Epoxy Resin Type: ANSI A118.3.
   2. Furan Resin Type: ANSI A118.5.

G. Elastomeric Waterproofing Membrane and Bond Coat:
   1. TCNA F122-14 (on ground concrete) and TCNA F112A-14 (above ground concrete).
   2. ANSI A118.10.
   3. One component polyurethane, liquid applied material having the following additional physical properties:
      a. Hardness: Shore "A" between 40-60.
      b. Elongation: Between 300-600 percent.

c. Tensile strength: Between .27 - .41 Newton per square millimeter (40-60 pounds per square inch gauge).

d. No volatile compounds (VOC).

4. Coal tar modified urethanes are not acceptable.

H. Waterproofing Isolation Membrane:

1. Sheet System TCNA F122-14 (on-ground concrete) and TCNA F122A-14 (above-ground concrete).
2. Composite sheet consisting of ASTM D5109, Type II, Grade I Chlorinated Polyethylene (CM) sheet reinforced on both sides with a non-woven polyester fiber.
3. Designed for use in wet areas as an isolation and positive waterproofing membranes for thin-set bonding of sheet to substrate and thin-set bonding of ceramic and porcelain tile or marble to sheet. Suited for both horizontal and vertical applications.
4. Conform to the following additional physical properties:

Property	Units	Results	Test Method
Hardness Shore A	Points	70-80	ASTM D2240 (10 Second Reading)
Shrinkage	Percent	5 maximum	ASTM D1204
Brittleness		No crack remains flexible at temperature -37 degrees C (-35 degrees F)	ASTM D2497 13 mm (1/2-inch) Mandrel Bend
Retention of Properties after Heat Aging	Percent of original	80 Tensile 80 Breaking 80 Elongation	ASTM D3045, 90 degrees C (194 degrees F) for 168 hours

5. Manufacturer’s standard sheet size with prefabricated or preformed inside and outside corners.
6. Sheet manufacturer’s solvent welding liquid or xylene and edge sealant.

2.6 GROUTING MATERIALS

A. Coloring Pigments:
   1. Pure mineral pigments, lime proof and nonfading, complying with ASTM C979/C979M.
   2. Coloring pigments may only be added to grout by the manufacturer.
   3. Job colored grout is not acceptable.
   4. Use is required in Commercial Portland Cement Grout, Dry-Set Grout, and Latex-Portland Cement Grout.

B. Sand-Portland Cement Grout: ANSI A108.10, consisting of white or gray cement and white or colored aggregate as required to produce color indicated. Zero VOC content.

C. Standard Cement Grout: ANSI A118.6.

D. High Performance Tile Grout: ANSI A118.7 with a VOC content of 65 g/L or less when calculated according to 40 CFR 59 (EPA Method 24) .
   1. Polymer Type: Ethylene vinyl acetate or acrylic additive, in dry, redispersible form, prepackaged with other dry ingredients.
   2. Polymer Type: Acrylic resin or styrene-butadiene rubber in liquid-latex form for addition to prepackaged dry-grout mix.

E. Water-Cleanable Epoxy Grout: ANSI A118.3 , with a VOC content of 65 g/L or less when calculated according to 40 CFR 59 (EPA Method 24) .
   1. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 60 and 100 degrees C (140 and 212 degrees F), respectively, and certified by manufacturer for intended use.

2.7 PATCHING AND LEVELING COMPOUND

A. Portland cement base, polymer-modified, self-leveling compound, manufactured specifically for resurfacing and leveling concrete floors. Products containing gypsum are not acceptable.

B. Provide a patching and leveling compound with the following minimum physical properties:
   1. Compressive strength - 25 MPa (3500 psig) per ASTM C109/C109M.
   2. Flexural strength - 7 MPa (1000 psig) per ASTM C348 (28 day value).
   3. Tensile strength – 4.1 MPa (600 psi) per ANSI 118.7.
   4. Density – 1.9.

C. Capable of being applied in layers up to 38 mm (1-1/2 inches) thick without fillers and up to 101 mm (4 inches) thick with fillers, being brought to a feather edge, and being trowelled to a smooth finish.

D. Primers, fillers, and reinforcement as required by manufacturer for application and substrate condition.

E. Ready for use in 48 hours after application.

2.8 MARBLE

A. Soundness Classification in accordance with MIA Design Manual III Groups.

B. Thresholds:

1. Group A, Minimum abrasive hardness (Ha) of 10.0 per ASTM C1353/C1353M or ASTM C241/C241M.
2. Honed finish on exposed faces.
3. Thickness and contour as indicated in construction documents.
4. Fabricate from one piece without holes, cracks, or open seams; full depth of wall or frame opening by full width of wall or frame opening; 19 mm (3/4-inch) minimum thickness and 6 mm (1/4-inch) minimum thickness at beveled edge.
5. Set not more than 13 mm (1/2-inch) above adjoining finished floor surfaces, with transition edges beveled on a slope of no greater than 1:2. On existing floor slabs provide 13 mm (1/2-inch) above ceramic tile surface with bevel edge joint top flush with adjacent floor.
6. One piece full width of door opening. Notch thresholds to match profile of doorjambs.

2.9 METAL DIVIDER STRIPS

A. Terrazzo type divider strips.

B. Heavy top type strip with 5 mm (3/16 inch) wide top and 38 mm (1 1/2 inch) long leg. Height to match tile and setting-bed thickness.

C. Embedded leg perforated and deformed for keying to mortar.

D. Half-hard brass white zine alloy nickel silver stainless-steel, ASTM A666, 300 Series exposed-edge material.

2.10 WATER

A. Clean, potable and free from salts and other injurious elements to mortar and grout materials.

2.11 CLEANING COMPOUNDS

A. Specifically designed for cleaning masonry and concrete and which will not prevent bond of subsequent tile setting materials including patching and leveling compounds and elastomeric waterproofing membrane and coat.

B. Materials containing acid or caustic Material are not acceptable.

2.12 FLOOR MORTAR BED REINFORCING

A. ASTM A1064/A1064M welded wire fabric without backing, MW3 x MW3 (2 x 2-W0.5 x W0.5).

2.13 POLYETHYLENE SHEET

A. Polyethylene sheet conforming to ASTM D4397.

B. Nominal thickness: 0.15 mm (6 mils).

PART 3 - EXECUTION

3.1 ENVIRONMENTAL REQUIREMENTS

A. Maintain ambient temperature of work areas at not less than 16 degrees C (60 degrees F), without interruption, for not less than 24 hours before installation and not less than three (3) days after installation.

B. Maintain higher temperatures for a longer period of time where required by manufacturer's recommendation and ANSI Specifications for installation.

C. Do not install tile when the temperature is above 38 degrees C (100 degrees F).

D. Do not install materials when the temperature of the substrate is below 16 degrees C (60 degrees F).

E. Do not allow temperature to fall below 10 degrees C (50 degrees F) after third day of completion of tile work.

3.2 ALLOWABLE TOLERANCE

A. Variation in plane of sub-floor, including concrete fills leveling compounds and mortar beds:

1. Not more than 6 mm in 3048 mm (1/4 inch in 10 feet) from required elevation where portland cement mortar setting bed is used.
2. Not more than 3 mm in 3048 mm (1/8 inch in 10 feet) where dry-set portland cement, and latex-portland cement mortar setting beds and chemical-resistant bond coats are used.

B. Variation in Plane of Wall Surfaces:

1. Not more than 6 mm in 2438 mm (1/4 inch in 8 feet) from required plane where portland cement mortar setting bed is used.
2. Not more than 3 mm in 2438 mm (1/8 inch in 8 feet) where dry-set or latex-portland cement mortar or organic adhesive setting materials is used.

3.3 SURFACE PREPARATION

A. Patching and Leveling:
   1. Mix and apply patching and leveling compound in accordance with manufacturer's instructions.
   2. Fill holes and cracks and align concrete floors that are out of required plane with patching and leveling compound.
      a. Thickness of compound as required to bring finish tile system to elevation shown on construction documents.
      b. Float finish except finish smooth for elastomeric waterproofing.
      c. At substrate expansion, isolation, and other moving joints, allow joint of same width to continue through underlayment.
   3. Apply patching and leveling compound to concrete and masonry wall surfaces that are out of required plane.
   4. Apply leveling coats of material compatible with wall surface and tile setting material to wall surfaces, other than concrete and masonry that are out of required plane.

B. Mortar Bed for Slopes to Drains:
   1. Slope compound to drain where drains are shown on construction documents.
   2. Install mortar bed in depressed slab sloped to drains not less than 3.2 mm in 305 mm (1/8 inch per foot).
   3. Allow not less than 50 mm (2 inch) depression at edge of depressed slab.
   4. Screed for slope to drain and float finish.
   5. Cure mortar bed for not less than seven (7) days. Do not use curing compounds or coatings.
   6. Perform flood test to verify mortar bed slopes to drain before installing tile. Contracting Officer Representative (COR) to be present during flood test.

C. Additional preparation of concrete floors for tile set with epoxy, or furan-resin is to be in accordance with the manufacturer's printed instructions.

D. Cleavage Membrane:

1. Install polythene sheet as cleavage membrane in depressed slab when waterproof membrane is not scheduled or indicated.
2. Turn up at edge of depressed floor slab to top of floor.

E. Walls:

1. In manual cart wash or other wet areas cover studs with polyethylene sheet.
2. Apply leveling coats of material compatible with wall surface and tile setting material to wall surfaces, other than concrete and masonry that are out of required plane.
3. Apply metal lath to framing in accordance with ANSI A108.1:
   a. Use fasteners specified in paragraph "Fasteners." Use washers when lath opening is larger than screw head.
   b. Apply scratch and leveling coats to metal lath in accordance with ANSI A108.1C.
   c. Total thickness of scratch and leveling coats:
      1) Apply 9 mm to 16 mm (3/8 inch to 5/8 inch) thick over solid backing.
      2) 16 mm to 19 mm (5/8 to 3/4 inch) thick on metal lath over studs.
      3) Where wainscots are required to finish flush with wall surface above, adjust thickness required for flush finish.
   d. Apply scratch and leveling coats more than 19 mm (3/4 inch) thick in two (2) coats.

F. Existing Floors and Walls:

1. Remove existing composition floor finishes and adhesive. Prepare surface by grinding, chipping, self-contained power blast cleaning or other suitable mechanical methods to completely expose uncontaminated concrete or masonry surfaces. Follow safety requirements of ANSI A10.20.
2. Remove existing concrete fill or topping to structural slab. Clean and level the substrate for new setting bed and waterproof membrane or cleavage membrane.

3. Where new tile bases are required to finish flush with plaster above or where they are extensions of similar bases in conjunction with existing floor tiles, cut channel in floor slab and expose rough wall construction sufficiently to accommodate new tile base and setting material.

3.4 CEMENTITIOUS BACKER UNITS

A. Remove polyethylene wrapping from cementitious backer units and separate to allow for air circulation. Allow moisture content of backer units to dry down to a maximum of 35 percent before applying joint treatment and tile.

B. Install in accordance with ANSI A118.9 except as specified otherwise.

C. Install units horizontally or vertically to minimize joints with end joints over framing members. Units with rounded edges; face rounded edge away from studs to form a “V” joint for joint treatment.

D. Secure cementitious backer units to each framing member with screws spaced not more than 203 mm (8 inches) on center and not closer than 13 mm (1/2 inch) from the edge of the backer unit or as recommended by backer unit manufacturer. Install screws so that the screw heads are flush with the surface of the backer unit.

E. Where backer unit joins shower pans or waterproofing, lap backer unit over turned up waterproof system. Install fasteners only through top one-inch of turned up waterproof systems.

F. Do not install joint treatment for seven (7) days after installation of cementitious backer unit.

G. Joint Treatment:

1. Fill horizontal and vertical joints and corners with latex-portland cement mortar. Apply fiberglass tape over joints and corners and embed with same mortar.
2. Leave 6 mm (1/4 inch) space for sealant at lips of tubs, sinks, or other plumbing receptors.

3.5 GLASS MAT WATER-RESISTANT BACKING BOARD

A. Install in accordance with manufacturer’s instructions.
TCNA Systems W245-1.

B. Treat joints with tape and latex-portland cement mortar or adhesive.

3.6 MARBLE

A. Secure thresholds and stools in position with minimum of two stainless steel dowels.

B. Set in dry-set portland cement mortar or latex-portland cement mortar bond coat.

C. Set threshold to finish 13 mm (1/2 inch) above ceramic tile floor unless shown otherwise on construction documents, with bevel edge joint top flush with adjacent floor similar to TCNA detail TR611-14.

3.7 METAL DIVIDER STRIPS

A. Install metal divider strips in floor joints between ceramic tile floors and between tile floors and adjacent flooring of other materials where the finish floors are flush unless shown otherwise on construction documents.

B. Set divider strip in mortar bed to line and level centered under doors or in openings.

C. At preformed sealant joint: Refer to Section 07 95 13, EXPANSION JOINT COVER ASSEMBLIES.

1. Comply with recommendations in TCNA for Vertical and Horizontal Joint Design Essentials. TCNA Systems EJ 171.
   a. Locate joint in tile surfaces directly above joint in sub-floor or where indicated when used with isolation membranes to allow off-setting of joint location from sub-floor joint.
   b. Fasten full length to sub-floor using a construction adhesive.
   c. Trowel setting material with full coverage over the entire leg.
2. Set tile up against the joint ensuring that the top edge of the joint is flush or slightly below the top of the tile.

3.8 CERAMIC TILE - GENERAL

A. Comply with ANSI A108/A118/A136 series of tile installation standards applicable to methods of installation and TCNA Installation Guidelines.

B. Installing Mortar Beds for Floors:

1. Install mortar bed in a manner that does not damage cleavage or waterproof membrane; 32 mm (1-1/2 inch) minimum thickness.
2. Install floor mortar bed reinforcing centered in mortar fill.
3. Screed finish to level plane or slope to drains shown on construction documents, float finish.

4. For thin set systems cure mortar bed not less than seven (7) days. Do not use curing compounds or coatings.
5. For tile set with portland cement paste over plastic mortar bed coordinate to set tile before mortar bed sets.

C. Setting Beds or Bond Coats:

1. Where recessed or depressed floor slabs are filled with portland cement mortar bed, set ceramic mosaic floor tile in either portland cement paste over plastic mortar bed or latex-portland cement mortar over cured mortar bed except as specified otherwise, ANSI A108-1C, TCNA System F121-14 or F111-14.
2. Set floor tile in elastomeric bond coat over elastomeric membrane per ANSI 108.13, TCNA System F122-14 where indicated on construction documents.
3. Set wall tile installed over concrete backer board in latex-portland cement mortar, ANSI A108.1B.
4. Set wall tile installed over portland cement mortar bed on metal lath base in portland cement paste over plastic mortar bed, or dry-set portland cement mortar or latex-portland cement mortar over a cured mortar bed, ANSI A108.1C, TCNA System W231-14, W241-14.
5. Set tile installed over gypsum board and gypsum plaster in organic adhesive, ANSI A108.1, TCNA System W242-14.
6. Set trim shapes in same material specified for setting adjoining tile.

D. Workmanship:

1. Lay out tile work so that no tile less than one-half full size is used. Make all cuts on the outer edge of the field. Align new tile work scheduled for existing spaces to the existing tile work unless specified otherwise.
2. Set tile firmly in place with finish surfaces in true planes. Align tile flush with adjacent tile unless shown otherwise on construction documents.
3. Form intersections and returns accurately.
4. Cut and drill tile neatly without marring surface.
5. Cut edges of tile abutting penetrations, finish, or built-in items:

a. Fit tile closely around electrical outlets, piping, fixtures and fittings, so that plates, escutcheons, collars and flanges will overlap cut edge of tile.

b. Seal tile joints water tight as specified in Section 07 92 00, JOINT SEALANTS, around electrical outlets, piping fixtures and fittings before cover plates and escutcheons are set in place.

6. Completed work is to be free from hollow sounding areas and loose, cracked or defective tile.

7. Remove and reset tiles that are out of plane or misaligned.

8. Floors:

a. Extend floor tile beneath casework and equipment, except those units mounted in wall recesses.

b. Align finish surface of new tile work flush with other and existing adjoining floor finish where indicated in construction documents.

c. In areas where floor drains occur, slope tile to drains.

d. Push and vibrate tiles over 203 mm (8 inches) square to achieve full support of bond coat.

9. Walls:

a. Cover walls and partitions, including pilasters, furred areas, and freestanding columns from floor to ceiling, or from floor to nominal wainscot heights as indicated in construction documents with tile.

b. Finish reveals of openings with tile, except where other finish materials are indicated in construction documents.

c. Finish wall surfaces behind and at sides of casework and equipment, except those units mounted in wall recesses, with same tile as scheduled for room proper.

10. Joints:

a. Keep all joints in line, straight, level, perpendicular and of even width unless shown otherwise on construction documents.

b. Make joints 2 mm (1/16 inch) wide for glazed wall tile and mosaic tile work.

11. Back Buttering: For installations indicated below, obtain 100 percent mortar coverage by complying with applicable special

requirements for back buttering of tile in referenced ANSI A108/A118/A136 series of tile installation standards:

a. Tile wall installations in wet areas, including showers, tub enclosures, laundries and swimming pools.
b. Tile installed with chemical-resistant mortars and grouts.
c. Tile wall installations composed of tiles 203 by 203 mm (8 by 8 inches) or larger.
d. Exterior tile wall installations.

3.9 CERAMIC TILE INSTALLED WITH PORTLAND CEMENT MORTAR

A. Mortar Mixes for Floor, Wall and Base Tile (including Showers , and Therapeutic Pools): ANSI A108.1A. except specified otherwise.
B. Installing Wall and Base Tile: ANSI A108.1A, except specified otherwise.
C. Installing Floor Tile: ANSI A108.1A, except as specified otherwise. Slope mortar beds to floor drains at a minimum of 3 mm in 305 mm (1/8 inch per foot).

3.10 PORCELAIN TILE INSTALLED WITH LATEX PORTLAND CEMENT BONDING MORTAR

A. Due to the denseness of porcelain tile use latex portland cement bonding mortar that meets the requirements of ANSI A108.01. Mix bonding mortars in accordance with manufacturer’s instructions. Provide liquid ratios and comply with dwell times during the placement of bonding mortar and tile.

3.11 THIN SET CERAMIC AND PORCELAIN TILE INSTALLED WITH DRY-SET PORTLAND CEMENT AND LATEX-PORTLAND CEMENT MORTAR

A. Installation of Tile: ANSI A108.1B, except as specified otherwise.
B. Slope tile work to drains at not less than 3 mm in 305 mm (1/8 inch per foot).

3.12 THIN SET CERAMIC AND PORCELAIN TILE INSTALLED WITH ORGANIC ADHESIVE

A. Installation of Tile: ANSI A108.4.

3.13 THIN SET CERAMIC AND PORCELAIN TILE INSTALLED WITH CHEMICAL-RESISTANT BOND COAT

A. Epoxy Resin Type: Install tile in accordance with Installation of Tile with Epoxy Mortar; ANSI A108.6.
B. Furan Resin Type: Proportion, mix and place in accordance with the manufacturer's printed instructions. Set tile in accordance with ANSI A108.8.

3.14 CERAMIC AND PORCELAIN TILE INSTALLED WITH ELASTOMERIC BOND COAT

A. Surface Preparation: Prepare surfaces as specified.

B. Installation of Elastomeric Membrane: ANSI A108.10 and TCNA F122-14 (on ground concrete) and F122A-14 (above-ground concrete).

1. Prime surfaces, where required, in accordance with manufacturer's instructions.
2. Install first coat of membrane material in accordance with manufacturer's instructions, in thickness of 0.76 to 1.3 mm (30 to 50 mils).
3. Extend material over flashing rings of drains and turn up vertical surfaces not less than 101 mm (4 inches) above finish floor surface.
4. When material has set, recoat areas with a second coat of elastomeric membrane material for a total thickness of 1.3 to 1.9 mm (50 to 75 mils).
5. After curing test for leaks with 25 mm (1 inch) of water for 24 hours.

C. Installation of Tile in Elastomeric Membrane:

1. Spread no more material than can be covered with tile before material starts to set.
2. Apply tile in second coat of elastomeric membrane material in accordance with the coating manufacturer's instructions in lieu at aggregate surfacing specified in ASTM C1127. Do not install top coat over tile.

3.15 GROUTING

A. Grout Type and Location:

1. Grout for glazed wall and base tile, and unglazed mosaic tile portland cement grout, latex-portland cement grout, dry-set grout, or commercial portland cement grout.

B. Workmanship:

1. Install and cure grout in accordance with the applicable standard.
2. Sand Portland Cement Grout: ANSI A108.10.
3. Standard Cement Grout: ANSI A118.6.
4. High Performance Grout: ANSI A118.7.
5. Epoxy Grout: ANSI A108.6.
6. Water-Cleanable Epoxy Grout: ANSI A118.3.

7. Furan and Commercial Portland Cement Grout: ANSI A118.5 and in accordance with the manufacturer's printed instructions.

3.16 MOVEMENT JOINTS

A. Prepare tile expansion, isolation, construction and contraction joints for installation of sealant. Refer to Section 07 92 00, JOINT SEALANTS.

B. TCNA details EJ 171-14.

C. At expansion joints, rake out joint full depth of tile and setting bed and mortar bed. Do not cut waterproof or isolation membrane.

D. Rake out grout at joints between tile, at toe of base, and where indicated in construction documents not less than 6 mm (1/4 inch) deep.

3.17 CLEANING:

A. Thoroughly sponge and wash tile. Polish glazed surfaces with clean dry cloths.

B. Methods and materials used are not permitted to damage or impair appearance of tile surfaces.

C. The use of acid or acid cleaners on glazed tile surfaces is prohibited.

D. Clean tile grouted with epoxy, furan and commercial portland cement grout and tile set in elastomeric bond coat as recommended by the manufacturer of the grout and bond coat.

3.18 PROTECTION

A. Keep traffic off tile floor, until grout and setting material is fully set and cured.

B. Where traffic occurs over tile floor is unavoidable, cover tile floor with not less than 9 mm (3/8 inch) thick plywood, wood particle board, or hardboard securely taped in place. Do not remove protective cover until time for final inspection. Clean tile of any tape, adhesive and stains.

3.19 TESTING FINISH FLOOR

A. Test floors in accordance with ASTM C627 to show compliance with codes 1 through 10.

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12-01-18

SECTION 09 51 00

ACOUSTICAL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Acoustical units.
2. Metal ceiling suspension system for acoustical ceilings.
3. Adhesive application.

1.2 RELATED REQUIREMENTS

A. Adhesive VOC Limits: Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

B. Color, pattern, and location of each type of acoustical unit: Section 09 06 00, SCHEDULE FOR FINISHES.

C. Ceiling Suspension System: Section 09 22 16, NON-STRUCTURAL METAL FRAMING.

D. Lay in gypsum board ceiling panels: Section 09 29 00, GYPSUM BOARD.

1.3 APPLICABLE PUBLICATIONS

A. Comply with references to extent specified in this section.

B. ASTM International (ASTM):

1. A641/A641M-09a(2014) - Zinc-coated (Galvanized) Carbon Steel Wire.
2. A653/A653M-15e1 - Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-coated (Galvannealed) by the Hot-Dip Process.
3. C423-09a - Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
4. C634-13 - Terminology Relating to Environmental Acoustics.
5. C635/C635M-13a - Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
6. C636/C636M-13 - Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels.
7. D1779-98(2011) - Adhesive for Acoustical Materials.
8. E84-15b - Surface Burning Characteristics of Building Materials.
9. E119-16 - Fire Tests of Building Construction and Materials.
10. E413-16 - Classification for Rating Sound Insulation.

11. E580/E580M-14 - Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions.
12. E1264-14 - Classification for Acoustical Ceiling Products.

C. International Organization for Standardization (ISO):
1. ISO 14644-1 - Classification of Air Cleanliness.

1.4 PREINSTALLATION MEETINGS

A. Conduct preinstallation meeting at project site minimum 30 days before beginning Work of this section.
1. Required Participants:
a. Contracting Officer's Representative.
b. Architect/Engineer. and Interior Designer.
c. VA Interior Designer.
d. Inspection and Testing Agency.
e. Contractor.
f. Installer.
g. Manufacturer's field representative.
h. Other installers responsible for adjacent and intersecting work, including sprinkler HVAC and lighting installers.
2. Meeting Agenda: Distribute agenda to participants minimum 3 days before meeting.
a. Installation schedule.
b. Installation sequence.
c. Preparatory work.
d. Protection before, during, and after installation.
e. Installation.
f. Terminations.
g. Transitions and connections to other work.
h. Inspecting and testing.
i. Other items affecting successful completion.
3. Document and distribute meeting minutes to participants to record decisions affecting installation.

1.5 SUBMITTALS

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

B. Submittal Drawings:

1. Show size, configuration, and fabrication and installation details.

C. Manufacturer's Literature and Data:

1. Description of each product.
2. Ceiling suspension system indicating manufacturer recommendation for each application.
3. Installation instructions.
4. Warranty.

D. Samples:

1. Acoustical units, 150 mm (6 inches) in size, each type, including units specified to match existing.
   a. Submit quantity required to show full color and texture range.
2. Suspension system, trim and molding, 300 mm (12 inches) long.
3. Colored markers for access service.
4. Approved samples may be incorporated into work.

E. Sustainable Construction Submittals:

1. Recycled Content: Identify post-consumer and pre-consumer recycled content percentage by weight.
2. Biobased Content:
   a. Show type and quantity for each product.
   b. Show volatile organic compound types and quantities.

F. Certificates: Certify each product complies products comply with specifications.

1. Acoustical units, each type.

G. Qualifications: Substantiate qualifications comply with specifications.

1. Manufacturer with project experience list .

H. Operation and Maintenance Data:

1. Care instructions for each exposed finish product.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Regularly manufactures specified products.
2. Manufactured specified products with satisfactory service on five similar installations for minimum five years.
   a. Project Experience List: Provide contact names and addresses for completed projects.

1.7 DELIVERY

A. Deliver products in manufacturer's original sealed packaging.

B. Mark packaging, legibly. Indicate manufacturer's name or brand, type, color, production run number, and manufacture date.

C. Before installation, return or dispose of products within distorted, damaged, or opened packaging.

1.8 STORAGE AND HANDLING

A. Store products indoors in dry, weathertight conditioned facility.

B. Protect products from damage during handling and construction operations.

1.9 FIELD CONDITIONS

A. Environment:

1. Product Temperature: Minimum 21 degrees C (70 degrees F) for minimum 48 hours before installation.
2. Work Area Ambient Conditions: HVAC systems are complete, operational, and maintaining facility design operating conditions continuously, beginning 48 hours before installation until Government occupancy.
3. Install products when building is permanently enclosed and when wet construction is completed, dried, and cured.

1.10 WARRANTY

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

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Ceiling System: Acoustical ceilings units on exposed concealed grid suspension systems.

2.2 SYSTEM PERFORMANCE

A. Design product complying with specified performance:

1. Maximum Deflection: 1/360of span, maximum.

B. Fire Resistance: ASTM E119; as component of 1 2 hour rated floor-ceiling roof-ceiling assembly.

C. Surface Burning Characteristics: When tested according to ASTM E84.

1. Flame Spread Rating: 25 maximum.
2. Smoke Developed Rating: 450 maximum.

2.3 PRODUCTS - GENERAL

A. Basis of Design: Section 09 06 00, SCHEDULE FOR FINISHES.

B. Provide acoustical units from one manufacturer.

1. Provide each product exposed to view from one production run.

C. Provide suspension system from same manufacturer.

2.4 ACOUSTICAL UNITS

A. General:

1. Ceiling Panel and Tile: ASTM E1264, bio-based content according to USDA Bio-Preferred Product requirements.
   a. Mineral Fiber: 3.6 kg/sq. m (3/4 psf) weight, minimum.
   b. Integrally colored units.
2. Classification: Provide type and form as follows:
   a. Type III Units - Mineral base with water-based painted finish maximum 10 g/l VOC; Form 2 - Water felted, minimum 16 mm (5/8 inch) thick.
   b. Type IV Units - Mineral base with membrane-faced overlay, Form 2 - Water felted, minimum 16 mm (5/8 inch) thick. Apply poly (vinyl) chloride over paint coat.
   c. NRC (Noise Reduction Coefficient): ASTM C423, minimum 0.55 unless specified otherwise.
   d. CAC (Ceiling Attenuation Class): ASTM E413, 40-44 range unless specified otherwise.
   e. LR (Light Reflectance): Minimum 0.75.
3. Lay-in panels: Sizes as indicated on Drawings, with square or edges .
   a. Sizes:
      1) Edge and Joint Detail: Square edges and joints as required to suit suspension and access system.

B. SPECIAL FACED ACOUSTICAL TILE UNITS AT(SP): Anti-microbial coated surfaces suitable for use in Class 5 Clean Rooms per ISO 14644-1. Special faced acoustical tile units shall meet all general requirements stated in this specification.

1. Type XX-A Units - Perforated Ceramic Units for Wet Service.
   a. Mineral wool material, fired in kiln to produce a stable panel, totally unaffected by moisture when submerged in water.
   b. No damage when subjected to 10 cycles of steam at 135 degrees C (275 degrees F) and cooling to 10 degrees C (50 degrees F).
   c. Minimum of 16 mm (5/8 inch) thick.

d. Not affected when immersed in five percent chlorine solution, except for paint finish.

2.5 METAL SUSPENSION SYSTEM

A. General: ASTM C635, intermediate-duty heavy-duty system, except as otherwise specified.
   1. Suspension System: Provide the following:
      a. Extruded aluminum.
   2. Main and Cross Runner: Use same construction Do not use lighter-duty sections for cross runners.

B. Exposed Grid Suspension System: Support of lay-in panels.
   1. Grid Width: 22 mm (7/8 inch) minimum with 8 mm (5/16 inch) minimum panel bearing surface.
   2. Molding: Fabricate from the same material with same exposed width and finish.
   3. Finish: Baked-on enamel flat texture finish.
      a. Color: To match adjacent acoustical units unless specified otherwise in Section 09 06 00, SCHEDULE FOR FINISHES.

C. Concealed Grid Suspension System: Mineral base acoustical tile support.
   1. Concealed grid upward access suspension system initial opening, 300 mm by 600 mm (12 by 24 inches).
   2. Flange Width: 22 mm (7/8 inch) minimum except:
      a. Access Hook and Angle: 11 mm (7/16 inch) minimum.

D. Carrying Channels Secondary Framing: Cold-rolled or hot-rolled steel, black asphaltic paint finish, rust free.
   1. Weight per 300 m (per thousand linear feet), minimum:

Size		Cold-rolled		Hot-rolled	
mm	inches	kg	pound	kg	pound
38	1-1/2	215.4	475	508	1120
50	2	267.6	590	571.5	1260

E. Anchors and Inserts: Provide anchors or inserts to support twice the loads imposed by hangers.
   1. Hanger Inserts: Steel, zinc-coated (galvanized after fabrication).
      a. Nailing type option for wood forms:
         1) Upper portion designed for anchorage in concrete and positioning lower portion below surface of concrete approximately 25 mm (one inch).

2) Lower portion provided with minimum 8 mm (5/16 inch) hole to permit attachment of hangers.

b. Flush ceiling insert type:

1) Designed to provide a shell covered opening over a wire loop to permit attachment of hangers and keep concrete out of insert recess.

2) Insert opening inside shell approximately 16 mm (5/8 inch) wide by 9 mm (3/8 inch) high over top of wire.

3) Wire 5 mm (3/16 inch) diameter with length to provide positive hooked anchorage in concrete.

F. Clips: Galvanized steel, designed to secure framing member in place.

G. Tile Splines: ASTM C635.

H. Wire: ASTM A641.

1. Size:

a. Wire Hangers: Minimum diameter 2.68 mm (0.1055 inch).

b. Bracing Wires: Minimum diameter 3.43 mm (0.1350 inch).

2.6 ACCESSORIES

A. Adhesives: Low pollutant-emitting, water based type recommended by adhered product manufacturer for each application.

B. Perimeter Seal: Vinyl, polyethylene or polyurethane open cell sponge material, density of 1.3 plus or minus 10 percent, compression set less than 10 percent with pressure sensitive adhesive coating on one side.

1. Thickness: As required to fill voids between back of wall molding and finish wall.

2. Size: Minimum 9 mm (3/8 inch) wide strip.

C. Access Identification Markers: Colored markers with pressure sensitive adhesive on one side, paper or plastic, 6 to 9 mm (1/4 to 3/8 inch) diameter.

1. Color Code: Provide the following color markers for service identification:

Color	Service
Red	Sprinkler System: Valves and Controls
Green	Domestic Water: Valves and Controls
Yellow	Chilled Water and Heating Water
Orange	Ductwork: Fire Dampers
Blue	Ductwork: Dampers and Controls

Color	Service
Black	Gas: Laboratory, Medical, Air and Vacuum

PART 3 - EXECUTION

3.1 PREPARATION

A. Examine and verify substrate suitability for product installation.

B. Protect existing construction and completed work from damage.

C. Remove existing acoustical panels and suspension system to permit new installation.

3.2 INSTALLATION - GENERAL

A. Install products according to manufacturer's instructions and approved submittal drawings .

1. When manufacturer's instructions deviate from specifications, submit proposed resolution for Contracting Officer's Representative consideration.

3.3 ACOUSTICAL UNIT INSTALLATION

A. Applications:

1. Cut acoustic units for perimeter borders and penetrations to fit tight against penetration for joint not concealed by molding.

B. Layout acoustical unit symmetrically, with minimum number of joints.

C. Installation:

1. Install acoustic tiles after wet finishes have been installed and solvents have cured.
2. Install lay-in acoustic panels in exposed grid with minimum 6 mm (1/4 inch) bearing at edges on supports.
   a. Install tile to lay level and in full contact with exposed grid.
   b. Replace cracked, broken, stained, dirty, or tile.
3. Tile in concealed grid upward access suspension system:
   a. Install acoustical tile with joints close, straight and true to line, and with exposed surfaces level and flush at joints.
   b. Make corners and arises full, and without worn or broken places.
   c. Locate acoustical units providing access to service systems.
4. Markers:
   a. Install color coded markers to identify the various concealed piping, mechanical, and plumbing systems.

b. Attach colored markers to exposed grid on opposite sides of the units providing access.

c. Attach marker on exposed ceiling surface of upward access acoustical unit.

D. Touch up damaged factory finishes.

1. Repair painted surfaces with touch up primer.

3.4 CEILING SUSPENSION SYSTEM INSTALLATION

A. General: Install according to ASTM C636.

1. Use direct or indirect hung suspension system or combination of both.
2. Support a maximum area of 1.48 sq. m (16 sq. ft.) of ceiling per hanger.
3. Prevent deflection in excess of 1/360 of span of cross runner and main runner.
4. Provide additional hangers located at each corner of support components.
5. Provide minimum 100 mm (4 inch) clearance from the exposed face of the acoustical units to the underside of ducts, pipe, conduit, secondary suspension channels, concrete beams or joists; and steel beam or bar joist unless furred system is shown.
6. Provide main runners minimum 1200 mm (48 inches) in length.
7. Install hanger wires vertically. Angled wires are not acceptable except for seismic restraint bracing wires.

B. Direct Hung Suspension System: ASTM C635.

1. Support main runners by hanger wires attached directly to the structure overhead.
2. Maximum spacing of hangers, 1200 mm (4 feet) on centers unless interference occurs by mechanical systems. Use indirect hung suspension system where not possible to maintain hanger spacing.

C. Anchorage to Structure:

1. Concrete:

a. Install hanger inserts and wire loops required for support of hanger and bracing wire. Install hanger wires with looped ends through steel deck when steel deck does not have attachment device.

b. Use eye pins or threaded studs with screw-on eyes in existing or already placed concrete structures to support hanger and bracing wire. Install in sides of concrete beams or joists at mid height.

2. Steel:

a. Install carrying channels for attachment of hanger wires.

1) Size and space carrying channels to support load within performance limit.

2) Attach hangers to steel carrying channels, spaced four feet on center, unless area supported or deflection exceeds the amount specified.

b. Attach carrying channels to the bottom flange of steel beams spaced not 1200 mm (4 feet) on center before fireproofing is installed. Weld or use steel clips for beam attachment.

c. Attach hangers to bottom chord of bar joists or to carrying channels installed between the bar joists when hanger spacing prevents anchorage to joist. Rest carrying channels on top of the bottom chord of the bar joists, and securely wire tie or clip to joist.

D. Indirect Hung Suspension System: ASTM C635.

1. Space carrying channels for indirect hung suspension system maximum 1200 mm (4 feet) on center. Space hangers for carrying channels maximum 2400 mm (8 feet) on center or for carrying channels less than 1200 mm (4 feet) or center so as to insure that specified requirements are not exceeded.

2. Support main runners by specially designed clips attached to carrying channels.

E. Seismic Ceiling Bracing System:

1. Install according to ASTM E580.

2. Connect bracing wires to structure above as specified for anchorage to structure and to main runner or carrying channels of suspended ceiling at bottom.

3.5 CEILING TREATMENT

A. Perimeter Seal:

1. Install perimeter seal between vertical leg of wall molding and finish wall, partition, and other vertical surfaces.

2. Install perimeter seal to finish flush with exposed faces of horizontal legs of wall molding.

B. Existing ceiling:

1. Where extension of existing ceilings occurs, match existing.
2. Where acoustical units are salvaged and reinstalled or joined, use salvaged units within a space. Do not mix new and salvaged units within a space which results in contrast between old and new acoustic units.
3. Comply with specifications for new acoustical units for new units required to match appearance of existing units.

C. Fire-Rated System:

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

3.6 CLEANING

A. Remove excess adhesive before adhesive sets.

B. Clean exposed surfaces. Remove contaminants and stains.

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01-01-21

SECTION 09 65 13

RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Resilient base (RB) adhered to interior walls and partitions.

1.2 RELATED REQUIREMENTS

A. Sheet Flooring Integral Base: Section 09 65 16, RESILIENT SHEET FLOORING.

1.3 APPLICABLE PUBLICATIONS

A. Comply with references to extent specified in this section.

B. ASTM International (ASTM):

F1344-15.....Rubber Floor Tile.

F1859-14e1.....Rubber Sheet Floor Covering without Backing.

F1860-14e1.....Rubber Sheet Floor Covering with Backing.

F1861-16.....Resilient Wall Base.

D4259-18.....Preparation of Concrete by Abrasion Prior to Coating Application.

C. International Concrete Repair Institute (ICRI):

310.2R-2013.....Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair.

1.4 SUBMITTALS

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

B. Manufacturer's Literature and Data:

1. Description of each product.
2. Adhesives and primers indicating manufacturer's recommendation for each application.
3. Installation instructions.

C. Samples:

1. Resilient Base: 150 mm (6 inches) long, each type and color.
2. Sheet Rubber Flooring: 300 mm (12 inches) square, each type and color.

D. Sustainable Construction Submittals:

1. Recycled Content: Identify post-consumer and pre-consumer recycled content percentage by weight.
2. Low Pollutant-Emitting Materials:
   a. Sheet Rubber Flooring: Submit Floor Score label.
   b. Show volatile organic compound types and quantities.

E. Operation and Maintenance Data:
1. Care instructions for each exposed finish product.

1.5 DELIVERY

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

1.6 STORAGE AND HANDLING

A. Store products indoors in dry, weathertight facility.
B. Protect products from damage when handling and during construction operations.

1.7 FIELD CONDITIONS

A. Environment:
1. Product Temperature: Minimum 21 degrees C (70 degrees F) for minimum 48 hours before installation.
2. Work Area Ambient Temperature Range: 21 to 27 degrees C (70 to 80 degrees F) continuously, beginning 48 hours before installation.
3. Install products when building is permanently enclosed and when wet construction is completed, dried, and cured.

1.8 WARRANTY

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

PART 2 - PRODUCTS

2.1 PRODUCTS

A. Basis of Design: Section 09 06 00, SCHEDULE FOR FINISHES.
B. Provide each product from one manufacturer and from one production run.
C. Sustainable Construction Requirements:
1. Sheet Rubber Flooring Recycled Content: 90 percent total recycled content, minimum.

2. Low Pollutant-Emitting Materials: Comply with VOC limits specified in Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS for the following products:
   a. Flooring Adhesives and Sealants.

2.2 RESILIENT BASE

A. Resilient Base: 3 mm (1/8 inch) thick, 150 mm (6 inches) high.
   1. Type: Rubber
   2. ASTM F1861, Type TP thermoplastic rubber.

B. Applications:
   1. Other Locations: Style B - Cove.

2.3 PRIMER (FOR CONCRETE FLOORS)

A. Primer: Type recommended by adhesive manufacturer.

2.4 LEVELING COMPOUND (FOR CONCRETE FLOORS)

A. Leveling Compound: Provide products mixed with latex or polyvinyl acetate resins.

2.5 ADHESIVES

A. Adhesives: Low pollutant-emitting, water based type recommended by adhered product manufacturer for each application.

PART 3 - EXECUTION

3.1 PREPARATION

A. Examine and verify substrate suitability for product installation.

B. Protect existing construction and completed work from damage.

C. Remove existing base to permit new installation.
   1. Dispose of removed materials according to these specifications and as required by law.

D. Correct substrate deficiencies.
   1. Walls shall be straight and true to within a horizontal deviation of 3 mm (1/8 inch) in 3 M (10 feet).
   2. Remove projections and irregularities to provide a smooth surface.
   3. Flooring shall apply leveling compound to achieve a vertical deviation of 3 mm (1/8 inch) in 3 m (10 feet) maximum surface variation.

E. Clean substrates. Remove contaminants capable of affecting subsequently installed product's performance.
   1. Mechanically clean concrete floor substrate according to ASTM D4259.
   2. Surface Profile: ICRI Guideline No. 310.2R.

F. Allow substrate to dry and cure for a minimum of 24 hours past installation on the finished wall surface.

G. Perform flooring manufacturer’s recommended bond, substrate moisture content, and pH tests.

3.2 INSTALLATION GENERAL

A. Install products according to manufacturer's instructions.

1. When instructions deviate from specifications, submit proposed resolution for Contracting Officer consideration.

3.3 RESILIENT BASE INSTALLATION

A. Applications:

1. Install resilient base in rooms scheduled on Drawings.
2. Install resilient base on casework? and other curb supported fixed equipment.
3. Extend resilient base into closets, alcoves, and cabinet knee spaces, and around columns within scheduled room.

B. Lay out resilient base with minimum number of joints.

1. Length: 600 mm (24 inches) minimum, each piece.
2. Locate joints 150 mm (6 inches) minimum from corners and intersection of adjacent materials.

C. Installation:

1. Apply adhesive uniformly for full contact between resilient base and substrate.
2. Set resilient base with hairline butted joints aligned along top edge.
3. Preformed inside and outside corners are not acceptable.

D. Field form corners and end stops.

1. V-groove back of outside corner.
2. V-groove face of inside corner and notch cove for miter joint.

E. Roll resilient base ensuring complete adhesion.

3.4 CLEANING

A. Remove excess adhesive before adhesive sets.

B. Clean exposed resilient base, surfaces. Remove contaminants and stains.

1. Clean with mild detergent. Leave surfaces free of detergent residue.

C. Polish exposed resilient base to gloss sheen.

3.5 PROTECTION

A. Prohibit traffic on resilient flooring 72 hours, minimum, after installation.

B. Protect products from construction traffic and operations.

1. Cover resilient flooring with reinforced kraft paper, and plywood or hardboard.
2. Maintain protection until directed by Contracting Officer's Representative.

C. Replace damaged products and re-clean.

1. Damaged Products include cut, gouged, scraped, torn, and unbonded products.

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06-01-22

SECTION 09 65 16

RESILIENT SHEET FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Welded seam sheet flooring (WSF) with heat welded seams and integral cove base .

1.2 RELATED REQUIREMENTS

A. Adhesive VOC Limits: Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

B. Color, Pattern and Texture: Section 09 06 00, SCHEDULE FOR FINISHES.

C. Resilient Base over Base of Manufactured Wood Casework: Section 09 65 13, RESILIENT BASE AND ACCESSORIES.

1.3 APPLICABLE PUBLICATIONS

A. Comply with references to extent specified in this section.

B. ASTM International (ASTM):

1. D4259-88(2012) - Abrading Concrete.
2. E648-15e1 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.
3. E662-15a - Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials.
4. F1303-04(2014) - Sheet Vinyl Floor Covering with Backing.
5. F1516-18 – Sealing Seams of Resilient Flooring Products by Heat Weld Method
6. F1913-04(2014) - Vinyl Sheet Floor Covering Without Backing.

C. International Concrete Repair Institute (ICRI):

1. 310.2R-13 - Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays, and Concrete Repair.

D. SCS Global Services (SCS):

1. FloorScore.

1.4 SUBMITTALS

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

1. Show size, configuration, and fabrication and installation details.

B. Manufacturer's Literature and Data:

1. Description of each product.

2. Application and installation indicating manufacturer's recommendation for each application's instructions.
3. Warranty.

C. Samples:
1. Sheet material, 38 mm by 300 mm (1-1/2 inch by 12 inch), of each color and pattern with welded seam using specified welding rod 300 mm (12 inches) square for each type, pattern and color .
2. Cap strip and fillet strip, 300 mm (12 inches) for integral base of each color and style.
3. Shop Drawings and Certificates: Layout of joints showing patterns where joints are expressed, and type and location of obscure type joints. Indicate orientation of directional patterns.
4. Certificates: Quality Control Certificate Submittals and lists specified in paragraph, QUALIFICATIONS.
5. Edge strips: 150 mm (6 inches) long each type.
6. Primer: Pint container, each type.

D. Sustainable Construction Submittals:
1. Low Pollutant-Emitting Materials:
a. Sheet Flooring: Submit FloorScore label.
b. Identify volatile organic compound types and quantities.

E. Certificates: Certify each product complies with specifications.
1. Heat welded seaming is manufacturer's prescribed method of installation.

F. Qualifications: Substantiate qualifications comply with specifications.
1. Manufacturer with project experience list .
2. Installer with project experience list .

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A company specializing in installation with minimum three (3) years' experience and employs experienced flooring installers who have retained, and currently hold, an INSTALL Certification, or a certification from a comparable certification program.
1. Installers to be certified by INSTALL or a comparable certification program with the following minimum criteria:
a. US Department of Labor approved four (4) year apprenticeship program, 160 hours a year.

b. Career long training.

c. Manufacturer endorsed training.

d. Fundamental journeyman skills certification.

B. Furnish product type materials from the same production run.

1.6 DELIVERY

A. Deliver products in manufacturer's original sealed packaging.

B. Mark packaging, legibly. Indicate manufacturer's name or brand, type, color, production run number, and manufacture date.

C. Before installation, return or dispose of products within distorted, damaged, or opened packaging.

1.7 STORAGE AND HANDLING

A. Store products indoors in dry, weathertight, conditioned facility.

B. Protect products from damage during handling and construction operations.

1.8 FIELD CONDITIONS

A. Environment:

1. Product Temperature: Minimum 21 degrees C (70 degrees F) for minimum 48 hours before installation.

2. Work Area Ambient Temperature Range: Minimum 18 to 38 degrees C (65 to 100 degrees F) continuously, beginning 48 hours before installation. Maintain room temperature above 18 degrees C (65 degrees F) after installation. In addition, refer to manufacturer’s instructions for preferred ambient temperatures.

3. Install products when building is permanently enclosed and when wet construction is completed, dried, and cured.

1.9 WARRANTY

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

B. Manufacturer's Warranty: Warrant resilient sheet flooring against material and manufacturing defects.

1. Warranty Period: 10 years.

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

A. Sheet Flooring:

1. Critical Radiant Flux: ASTM E648; 0.45 watts per sq.cm or more, Class I.

2. Smoke Density: ASTM E662; less than 450.

2.2 PRODUCTS - GENERAL

A. Basis of Design: Section 09 06 00, SCHEDULE FOR FINISHES.

B. Provide vinyl sheet color and pattern from one production run for each type of vinyl sheet.

C. Sustainable Construction Requirements:

1. Low Pollutant-Emitting Materials: Comply with VOC limits specified in Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS for the following products:

a. Flooring Adhesives and Sealants.

b. Vinyl Sheet Flooring.

2.3 RESILIENT SHEET FLOORING

A. Resilient Sheet Flooring (RSF): ASTM F1913; Vinyl, without backing.

1. Wear Surface: Smooth.

2. Thickness: 2 mm (0.080 inches).

B. Resilient Sheet Flooring (RSF): ASTM F1303; Type II, Grade 1, vinyl, with backing.

1. Wear Surface: Smooth.

2. Wear Layer Thickness: Minimum 1.00 mm (0.020 inches).

3. Total Thickness: 3 mm (0.120 inches).

C. Sheet Size: Provide maximum size sheet produced by manufacturer to minimize joints.

1. Minimum Width: 1800 mm (72 inches).

2.4 WELDED SEAM SHEET FLOORING

A. Welded Seam Sheet Flooring (WSF): ASTM F1516; Type I Type II vinyl with backing.

1. Wear Surface: Smooth.

2. Wear Layer Thickness: Minimum 1.0 mm (0.040 inches).

3. Total Thickness: 3 mm (0.120 inches).

B. Sheet Size: Provide maximum size sheet produced by manufacturer to minimize joints.

1. Minimum Width: 1200 mm (48 inches).

2.5 ACCESSORIES

A. Bonding Chemical: Flooring manufacturer's standard seam bonding chemical.

B. Welding Rod: Flooring manufacturer's standard, in color matching field color of sheet flooring.

C. Adhesives: Water resistant type recommended by flooring manufacturer to suit application.

D. Base Accessories:

1. Fillet Strip: 19 mm (3/4 inch) radius fillet strip compatible with flooring material.
2. Cap Strip: J-Shape extruded flanged reducer strip compatible with flooring material approximately 25 mm (1 inch) exposed height with 13 mm (1/2 inch) flange.

E. Leveling Compound:

1. Provide cementitious type with latex or polyvinyl acetate resins additive.

F. Primer:

1. Type recommended by adhesive or flooring manufacturer.

G. Edge Strips:

1. Extruded aluminum, mill finish, mechanically cleaned.
2. 28 mm (1-1/8 inch) wide, 6 mm (1/4 inch) thick, bevel one edge to 3 mm (1/8 inch) thick.
3. Drill and counter sink edge strips for flat head screws. Space holes near ends and approximately 225 mm (9 inches) on center.
4. Fasteners: Stainless steel, type to suit application.

H. Sealant:

1. As specified in Section 07 92 00, JOINT SEALANTS.
2. Compatible with flooring.

I. Polish: Type recommended by flooring manufacturer to suit application and anticipated traffic.

PART 3 - EXECUTION

3.1 PREPARATION

A. Examine and verify substrate suitability for product installation.

B. Protect existing construction and completed work from damage.

C. Remove existing sheet flooring to permit new installation.

1. Do not use solvents for removing adhesives.
2. Dispose of removed materials according to these specifications and as required by law.

D. Ensure interior finish work such as drywall finishing, concrete, ceiling work, and painting work is complete and dry before installation for at least 24 hours past installation on floor and wall surfaces.
   1. Complete mechanical, electrical, and other work above ceiling line.
   2. Ensure heating, ventilating, and air conditioning systems are installed and operating in order to maintain temperature and humidity requirements according to these specifications.

E. Correct substrate deficiencies.
   1. Fill cracks, pits, and dents with leveling compound.
   2. Remove projections and irregularities to provide a smooth surface.
   3. Flooring installer shall apply leveling flooring substrate to achieve a vertical deviation of 3 mm (1/8 inch) maximum variation in 10 feet.

F. Clean substrates. Remove contaminants capable of affecting subsequently installed product's performance.
   1. Mechanically clean concrete floor substrate according to ASTM D4259.
   2. Surface Profile: ICRI 310.2R CSP 3 to CSP 4.

G. Perform flooring manufacturer’s recommended bond, substrate moisture content, and pH tests.

H. Broom or vacuum clean substrates immediately before flooring installation.

I. Primer: Apply primer according to manufacturer’s instructions.

3.2 INSTALLATION - GENERAL

A. Install products according to manufacturer's instructions.
   1. When manufacturer's instructions deviate from specifications, submit proposed resolution for Contracting Officer's Representative consideration.

3.3 INSTALLATION OF FLOORING

A. Flooring Layout:
   1. Arrange pattern in one direction with side and end joints pattern matched as contract documents indicate for design intent.
   2. Extend flooring wall-to-wall, under cabinets, casework, sterile processing equipment and furniture, and other equipment for seamless flooring installation.
   3. Arrange sheets to minimize seams.

4. Locate seams in inconspicuous and low traffic areas, minimum 150 mm (6 inches) away from parallel joints in flooring substrates.

B. Match edges of flooring for color shading and pattern at seams.

C. Install flooring flush with adjacent floor finishes.

D. Extend flooring into toe spaces, door reveals, closets, and similar openings.

E. Install flooring fully adhered to substrate.

1. Air pockets or loose edges are not acceptable.
2. Trim sheet materials tight to flooring penetrations; seal joints at pipe with waterproof sealant specified in Section 07 92 00, JOINT SEALANTS.

F. Butt joints tight, without gaps and bulges.

G. Installation of Edge Strips:

1. Install edge strips at flooring terminations and transitions to other floor finishes.
2. Locate edge strips under center lines of doors unless otherwise indicated.
3. Set edge strips in adhesive and mechanically fasten to substrate.

3.4 INTEGRAL COVE BASE INSTALLATION

A. Set preformed fillet strip at floor intersection with walls and other vertical surfaces.

B. Extend flooring over fillet strip and 150 mm (6 inches) 150 mm (6 inches) up wall surface. Base at Manufactured Wood Casework may be 100 mm (4 inches) high.

C. Form straight or radius internal and external corners to suit Application.

D. Adhere base to wall surface. Base to be in vertical alignment with wall finish above.

E. Terminate base exposed top edge with cap strip. Seal cap strip to wall with sealant.

F. Weld joints as specified for flooring.

G. Provide continuous sealant between wall base and wall surface above.

3.5 HEAT WELDING

A. Heat weld joints of flooring and base using welding rod.

B. Route joint, insert welding rod into routed space, and fuse flooring and welding rods for seamless, watertight installation.

1. Fuse joints for seamless weld.

C. Finish joints flush, free from voids, and recessed or raised areas.

3.6 CLEANING

A. Remove excess adhesive before adhesive sets.

B. Clean and polish materials.

C. Vacuum floor thoroughly.

D. Perform initial maintenance according to flooring manufacturer's instructions.

1. Delay washing flooring until adhesive is fully set and welded joints can contain wash water.

3.7 PROTECTION

A. Protect flooring from traffic and construction operations.

B. Keep traffic off sheet flooring for minimum 24 hours after installation.

C. Cover flooring with reinforced kraft paper, and plywood or hardboard.

D. Remove protective materials immediately before acceptance.

E. Repair damage.

F. Apply polish to vinyl flooring or as per manufacturers requirements.

G. Buff flooring to uniform sheen or as per manufacturers requirements.

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SECTION 09 67 23.60

RESINOUS URETHANE AND EPOXY MORTAR FLOORING (RES-6A)

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies Resinous (Resinous urethane and epoxy mortars) flooring with integral cove base :

1. High Abuse Climatic Troweled and Sealed Urethane Mortar Flooring System.

1.2 RELATED WORK

A. Substrate Preparation for Floor Finishes: Section 09 05 16.

B. Color and location of each type of resinous (urethane and epoxy mortar) flooring: As indicated in the drawings, COLOR AND FINISH LEGEND.

C. Floor Drains: Division 22, PLUMBING.

1.3 SUBMITTALS

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

B. Manufacturer's Literature and Data:

1. Description of each product to be provided.
2. Application and installation instructions.
3. Maintenance Instructions: Submit manufacturer’s written instructions for recommended maintenance practices.

C. Qualification Data: For Installer.

D. Sustainable Submittal:

1. Product data for products having recycled content, submit documentation indicating percentages by weight of postconsumer and pre consumer recycled content.
   a. Include statements indicating costs for each product having recycled content, and low emitting materials.
2. Product data for Environmental Quality Credit EQ 4.2 low emitting materials, include printed statement of VOC content indicating compliance with environmental requirements.
3. Product data for Material Resource Credit MR 4.1, 12%-35% post-consumer recycled glass content.
4. Product data for Material Resource Credit MR 6, renewable resin.

5. Product data for field applied, interior, paints, coatings, and primers, include printed statement of VOC content indicating compliance with environmental requirements.

E. Samples:
1. Each color and texture specified in Section 09 06 00, SCHEDULE FOR FINISHES.
2. Samples for verification: For each (color and texture) resinous flooring system required, 6 inches (152 mm) square, applied to a rigid backing by installer for this project.
3. Sample showing construction from substrate to finish surface in thickness specified and color and texture of finished surfaces. Finished flooring must match the approved samples in color and texture.

F. Shop Drawings: Include plans, sections, component details, and attachment to other trades. Indicate layout of the following:
1. Patterns.
2. Edge configurations.

G. Certifications and Approvals:
1. Manufacturer's certification of material and substrate compliance with specification.
2. Manufacturer's approval of installers.
3. Contractor's certificate of compliance with Quality Assurance requirements.

H. Warranty: As specified in this section.

1.4 QUALITY ASSURANCE

A. Manufacture Certificate: Manufacture shall certify that a particular resinous flooring system has been manufactured and in use for a minimum of (5) five years.

B. Installer Qualifications: Engage an experienced installer (applicator) who is experienced in applying resinous flooring systems similar in material, design, and extent to those indicated for this project for a minimum period of five (5) years, whose work has resulted in applications with a record of successful in-service performance, and who is acceptable to resinous flooring manufacturer.
1. Engage an installer who is certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated.

2. Contractor shall have completed at least five (5) projects of similar size and complexity. Include list of at least five (5) projects. List must include owner (purchaser); address of installation, contact information at installation project site; and date of installation.
3. Installer's Personnel: Employ persons trained for application of specified product.

C. Source Limitations:
1. Obtain primary resinous flooring materials including primers, resins, hardening agents, grouting coats and finish or sealing coats from a single manufacturer.
2. Provide secondary materials, including patching and fill material, joint sealant, and repair material of type and from source recommended by manufacturer of primary materials.

D. Pre-Installation Conference:
1. Convene a meeting not less than thirty days prior to starting work.
2. Attendance:
   a. Contractor
   b. VA Contracting Officer’s Representative.
   c. Manufacturer and Installer's Representative
3. Review the following:
   a. Environmental requirements
      1) Air and surface temperature
      2) Relative humidity
      3) Ventilation
      4) Dust and contaminates
   b. Protection of surfaces not scheduled to be coated
   c. Inspect and discus condition of substrate and other preparatory work performed
   d. Review and verify availability of material; installer’s personnel, equipment needed
   e. Design and patterns and edge conditions.
   f. Performance of the coating with chemicals anticipated in the area receiving the resinous (urethane and epoxy mortar/cement) flooring system
   g. Application and repair
   h. Field quality control

i. Cleaning

j. Protection of coating systems

k. One-year inspection and maintenance

l. Coordination with other work

E. Manufacturer’s Field Services: Manufacturer’s representative shall provide technical assistance and guidance for surface preparation and application of resinous flooring systems.

F. Contractor Job Site Log: Contractor shall document daily; the work accomplished environmental conditions and any other condition event significant to the long term performance of the urethane and epoxy mortar/cement flooring materials installation. The Contractor shall maintain these records for one year after Substantial Completion.

G. Volatile Organic Compound content to remain under 100g/liter.

1.5 MATERIAL PACKAGING DELIVERY AND STORAGE

A. Deliver materials to the site in original sealed packages or containers, clearly marked with the manufacturer's name or brand, type and color, production run number and date of manufacture.

B. Protect materials from damage and contamination in storage or delivery, including moisture, heat, cold, direct sunlight, etc.

C. Maintain temperature of storage area between 60 and 80 degrees F (15 and 26 degrees C).

D. Keep containers sealed until ready for use.

E. Do not use materials beyond manufacturer’s shelf life limits.

F. Package materials in factory pre-weighed and in single, easy to manage batches sized for ease of handling and mixing proportions from entire package or packages. No On site weighing or volumetric measurements are allowed.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring applications.

1. Maintain material and substrate temperature between 65 and 85 degrees F (18 and 30 degrees C) during resinous flooring application and for not less than 24 hours after application.

2. Concrete substrate shall comply with section 09 05 16, SUBSURFACE PREPERATION FOR FLOOR FINISHES.

B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.

C. Close spaces to traffic during resinous flooring application and for not less than 24 hours after application, unless manufacturer recommends a longer period.

1.7 WARRANTY

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

B. Warranty: Manufacture shall furnish a single, written warranty covering the full assembly (including substrata) for both material and workmanship for a extended period of three (3) full years from date of installation, or provide a joint and several warranty signed on a single document by manufacturer and applicator jointly and severally warranting the materials and workmanship for a period of three (3) full years from date of installation. A sample warranty letter must be included with bid package or bid may be disqualified.

1.8 APPLICABLE PUBLICATIONS

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

B. ASTM Standard C722-04 (2012), "Standard Specification for Chemical-Resistant Monolithic Floor Surfacings," ASTM International, West Conshohocken, PA, 2006, DOI: 10.1520/C0722-04R12, www.astm.org.

1. Specification covers the requirements for aggregate-filled, resin-based, monolithic surfacings for use over concrete.

C. ASTM International(ASTM):

C307-18.....Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacings

C413-18.....Absorption of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes

C531-18.....Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes

C579-18.....Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes

C580-18.....Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes

D638-14.....Tensile Properties of Plastics

D1308-02(2013).....Effect of Household Chemicals on Clear and Pigmented Organic Finishes

D2240-15e1.....Rubber Property—Durometer Hardness

D2794-93(2019).....Resistance of Organic Coatings to the Effects of Rapid Deformation Impact

D4060-19.....Abrasion Resistance of Organic Coatings by the Taber Abraser

D4259-18.....Abrading Concrete to alter the surface profile of the concrete and to remove foreign materials and weak surface laitance

D7234-19.....Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers

E96/E96M-16.....Water Vapor Transmission of Materials

F1869-16a.....Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

F2170-19a.....Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION FOR RES-6A (HEAVY DUTY CLIMATIC)

A. System Descriptions:

1. Monolithic, multi-component urethane chemistry resinous flooring system, Screed and steel finish trowel applied, chemical and thermal cycling and shock resistant. Self priming multiple component polyurethane mortar, quartz aggregates for texture and associated high performance urethane sealer. Temperature resistance to 250 degrees F (121 degrees C) where required.

B. Products: Subject to compliance with applicable fire, health, environmental, and safety requirements for storage, handling, installation, and clean up.

C. System Components: Verify specific requirements as systems vary by manufacturer. Verify mortar base product, build up layers of broadcast systems will not be accepted. Verify compatibility with substrate. Use manufacturer's standard components, compatible with each other and as follows:

1. Mortar (Body coat):
   a. Resin: Urethane with rapidly renewable resin components.
   b. Formulation Description: Multiple component high solids.
   c. Application Method: Screed and steel finish trowel.
   d. Thickness of coat(s): Verify thickness as systems vary by manufacturer; Nominal thickness 3/16 to 1/4 inch (4.76 to 6.35mm).
   e. Number of Coats: One.
   f. Aggregates: Quartz texture broadcast into wet urethane mortar base.
2. Seal Coat(s):
   a. Resin: Urethane.
   b. Formulation Description: Pigmented Two-component, high solids.
   c. Application Method: Squeegee and Back roll.
   d. Number of Coats: One.

D. Physical Properties:

1. Physical Properties of flooring system when tested as follows:

Property	Test	Value
Compressive Strength	ASTM C579	5,000 psi after 7 days
Tensile Strength	ASTM C307	1,000 psi
Flexural Strength	ASTM C580	2,000 psi
Water Absorption	ASTM C413	< 1%

Coefficient of friction dry/slip index wet	ASTM F1679	>1.0 dry >1.0 wet
Impact Resistance	ASTM D2794	> 160 in. lbs
Abrasion Resistance	ASTM D4060	0.05 gm maximum weight loss
Thermal Coefficient of Linear Expansion	ASTM C531	1.1×10^{-5} mm/ °C mm
Hardness Shore D	ASTM D2240	80 to 84
Bond Strength	ASTM D7234	100% bond to concrete failure

E. Chemical Resistance in accordance ASTM D1308 - 02(2007) "Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes". ASTM International, West Conshohocken, PA, 2006, DOI: 10.1520/D1308-02R07, www.astm.org. No effect to the following exposures:
   1. Acetic acid (5%)
   2. Ammonium hydroxide (10%)
   3. Citric Acid (50%)
   4. Fatty Acid
   5. Motor Oil, 20W
   6. Hydrochloric acid (20%)
   7. Sodium Chloride
   8. Sodium Hypochlorite (10%)
   9. Sodium Hydroxide (30%)
   10. Sulfuric acid (25%)
   11. Urine, Feces
   12. Hydrogen peroxide (10%)

2.3 SUPPLEMENTAL MATERIALS

A. Textured Top Coat: Type recommended or produced by manufacturer of seamless resinous flooring system, slip resistance, type and profile of for desired final finish.

B. Joint Sealant: Type recommended or produced by resinous flooring manufacturer for type of service or joint conditioned indicated.

C. Waterproof Membrane: Type recommended or produced by manufacturer of resinous floor coatings for type of service and conditions as indicated in Drawings and specified.

D. Provide a chemical resistant epoxy novolac top coat capable of resisting sustained temperatures up to 120°C (250°F).

E. Crack Isolation Membrane: Type recommended or produced by manufacturer of resinous flooring for conditions as indicated in Drawings and specified .

F. Patching and Fill Material: Resinous product of or approved by resinous coating manufacturer for application indicated. Resinous based materials only. Cementitous or single component product are not expectable.

2.4 BASE CAP STRIP

A. Zinc cove strip.

B. Shape for 2mm depth of base material, "J" or “L” configuration.

C. Finish:

1. Finish exposed surfaces in accordance with NAAMM Metal Finishes Manual.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where monolithic resinous (urethane and epoxy mortar) flooring system with integral base is to be installed with the VA Contracting Officer’s Representative.

B. Moisture Vapor Emission Testing: Perform moisture vapor transmission testing in accordance with ASTM F1869 to determine the MVER of the substrate prior to commencement of the work. See section 3.4, 3.

3.2 PROJECT CONDITIONS

A. Maintain temperature of rooms (air and surface) where work occurs, between 70 and 90 degrees F (21 and 32 degrees C) for at least 48 hours, before, during, and 24 hours after installation. Maintain temperature at least 70 degrees F (21 degrees C) during cure period.

B. Maintain relative humidity less than 75 percent.

C. Do not install materials until building is permanently enclosed and wet construction is complete, dry, and cured.

D. Maintain proper ventilation of the area during application and curing time period.

1. Comply with infection control measures of the VA Medical Center.

3.3 INSTALLATION REQUIREMENTS

A. The manufacturer's instructions for application and installation shall be reviewed with the VA Contracting Officer's Representative for the seamless resinous (urethane and epoxy mortar) flooring system with integral cove base and trench liner.

B. Substrate shall be approved by manufacture technical representative.

3.4 PREPARATION

A. General: Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry, and neutral Ph substrate for resinous flooring application.

B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.

1. Prepare concrete substrates as follows:
   a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and re circulates the shot by vacuum pickup.
   b. Comply with ASTM D4259 requirements, unless manufacturer's written instructions are more stringent.
2. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written recommendations.
3. Verify that concrete substrates are dry.
   a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with application only after substrates have maximum moisture-vapor-emission rate of [**5 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m)** in 24 hours.
   b. MVT threshold for monolithic resinous flooring shall not exceed 3 lbs/1000 square feet (0.0001437 kPa) in a 24 hour period.
   c. When MVT emission exceeds this limit, apply manufacturer's recommended vapor control primer or other corrective measures as recommended by manufacturer prior to application of flooring or membrane systems.
   d. Perform in situ probe test, ASTM F2170. Proceed with application only after substrates do not exceed a maximum potential equilibrium relative humidity of 75-80 percent.
   e. Provide a written report showing test placement and results.

4. Verify that concrete substrates have neutral Ph and that resinous flooring will adhere to them. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.

C. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.

D. Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.

E. Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written recommendations. Allowances should be included for flooring manufacturer recommended joint fill material, and concrete crack treatment.

F. Prepare wall to receive integral cove base and trench liner:

1. Verify wall material is acceptable for resinous flooring application, if not, install material (e.g. cement board) to receive base.
2. Fill voids in wall surface to receive base, install undercoats (e.g. water proofing membrane, and/or crack isolation membrane) as recommended by resinous flooring manufacturer.
3. Install base and trench liner prior to flooring if required by resinous flooring manufacturer.
4. Grind, cut or sand protrusions to receive base application.

3.5 APPLICATION

A. General: Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.

1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
3. At substrate expansion and isolation joints, provide joint in resinous flooring to comply with resinous flooring manufacturer's written recommendations.

a. Apply joint sealant to comply with manufacturer's written recommendations.

B. Apply Primer: over prepared substrate at manufacturer's recommended spreading rate.

C. Apply cove base: Trowel to wall surfaces at a 1 inch radius, before applying flooring. Apply according to manufacturer's written instructions and details including those for taping, mixing, priming, and troweling, sanding, and top coating of cove base. Round internal and external corners.

D. Trowel mortar base: Mix mortar material according to manufacturer's recommended procedures. Climatic and non-climatic resinous flooring systems may vary slightly on mode of application. Application should be based upon the following: Uniformly spread mortar over substrate using a specially designed screed box adjusted to manufacturer's recommended height. Metal trowel (hand or power) single mortar coat in thickness indicated for flooring system, grout to fill substrate voids. When cured, sand to remove trowel marks and roughness

E. Topcoat: Mix and roller apply the topcoat(s) with strict adherence to manufacturer's installation procedures and coverage rates.

3.6 TOLERANCE

A. From line of plane: Maximum 1/8 inch (3.18 mm) in total distance of flooring and base.

B. From radius of cove: Maximum of 1/8 inch (3.18 mm) plus or 1/16-inch (1.59 mm) minus.

3.7 ENGINEERING DETAILS

A. Chase edges to “lock” the flooring system into the concrete substrate along lines of termination.

B. Penetration Treatment: Lap and seal resinous system onto the perimeter of the penetrating item by bridging over compatible elastomer at the interface to compensate for possible movement.

C. Trenches: Continue flooring system into trenches to maintain monolithic protection. Treat cold joints to assure bridging of potential cracks.

D. Treat floor drains by chasing the flooring system to lock in place at point of termination.

E. Treat control joints to bridge potential cracks and to maintain monolithic protection. Treat cold joints and construction joints to

bridge potential cracks and to maintain monolithic protection on horizontal and vertical surfaces as well as horizontal and vertical interfaces.

F. Discontinue Resinous floor system at vertical and horizontal contraction and expansion joints by installing backer rod and compatible sealant after coating installation is completed. Provide sealant type recommended by manufacturer for traffic conditions and chemical exposures to be encountered.

3.8 CURING, PROTECTION AND CLEANING

A. Cure resinous flooring materials in compliance with manufacturer's directions, taking care to prevent contamination during stages of application and prior to completion of curing process.

B. Close area of application for a minimum of 24 hours.

C. Protect resinous flooring materials from damage and wear during construction operation.

1. Cover flooring with kraft type paper.
2. Optional 6 mm (1/4 inch) thick hardboard, plywood, or particle board where area is in foot or vehicle traffic pattern, rolling or fixed scaffolding and overhead work occurs.

D. Remove temporary covering and clean resinous flooring just prior to final inspection. Use cleaning materials and procedures recommended by resinous flooring manufacturer.

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01-01-21

SECTION 09 91 00
PAINTING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the painting and finishing as shown on the construction documents and/or specified herein, including, but not limited to, the following:

1. Prime coats which may be applied in shop under other sections.
2. Prime painting unprimed surfaces to be painted under this Section.
3. Painting items furnished with a prime coat of paint, including touching up of or repairing of abraded, damaged or rusted prime coats applied by others.
4. Painting ferrous metal (except stainless steel) exposed to view.
5. Painting galvanized ferrous metals exposed to view.
6. Painting gypsum drywall exposed to view.
7. Painting pipes, pipe coverings, conduit, ducts, insulation, hangers, supports and other mechanical and electrical items and equipment exposed to view.
8. Painting surfaces above, behind or below grilles, gratings, diffusers, louvers lighting fixtures, and the like, which are exposed to view through these items.
9. Painting includes shellacs, stains, varnishes, coatings specified, and striping or markers and identity markings.
10. Incidental painting and touching up as required to produce proper finish for painted surfaces, including touching up of factory finished items.
11. Painting of any surface not specifically mentioned to be painted herein or on construction documents, but for which painting is obviously necessary to complete the job, or work which comes within the intent of these specifications, is to be included as though specified.

1.2 RELATED WORK

A. Section 01 35 26, SAFETY REQUIREMENTS: Activity Hazard Analysis.

B. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS: Sustainable Design Requirements.

C. Section 02 83 33.13, LEAD-BASED PAINT REMOVAL AND DISPOSAL: Lead Paint Removal.

D. Division 05 METALS: Shop prime painting of steel and ferrous metals.

E. Division 08 OPENINGS: Shop prime painting of steel and ferrous metals.

F. Section 08 14 00, INTERIOR WOOD DOORS: Prefinished flush doors with transparent finishes.

G. Section 09 06 00, SCHEDULE FOR FINISHES: Type of Finish, Color, and Gloss Level of Finish Coat.

H. Section 09 96 59, RESINOUS SPECIALTY GLAZED COATING SYSTEMS FOR WALLS, CEILINGS, WALLBOARD, AND BLOCK CMU (RES-W1, RES-W2): Glazed wall surfacing or tile like coatings.

I. Division 10 SPECIALTIES: Shop prime painting of steel and ferrous metals.

J. Division 11 EQUIPMENT: Shop prime painting of steel and ferrous metals.

K. Division 12 FURNISHINGS: Shop prime painting of steel and ferrous metals.

L. Division 13 SPECIAL CONSTRUCTION: Shop prime painting of steel and ferrous metals.

M. Division 21 FIRE SUPPRESSION: Shop prime painting of steel and ferrous metals.

N. Division 22 PLUMBING: Shop prime painting of steel and ferrous metals.

O. Division 23 HEATING; VENTILATION AND AIR-CONDITIONING: Shop prime painting of steel and ferrous metals.

P. Division 26 ELECTRICAL: Shop prime painting of steel and ferrous metals.

Q. Division 27 COMMUNICATIONS: Shop prime painting of steel and ferrous metals.

R. Division 28 ELECTRONIC SAFETY AND SECURITY: Shop prime painting of steel and ferrous metals.

1.3 SUBMITTALS

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

B. Sustainable Design Submittals as described below:

1. Volatile organic compounds per volume as specified in PART 2 - PRODUCTS.

C. Painter qualifications.

D. Manufacturer's Literature and Data:

1. Before work is started, or sample panels are prepared, submit manufacturer's literature and technical data, the current Master Painters Institute (MPI) "Approved Product List" indicating brand

label, product name and product code as of the date of contract award, will be used to determine compliance with the submittal requirements of this specification. The Contractor may choose to use subsequent MPI "Approved Product List", however, only one (1) list may be used for the entire contract and each coating system is to be from a single manufacturer. All coats on a particular substrate must be from a single manufacturer. No variation from the MPI "Approved Product List" where applicable is acceptable.

E. Sample Panels:

1. After painters' materials have been approved and before work is started, submit sample panels showing each type of finish and color specified.
2. Panels to Show Color: Composition board, 100 x 250 mm (4 x 10 inch).
3. Panel to Show Transparent Finishes: Wood of same species and grain pattern as wood approved for use, 100 x 250 mm (4 x 10 inch face) minimum, and where both flat and edge grain will be exposed, 250 mm (10 inches) long by sufficient size, 50 x 50 mm (2 x 2 inch) minimum or actual wood member to show complete finish.
4. Attach labels to panel stating the following:
   a. Federal Specification Number or manufacturers name and product number of paints used.
   b. Specification code number specified in Section 09 06 00, SCHEDULE FOR FINISHES.
   c. Product type and color.
   d. Name of project.
5. Strips showing not less than 50 mm (2 inch) wide strips of undercoats and 100 mm (4 inch) wide strip of finish coat.

F. Sample of identity markers if used.

G. Manufacturers' Certificates indicating compliance with specified requirements:

1. Manufacturer's paint substituted for Federal Specification paints meets or exceeds performance of paint specified.
2. High temperature aluminum paint.
3. Epoxy coating.
4. Intumescent clear coating or fire-retardant paint.

1.4 DELIVERY AND STORAGE

A. Deliver materials to site in manufacturer's sealed container marked to show following:
   1. Name of manufacturer.
   2. Product type.
   3. Batch number.
   4. Instructions for use.
   5. Safety precautions.

B. In addition to manufacturer's label, provide a label legibly printed as following:
   1. Federal Specification Number, where applicable, and name of material.
   2. Surface upon which material is to be applied.
   3. Specify Coat Types: Prime; body; finish; etc.

C. Maintain space for storage, and handling of painting materials and equipment in a ventilated, neat and orderly condition to prevent spontaneous combustion from occurring or igniting adjacent items.

D. Store materials at site at least 24 hours before using, at a temperature between 7 and 30 degrees C (45 and 85 degrees F).

1.5 QUALITY ASSURANCE

A. Qualification of Painters: Use only qualified journeyman painters for the mixing and application of paint on exposed surfaces. Submit evidence that key personnel have successfully performed surface preparation and application of coating on a minimum of three (3) similar projects within the past three (3) years.

B. Paint Coordination: Provide finish coats which are compatible with the prime paints used. Review other Sections of these specifications in which prime paints are to be provided to ensure compatibility of the total coatings system for the various substrates. Upon request from other subcontractors, furnish information on the characteristics of the finish materials proposed to be used, to ensure that compatible prime coats are used. Provide barrier coats over incompatible primers or remove and re-prime as required. Notify the Contracting Officer Representative (COR) in writing of any anticipated problems using the coating systems as specified with substrates primed by others.

1.6 REGULATORY REQUIREMENTS

A. Paint materials are to conform to the restrictions of the local Environmental and Toxic Control jurisdiction.

1. Volatile Organic Compounds (VOC) Emissions Requirements: Field-applied paints and coatings that are inside the waterproofing system to not exceed limits of authorities having jurisdiction.
2. Lead-Base Paint:
   a. Comply with Section 410 of the Lead-Based Paint Poisoning Prevention Act, as amended, and with implementing regulations promulgated by Secretary of Housing and Urban Development.
   b. Regulations concerning prohibition against use of lead-based paint in federal and federally assisted construction, or rehabilitation of residential structures are set forth in Subpart F, Title 24, Code of Federal Regulations, Department of Housing and Urban Development.
   c. Do not use coatings having a lead content over 0.06 percent by weight of non-volatile content.
   d. For lead-paint removal, see Section 02 83 33.13, LEAD-BASED PAINT REMOVAL AND DISPOSAL.
3. Asbestos: Provide materials that do not contain asbestos.
4. Chromate, Cadmium, Mercury, and Silica: Provide materials that do not contain zinc-chromate, strontium-chromate, Cadmium, mercury or mercury compounds or free crystalline silica.
5. Human Carcinogens: Provide materials that do not contain any of the ACGIH-BKLT and ACGHI-DOC confirmed or suspected human carcinogens.
6. Use high performance acrylic paints in place of alkyd paints.

1.7 SAFETY AND HEALTH

A. Apply paint materials using safety methods and equipment in accordance with the following:
   1. Comply with applicable Federal, State, and local laws and regulations, and with the ACCIDENT PREVENTION PLAN, including the Activity Hazard Analysis (AHA) as specified in Section 01 35 26, SAFETY REQUIREMENTS. The AHA is to include analyses of the potential impact of painting operations on painting personnel and on others involved in and adjacent to the work zone.

B. Safety Methods Used During Paint Application: Comply with the requirements of SSPC PA Guide 10.

C. Toxic Materials: To protect personnel from overexposure to toxic materials, conform to the most stringent guidance of:
   1. The applicable manufacturer’s Material Safety Data Sheets (MSDS) or local regulation.

2. 29 CFR 1910.1000.

3. ACHIH-BKLT and ACGHI-DOC, threshold limit values.

1.8 APPLICABLE PUBLICATIONS

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

B. American Conference of Governmental Industrial Hygienists (ACGIH):

ACGIH TLV-BKLT-2012.....Threshold Limit Values (TLV) for Chemical Substances and Physical Agents and Biological Exposure Indices (BEIs)

ACGIH TLV-DOC-2012.....Documentation of Threshold Limit Values and Biological Exposure Indices, (Seventh Edition)

C. ASME International (ASME):

A13.1-07(R2013).....Scheme for the Identification of Piping Systems

D. Code of Federal Regulation (CFR):

40 CFR 59.....Determination of Volatile Matter Content, Water Content, Density Volume Solids, and Weight Solids of Surface Coating

E. Commercial Item Description (CID):

A-A-1272A.....Plaster Gypsum (Spackling Compound)

F. Federal Specifications (Fed Spec):

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

G. Master Painters Institute (MPI):

1.....Aluminum Paint

3.....Primer, Alkali Resistant, Water Based

4.....Interior/ Exterior Latex Block Filler

17.....Primer, Bonding, Waterbased

18.....Organic Zinc Rich Primer

22.....Aluminum Paint, High Heat (up to 590% - 1100F)

23.....Primer, Metal, Surface Tolerant

27.....Exterior / Interior Alkyd Floor Enamel, Gloss

31.....Polyurethane, Moisture Cured, Clear Gloss

36.....Knot Sealer

39.....Primer, Latex, for Interior Wood

43.....Interior Satin Latex, MPI Gloss Level 4
44.....Interior Low Sheen Latex, MPI Gloss Level 2
45.....Interior Primer Sealer
46.....Interior Enamel Undercoat
47.....Interior Alkyd, Semi-Gloss, MPI Gloss Level 5
48.....Interior Alkyd, Gloss, MPI Gloss Level 6
50.....Interior Latex Primer Sealer
51.....Interior Alkyd, Eggshell, MPI Gloss Level 3
52.....Interior Latex, MPI Gloss Level 3
53.....Interior Latex, Flat, MPI Gloss Level 1
54.....Interior Latex, Semi-Gloss, MPI Gloss Level 5
59.....Interior/Exterior Alkyd Porch & Floor Enamel, Low Gloss
60.....Interior/Exterior Latex Porch & Floor Paint, Low Gloss
66.....Interior Alkyd Fire Retardant, Clear Top-Coat (ULC Approved)
67.....Interior Latex Fire Retardant, Top-Coat (ULC Approved)
68.....Interior/ Exterior Latex Porch & Floor Paint, Gloss
71.....Polyurethane, Moisture Cured, Clear, Flat
77.....Epoxy Cold Cured, Gloss
79.....Marine Alkyd Metal Primer
90.....Interior Wood Stain, Semi-Transparent
91.....Wood Filler Paste
94.....Exterior Alkyd, Semi-Gloss
95.....Fast Drying Metal Primer
98.....High Build Epoxy Coating
99.....Sealer, Water-based, for Concrete Floors
101.....Epoxy Anti-Corrosive Metal Primer
107.....Primer, Rust-Inhibitive, Water-based

108.....High Build Epoxy Coating, Low Gloss
113.....Elastomeric, Pigmented, Exterior, Water-based, Flat
114.....Interior Latex, Gloss

115.....Epoxy-Modified Latex, Interior Gloss (MPI gloss level 6)

118.....Dry Fall, Latex Flat

119.....Exterior Latex, High Gloss (acrylic)

134.....Galvanized Water Based Primer

135.....Non-Cementitious Galvanized Primer

138.....Interior High Performance Latex, MPI Gloss Level 2

139.....Interior High Performance Latex, MPI Gloss Level 3

140.....Interior High Performance Latex, MPI Gloss Level 4

141.....Interior High Performance Latex (SG) MPI Gloss Level 5

144.....Latex, Interior, Institutional Low Odor / VOC, (MPI Gloss Level 2)

145.....Latex, Interior, Institutional Low Odor / VOC, (MPI Gloss Level 3)

146.....Latex, Interior, Institutional Low Odor / VOC, (MPI Gloss Level 4)

151.....Light Industrial Coating, Interior, Water-based, (MPI Gloss Level 3)

153.....Light Industrial Coating, Interior, Water-based, (MPI Gloss Level 4)

163.....Exterior Water Based Semi-Gloss Light Industrial Coating, MPI Gloss Level 5

164.....Exterior, Water Based, Gloss, Light Industrial Coating, MPI Gloss Level 6

H. Society for Protective Coatings (SSPC):

SSPC SP 1-82(R2004).....Solvent Cleaning

SSPC SP 2-82(R2004).....Hand Tool Cleaning

SSPC SP 3-28(R2004).....Power Tool Cleaning

SSPC SP 10/NACE No.2....Near-White Blast Cleaning

SSPC PA Guide 10.....Guide to Safety and Health Requirements

I. Maple Flooring Manufacturer’s Association (MFMA):

J. U.S. National Archives and Records Administration (NARA):

29 CFR 1910.1000.....Air Contaminants

K. Underwriter’s Laboratory (UL)

PART 2 - PRODUCTS

2.1 MATERIALS

A. Conform to the coating specifications and standards referenced in PART 3. Submit manufacturer's technical data sheets for specified coatings and solvents.

2.2 PAINT PROPERTIES

A. Use ready-mixed (including colors), except two component epoxies, polyurethanes, polyesters, paints having metallic powders packaged separately and paints requiring specified additives.

B. Where no requirements are given in the referenced specifications for primers, use primers with pigment and vehicle, compatible with substrate and finish coats specified.

C. Provide undercoat paint produced by the same manufacturer as the finish coats. Use only thinners approved by the paint manufacturer and use only to recommended limits.

D. VOC Content: For field applications that are inside the weatherproofing system, paints and coating to comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:

1. Flat Paints and Coatings: 50 gram/liter.
2. Non-flat Paints and Coatings: 150 gram/liter.
3. Dry-Fog Coatings: 400 gram/liter.
4. Primers, Sealers, and Undercoaters: 200 gram/liter.
5. Anticorrosive and Antirust Paints applied to Ferrous Metals: 250 gram/liter.
6. Zinc-Rich Industrial Maintenance Primers: 340 gram/liter.
7. Pretreatment Wash Primers: 420 gram/liter.
8. Shellacs, Clear: 730 gram/liter.
9. Shellacs, Pigmented: 550 gram/liter.

E. VOC test method for paints and coatings is to be in accordance with 40 CFR 59 (EPA Method 24). Part 60, Appendix A with the exempt compounds' content determined by Method 303 (Determination of Exempt Compounds) in the South Coast Air Quality Management District's (SCAQMD) "Laboratory Methods of Analysis for Enforcement Samples" manual.

2.3 PLASTIC TAPE

A. Pigmented vinyl plastic film in colors as specified in Section 09 06 00, SCHEDULE FOR FINISHES or specified.

B. Pressure sensitive adhesive back.

C. Snap on coil plastic markers.

D. Widths as shown on construction documents.

2.4 BIOBASED CONTENT

A. Paint products shall comply with following bio-based standards for biobased materials:

Material Type	Percent by Weight
Interior Paint	20 percent biobased material
Interior Paint- Oil Based and Solvent Alkyd	67 percent biobased material
Exterior Paint	20 percent biobased material
Wood & Concrete Stain	39 percent biobased content
Polyurethane Coatings	25 percent biobased content
Water Tank Coatings	59 percent biobased content
Wood & Concrete Sealer- Membrane Concrete Sealers	11 percent biobased content
Wood & Concrete Sealer- Penetrating Liquid	79 percent biobased content

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

PART 3 - EXECUTION

3.1 JOB CONDITIONS

A. Safety: Observe required safety regulations and manufacturer's warning and instructions for storage, handling and application of painting materials.

1. Take necessary precautions to protect personnel and property from hazards due to falls, injuries, toxic fumes, fire, explosion, or other harm.
2. Deposit soiled cleaning rags and waste materials in metal containers approved for that purpose. Dispose of such items off the site at end of each day’s work.

B. Atmospheric and Surface Conditions:

1. Do not apply coating when air or substrate conditions are:
   a. Less than 3 degrees C (5 degrees F) above dew point.
   b. Below 10 degrees C (50 degrees F) or over 35 degrees C (95 degrees F), unless specifically pre-approved by the COR and the

product manufacturer. Under no circumstances are application conditions to exceed manufacturer recommendations.

c. When the relative humidity exceeds 85 percent; or to damp or wet surfaces; unless otherwise permitted by the paint manufacturer’s printed instructions.

2. Maintain interior temperatures until paint dries hard.
3. Do no exterior painting when it is windy and dusty.
4. Do not paint in direct sunlight or on surfaces that the sun will warm.
5. Apply only on clean, dry and frost-free surfaces except as follows:
   a. Apply water thinned acrylic and cementitious paints to damp (not wet) surfaces only when allowed by manufacturer's printed instructions.
   b. Concrete and masonry when permitted by manufacturer’s recommendations, dampen surfaces to which water thinned acrylic and cementitious paints are applied with a fine mist of water on hot dry days to prevent excessive suction and to cool surface.
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 INSPECTION

A. Examine the areas and conditions where painting and finishing are to be applied and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.3 GENERAL WORKMANSHIP REQUIREMENTS

A. Application may be by brush or roller. Spray application only upon acceptance from the COR in writing.

B. Furnish to the COR a painting schedule indicating when the respective coats of paint for the various areas and surfaces will be completed. This schedule is to be kept current as the job progresses.

C. Protect work at all times. Protect all adjacent work and materials by suitable covering or other method during progress of work. Upon completion of the work, remove all paint and varnish spots from floors, glass and other surfaces. Remove from the premises all rubbish and accumulated materials of whatever nature not caused by others and leave work in a clean condition.

D. Remove and protect hardware, accessories, device plates, lighting fixtures, and factory finished work, and similar items, or provide in place protection. Upon completion of each space, carefully replace all removed items by workmen skilled in the trades involved.

E. When indicated to be painted, remove electrical panel box covers and doors before painting walls. Paint separately and re-install after all paint is dry.

F. Materials are to be applied under adequate illumination, evenly spread and flowed on smoothly to avoid runs, sags, holidays, brush marks, air bubbles and excessive roller stipple.

G. Apply materials with a coverage to hide substrate completely. When color, stain, dirt or undercoats show through final coat of paint, the surface is to be covered by additional coats until the paint film is of uniform finish, color, appearance and coverage, at no additional cost to the Government.

H. All coats are to be dry to manufacturer’s recommendations before applying succeeding coats.

I. Do not apply paint behind frameless mirrors that use mastic for adhering to wall surface.

3.4 SURFACE PREPARATION

A. General:

1. The Contractor shall be held wholly responsible for the finished appearance and satisfactory completion of painting work. Properly prepare all surfaces to receive paint, which includes cleaning, sanding, and touching-up of all prime coats applied under other Sections of the work. Broom clean all spaces before painting is started. All surfaces to be painted or finished are to be completely dry, clean and smooth.
2. See other sections of specifications for specified surface conditions and prime coat.
3. Perform preparation and cleaning procedures in strict accordance with the paint manufacturer’s instructions and as herein specified, for each particular substrate condition.
4. Clean surfaces before applying paint or surface treatments with materials and methods compatible with substrate and specified finish. Remove any residue remaining from cleaning agents used. Do not use solvents, acid, or steam on concrete and masonry. Schedule the cleaning

and painting so that dust and other contaminants from the cleaning process will not fall in wet, newly painted surfaces.

5. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
   a. Concrete: 12 percent.
   b. Fiber-Cement Board: 12 percent.
   c. Gypsum Board: 12 percent.

B. 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). 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. Fill flat head countersunk screws used for permanent anchors.
   b. Do not fill screws of item intended for removal such as glazing beads.
4. Spot prime abraded and damaged areas in shop prime coat which expose bare metal with same type of paint used for prime coat. Feather edge of spot prime to produce smooth finish coat.
5. Spot prime abraded and damaged areas which expose bare metal of factory finished items with paint as recommended by manufacturer of item.

C. 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.

D. Gypsum Board:
   1. Remove efflorescence, loose and chalking plaster or finishing materials.
   2. Remove dust, dirt, and other deterrents to paint adhesion.
   3. Fill holes, cracks, and other depressions with CID-A-A-1272A finished flush with adjacent surface, with texture to match texture of adjacent surface. Patch holes over 25 mm (1-inch) in diameter as specified in Section for plaster or gypsum board.

3.5 PAINT PREPARATION

A. Thoroughly mix painting materials to ensure uniformity of color, complete dispersion of pigment and uniform composition.
B. Do not thin unless necessary for application and when finish paint is used for body and prime coats. Use materials and quantities for thinning as specified in manufacturer's printed instructions.
C. Remove paint skins, then strain paint through commercial paint strainer to remove lumps and other particles.
D. Mix two (2) component and two (2) part paint and those requiring additives in such a manner as to uniformly blend as specified in manufacturer's printed instructions unless specified otherwise.
E. For tinting required to produce exact shades specified, use color pigment recommended by the paint manufacturer.

3.6 APPLICATION

A. Start of surface preparation or painting will be construed as acceptance of the surface as satisfactory for the application of materials.
B. Unless otherwise specified, apply paint in three (3) coats; prime, body, and finish. When two (2) coats applied to prime coat are the same, first coat applied over primer is body coat and second coat is finish coat.
C. Apply each coat evenly and cover substrate completely.
D. Allow not less than 48 hours between application of succeeding coats,
D. except as allowed by manufacturer's printed instructions, and approved by
D. COR.
E. Apply by brush or roller. Spray application for new or existing occupied
E. spaces only upon approval by acceptance from COR in writing.
   1. Apply painting materials specifically required by manufacturer to be applied by spraying.
   2. In new construction and in existing occupied spaces, where paint is applied by spray, mask or enclose with polyethylene, or similar air

tight material with edges and seams continuously sealed including items specified in "Building and Structural Work Field Painting"; "Work not Painted"; motors, controls, telephone, and electrical equipment, fronts of sterilizes and other recessed equipment and similar prefinished items.

F. Do not paint in closed position operable items such as access doors and panels, window sashes, overhead doors, and similar items except overhead roll-up doors and shutters.

3.7 PRIME PAINTING

A. After surface preparation, prime surfaces before application of body and finish coats, except as otherwise specified.

B. Spot prime and apply body coat to damaged and abraded painted surfaces before applying succeeding coats.

C. Additional field applied prime coats over shop or factory applied prime coats are not required except for exterior exposed steel apply an additional prime coat.

D. Prime rabbets for stop and face glazing of wood, and for face glazing of steel.

E. Metals except boilers, incinerator stacks, and engine exhaust pipes:

1. Steel and iron: MPI 79 (Marine Alkyd Metal Primer), MPI 95 (Fast Drying Metal Primer) . Use MPI 101 (Cold Curing Epoxy Primer) where MPI 77 (Epoxy Cold Cured, Gloss, MPI 98 (High Build Epoxy Coating) and MPI 108 (High Build Epoxy Marine Coating finish is specified.
2. Zinc-coated steel and iron: MPI 134 (Waterborne Galvanized Primer)and MPI 135 (Non-Cementitious Galvanized Primer) .
3. Aluminum scheduled to be painted: MPI 95 (Fast Drying Metal Primer).
4. Terne Metal: MPI 79 (Marine Alkyd Metal Primer) and MPI 95 (Fast Drying Metal Primer) .
5. Copper and copper alloys scheduled to be painted: MPI 95 (Fast Drying Metal Primer).
6. Machinery not factory finished: MPI 9 (Exterior Alkyd Enamel).
7. Asphalt coated metal: MPI 1 (Aluminum Paint).

F. Gypsum Board and Hardboard :

1. Surfaces scheduled to have MPI 10 (Exterior Latex, Flat), MPI 11
1. (Exterior Latex, Semi-Gloss), MPI 119 (Exterior Latex, High Gloss
1. (acrylic), MPI 53 (Interior Latex, Flat) , MPI Gloss Level 1 MPI 52
1. (Interior Latex, MPI Gloss Level 3), MPI 54 (Interior Latex, Semi-

1. Gloss, MPI Gloss Level 5)and MPI 114 (Interior Latex, Gloss) finish:
1. Use MPI 53 (Interior Latex, MPI Gloss Level 3), MPI 52 (Interior
1. Latex, MPI Gloss Level 3), MPI 54 (Interior Latex, Semi-Gloss,
1. MPI Gloss Level 5) and MPI 114 (Interior Latex, Gloss) respectively
2. Primer: MPI 50 (Interior Latex Primer Sealer) except use MPI 45 (Interior Primer Sealer) and MPI 46 (Interior Enamel Undercoat) in wet locations.

G. Concrete Floors: MPI 68 (Interior/ Exterior Latex Porch & Floor Paint,
G. Gloss) and MPI 60 (Interior/ Exterior Latex Porch & Floor Paint, Low
G. Gloss) . MPI 99 (Water-based Acrylic Curing and Sealing Compound).

3.8 INTERIOR FINISHES

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

B. Metal Work:
1. Apply to exposed surfaces.
2. Omit body and finish coats on surfaces concealed after installation except electrical conduit containing conductors over 600 volts.
3. Ferrous Metal, Galvanized Metal, and Other Metals Scheduled:
   a. Apply two (2) coats of MPI 47 (Interior Alkyd, Semi-Gloss) unless specified otherwise.
   b. Two (2) coats of MPI 48 (Interior Alkyd Gloss) and MPI 51 (Interior Alkyd, Eggshell) .
   c. One (1) coat of MPI 46 (Interior Enamel Undercoat) plus one coat of MPI 47 (Interior Alkyd, Semi-Gloss) on exposed interior surfaces of alkyd-amine enamel prime finished windows.
   d. Machinery: One (1) coat MPI 9 (Exterior Alkyd Enamel).

C. Gypsum Board:
1. One (1) coat of MPI 45 (Interior Primer Sealer) and MPI 46 (Interior Enamel Undercoat) plus one (1) coat of MPI 139 (Interior High-Performance Latex, MPI Gloss level 3).
2. Two (2) coats of MPI 138 (Interior High-Performance Latex, MPI Gloss Level 2).
3. One (1) coat of MPI 45 (Interior Primer Sealer) MPI 46 (Interior Enamel Undercoat) plus one (1) coat of MPI 54 (Interior Latex, Semi-Gloss, MPI Gloss Level 5) or MPI 114 (Interior Latex, Gloss).
4. One (1) coat of MPI 45 (Interior Primer Sealer) MPI 46 (Interior Enamel Undercoat) plus one (1) coat of MPI 48 (Interior Alkyd Gloss).

3.9 REFINISHING EXISTING PAINTED SURFACES

A. Clean, patch and repair existing surfaces as specified under "Surface Preparation". No "telegraphing" of lines, ridges, flakes, etc., through new surfacing is permitted. Where this occurs, sand smooth and re-finish until surface meets with COR's approval.

B. Remove and reinstall items as specified under "General Workmanship Requirements".

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. Refinish areas as specified for new work to match adjoining work unless specified or scheduled otherwise.

G. Coat knots and pitch streaks showing through old finish with MPI 36 (Knot Sealer) before refinishing.

H. Sand or dull glossy surfaces prior to painting.

I. Sand existing coatings to a feather edge so that transition between new and existing finish will not show in finished work.

3.10 PAINT COLOR

A. Color and gloss of finish coats is specified in Section 09 06 00, SCHEDULE FOR FINISHES.

B. For additional requirements regarding color see Articles, "REFINISHING EXISTING PAINTED SURFACE" and "MECHANICAL AND ELECTRICAL FIELD PAINTING 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.

3.11 MECHANICAL AND ELECTRICAL WORK FIELD PAINTING SCHEDULE

A. Field painting of mechanical and electrical consists of cleaning, touching-up abraded shop prime coats, and applying prime, body and finish coats to materials and equipment if not factory finished in space scheduled to be finished.

B. In spaces not scheduled to be finish painted in Section 09 06 00, SCHEDULE FOR FINISHES paint as specified below.

C. Paint various systems specified in Division 02 – EXISTING CONDITIONS, Division 21 – FIRE SUPPRESSION, Division 22 - PLUMBING, Division 23 – HEATING, VENTILATION AND AIR-CONDITIONING, Division 26 - ELECTRICAL, Division 27 - COMMUNICATIONS, and Division 28 – ELECTRONIC SAFETY AND SECURITY.

D. Paint after tests have been completed.

E. Omit prime coat from factory prime-coated items.

F. Finish painting of mechanical and electrical equipment is not required when located in interstitial spaces, above suspended ceilings, in concealed areas such as pipe and electric closets, pipe basements, pipe tunnels, trenches, attics, roof spaces, shafts and furred spaces except on electrical conduit containing feeders 600 volts or more.

G. Omit field painting of items specified in “BUILDING AND STRUCTURAL WORK FIELD PAINTING”; “Building and Structural Work not Painted”.

H. Color:

1. Paint items having no color specified in Section 09 06 00, SCHEDULE FOR FINISHES to match surrounding surfaces.
2. Paint colors as specified in Section 09 06 00, SCHEDULE FOR FINISHES
2. except for following:
   a. Gray: Heating, ventilating, air conditioning and refrigeration equipment (except as required to match surrounding surfaces), and water and sewage treatment equipment and sewage ejection equipment.
   b. Aluminum Color: Ferrous metal on outside of boilers and in connection with boiler settings including supporting doors and door frames and fuel oil burning equipment, and steam generation system (bare piping, fittings, hangers, supports, valves, traps and miscellaneous iron work in contact with pipe).
   c. Federal Safety Red: Exposed fire protection piping, hydrants, post indicators, electrical conducts containing fire alarm control wiring, and fire alarm equipment.

d. Federal Safety Orange: Entire lengths of electrical conduits containing feeders 600 volts or more.

e. Color to match brickwork sheet metal covering on breeching outside of exterior wall of boiler house.

I. Apply paint systems on properly prepared and primed surface as follows:

1. Exterior Locations:

a. Apply two (2) coats of MPI 8 (Exterior Alkyd, Flat) MPI 94 (Exterior Alkyd, Semi-gloss) MPI 9 (Exterior Alkyd Enamel) to the following ferrous metal items:

1) Vent and exhaust pipes with temperatures under 94 degrees C(201 degrees F), roof drains, fire hydrants, post indicators, yard hydrants, exposed piping and similar items.

b. Apply two (2) coats of MPI 10 (Exterior Latex, Flat) MPI 11 (Exterior Latex, Semi-Gloss) MPI 119 (Exterior Latex, High Gloss (acrylic)) to galvanized and zinc-copper alloy metal.

c. Apply one (1) coat of MPI 22 (High Heat Resistant Coating), 650 degrees C (1200 degrees F) to incinerator stacks, boiler stacks, and engine generator exhaust.

2. Interior Locations:

a. Apply two (2) coats of MPI 47 (Interior Alkyd, Semi-Gloss) to following items:

1) Metal under 94 degrees C (201 degrees F) of items such as bare piping, fittings, hangers and supports.

2) Equipment and systems such as hinged covers and frames for control cabinets and boxes, cast-iron radiators, electric conduits and panel boards.

3) Heating, ventilating, air conditioning, plumbing equipment, and machinery having shop prime coat and not factory finished.

3. Other exposed locations:

a. Metal surfaces, except aluminum, of cooling towers exposed to view, including connected pipes, rails, and ladders: Two (2) coats of MPI 1 (Aluminum Paint).

b. Cloth jackets of insulation of ducts and pipes in connection with plumbing, air conditioning, ventilating refrigeration and heating systems: One (1) coat of MPI 50 (Interior Latex Primer Sealer) and one (1) coat of MPI 10 (Exterior Latex, Flat) MPI 11 (Exterior Latex Semi-Gloss MPI 119 (Exterior Latex, High Gloss (acrylic)) .

3.12 BUILDING AND STRUCTURAL WORK FIELD PAINTING:

A. Painting and finishing of interior and exterior work except as specified here-in-after.

1. Painting and finishing of new and existing work including colors and gloss of finish selected is specified in Finish Schedule, Section 09 06 00, SCHEDULE FOR FINISHES.
2. Painting of disturbed, damaged and repaired or patched surfaces when entire space is not scheduled for complete repainting or refinishing.
3. Painting of ferrous metal and galvanized metal.
4. Painting of wood with fire retardant paint exposed in attics, when used as mechanical equipment space (except shingles).
5. Identity painting and safety painting.

B. Building and Structural Work not Painted:

1. Prefinished items:
   a. Casework, doors, elevator entrances and cabs, metal panels, wall covering, and similar items specified factory finished under other sections.
   b. Factory finished equipment and pre-engineered metal building components such as metal roof and wall panels.
2. Finished surfaces:
   a. Hardware except ferrous metal.
   b. Anodized aluminum, stainless steel, chromium plating, copper, and brass, except as otherwise specified.
   c. Signs, fixtures, and other similar items integrally finished.
3. Concealed surfaces:
   a. Inside duct shafts, interstitial spaces, above ceilings, attics, except as otherwise specified.
   b. Inside walls or other spaces behind access doors or panels.
   c. Surfaces concealed behind permanently installed casework and equipment.
4. Moving and operating parts:
   a. Shafts, chains, gears, mechanical and electrical operators, linkages, and sprinkler heads, and sensing devices.
   b. Tracks for overhead or coiling doors, shutters, and grilles.
5. Labels:
   a. Code required label, such as Underwriters Laboratories Inc., Intertek Testing Service or Factory Mutual Research Corporation.

b. Identification plates, instruction plates, performance rating, and nomenclature.

6. Galvanized metal:

a. Except where specifically specified to be painted.

7. Gaskets.

3.13 IDENTITY PAINTING SCHEDULE:

A. Identify designated service in new buildings or projects with extensive remodeling in accordance with ASME A13.1, unless specified otherwise, on exposed piping, piping above removable ceilings, piping in accessible pipe spaces, interstitial spaces, and piping behind access panels. For existing spaces where work is minor match existing.

1. Legend may be identified using snap-on coil plastic markers or by paint stencil applications.
2. Apply legends adjacent to changes in direction, on branches, where pipes pass through walls or floors, adjacent to operating accessories such as valves, regulators, strainers and cleanouts a minimum of 12.2 M (40 feet) apart on straight runs of piping. Identification next to plumbing fixtures is not required.
3. Locate Legends clearly visible from operating position.
4. Use arrow to indicate direction of flow using black stencil paint.
5. Identify pipe contents with sufficient additional details such as temperature, pressure, and contents to identify possible hazard. Insert working pressure shown on construction documents where asterisk appears for High, Medium, and Low Pressure designations as follows:

a. High Pressure - 414 kPa (60 psig) and above.

b. Medium Pressure - 104 to 413 kPa (15 to 59 psig).

c. Low Pressure - 103 kPa (14 psig) and below.

d. Add Fuel oil grade numbers.

6. Legend name in full or in abbreviated form as follows:

PIPING	COLOR OF EXPOSED PIPING	COLOR OF BACKGROUND	COLOR OF LETTERS	LEGEND ABBREVIATIONS
Blow-off		Green	White	Blow-off
Boiler Feedwater		Green	White	Blr Feed
A/C Condenser Water Supply		Green	White	A/C Cond Wtr Sup
A/C Condenser Water				

Return		Green	White	A/C Cond Wtr Ret
Chilled Water Supply		Green	White	Ch. Wtr Sup
Chilled Water Return		Green	White	Ch. Wtr Ret
Shop Compressed Air		Blue	White	Shop Air
Air-Instrument Controls		Green	White	Air-Inst Cont
Drain Line		Green	White	Drain
Emergency Shower		Green	White	Emg Shower
High Pressure Steam		Green	White	H.P. _____*
High Pressure Condensate Return		Green	White	H.P. Ret ____*
Medium Pressure Steam		Green	White	M. P. Stm ____*
Medium Pressure Condensate Return		Green	White	M.P. Ret _____*
Low Pressure Steam		Green	White	L.P. Stm _____*
Low Pressure Condensate Return		Green	White	L.P. Ret _____*
High Temperature Water Supply		Green	White	H. Temp Wtr Sup
High Temperature Water Return		Green	White	H. Temp Wtr Ret
Hot Water Heating Supply		Green	White	H. W. Htg Sup
Hot Water Heating Return		Green	White	H. W. Htg Ret
Gravity Condensate Return		Green	White	Gravity Cond Ret
Pumped Condensate Return		Green	White	Pumped Cond Ret
Vacuum Condensate Return		Green	White	Vac Cond Ret
Fuel Oil - Grade		Brown	White	Fuel Oil-Grade
(Diesel Fuel included under Fuel Oil)				
Boiler Water Sampling		Green	White	Sample
Chemical Feed		Green	White	Chem Feed
Continuous Blow-Down		Green	White	Cont. B D
Pumped Condensate		Green	White	Pump Cond
Pump Recirculating		Green	White	Pump-Recirc.
Vent Line		Green	White	Vent
Alkali		Orange	Black	Alk
Bleach		Orange	Black	Bleach
Detergent		Yellow	Black	Det
Liquid Supply		Yellow	Black	Liq Sup
Reuse Water		Yellow	Black	Reuse Wtr
Cold Water (Domestic)	White	Green	White	C.W. Dom
Hot Water (Domestic)				
Supply	White	Yellow	Black	H.W. Dom
Return	White	Yellow	Black	H.W. Dom Ret
Tempered Water	White	Yellow	Black	Temp. Wtr

Ice Water				
Supply	White	Green	White	Ice Wtr
Return	White	Green	White	Ice Wtr Ret
Reagent Grade Water		Green	White	RG
Reverse Osmosis		Green	White	RO
Sanitary Waste		Green	White	San Waste
Sanitary Vent		Green	White	San Vent
Storm Drainage		Green	White	St Drain
Pump Drainage		Green	White	Pump Disch
Chemical Resistant Pipe				
Waste		Orange	Black	Acid Waste
Vent		Orange	Black	Acid Vent
Atmospheric Vent		Green	White	ATV
Silver Recovery		Green	White	Silver Rec
Oral Evacuation		Green	White	Oral Evac
Fuel Gas		Yellow	Black	Gas
Fire Protection Water				
Sprinkler	Red	Red	White	Auto Spr
Standpipe	Red	Red	White	Stand
Sprinkler	Red	Red	White	Drain
Hot Water Supply Dom./ Solar Water		Green	White	H.W. Sup Dom/SW
Hot Water Return Dom./ Solar Water		Green	White	H.W. Ret Dom/SW

7. See Sections for methods of identification, legends, and abbreviations of the following:
   a. Regular compressed air lines: Section 22 15 00, GENERAL SERVICE COMPRESSED-AIR SYSTEMS.
   b. Conduits containing high voltage feeders over 600 volts: Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS / Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS / Section 28 05 28.33, CONDUITS AND BACKBOXES FOR ELECTRONIC SAFETY AND SECURITY.

B. Fire and Smoke Partitions:
   1. Identify partitions above ceilings on both sides of partitions except within shafts in letters not less than 64 mm (2 1/2 inches) high.
   2. Stenciled message: "SMOKE BARRIER" or, "FIRE BARRIER" as applicable.

3. Locate not more than 6096 mm (20 feet) on center on corridor sides of partitions, and with a least one (1) message per room on room side of partition.
4. Use semi-gloss paint of color that contrasts with color of substrate.

C. Identify columns in pipe basements and interstitial space:
1. Apply stenciled number and letters to correspond with grid numbering and lettering indicated on construction documents.
2. Paint numbers and letters 101 mm (4 inches) high, locate 45 mm (18 inches) below overhead structural slab.
3. Apply on four (4) sides of interior columns and on inside face only of exterior wall columns.
4. Color:
a. Use black on concrete columns.
b. Use white or contrasting color on steel columns.

3.14 PROTECTION CLEAN UP, AND TOUCH-UP:

A. Protect work from paint droppings and spattering by use of masking, drop cloths, removal of items or by other approved methods.
B. Upon completion, clean paint from hardware, glass and other surfaces and items not required to be painted of paint drops or smears.
C. Before final inspection, touch-up or refinished in a manner to produce solid even color and finish texture, free from defects in work which was damaged or discolored.

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01-01-21

SECTION 09 96 59

RESINOUS SPECIALTY GLAZED COATING SYSTEMS FOR WALLS, CEILINGS, WALLBOARD, AND BLOCK CMU (RES-W1, RES-W2)

PART 1 - GENERAL

1.1 DESCRIPTION

A. Section includes surface preparation and application of high-performance seamless glazed wall coating system on new or existing surfaces including masonry CMU and wall board substrates.
   1. Interior substrates:
      a. Wall board substrates.

B. Wall systems consist of multi component epoxy and or urethane resins, primer base and finishing coats.

1.2 RELATED WORK

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

1.3 SUBMITTALS

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

B. Manufacturer's Literature and Data:
   1. Description of each product to be provided.
   2. Application and installation instructions.
   3. Maintenance Instructions: Submit manufacturer’s written instructions for recommended maintenance practices.

C. Qualification Data: For Installer.

D. Sustainable Submittal:
   1. Product data for field applied, interior, paints, coatings, and primers, include printed statement of VOC content indicating compliance with environmental requirements.

E. Samples:
   1. Each color and texture specified in Section 09 06 00, SCHEDULE FOR FINISHES.
   2. Samples for verification: For each (color and texture) resinous wall/ceiling system required, 6 inches (152 mm) square, applied to a rigid backing by installer for this project.

3. Sample showing construction from substrate to finish surface in thickness specified and color and texture of finished surfaces. Finished resinous coating must match the approved samples in color and texture.

F. Shop Drawings: Include plans, sections, component details, and attachment to other trades. Indicate layout of the following:
   1. Patterns.
   2. Edge configurations.

G. Certification and Approval:
   1. Manufacturer's certification of material and substrata compliance.
   2. Manufacturer's approval of installers.
   3. Contractor's certificate of compliance with Quality Assurance requirements.

H. Warranty: As specified in this section.

1.4 QUALITY ASSURANCE

A. Manufacture Certificate: Manufacture shall certify that a particular resinous coating for wall/ceiling system has been in use for a minimum of five years.

B. Manufacturer Field Technical Service Representatives: Resinous flooring manufacture shall retain the services of Field Technical Service Representatives who are trained specifically on installing the system to be used on the project.
   1. Field Technical Services Representatives shall be employed by the system manufacture to assist in the quality assurance and quality control process of the installation and shall be available to perform field problem solving issues with the installer.

C. Installer Qualifications: Engage an installer who is certified in writing by resinous product manufacturer, who is experienced in applying resinous coating for wall/ceiling systems similar in material, design, and extent to those indicated for this project for a minimum period of 5 years, whose work has resulted in applications with a record of successful in-service performance, and who is acceptable to resinous coating for wall/ceiling manufacturer.

D. Source Limitations:

1. Obtain resinous coating materials including primers, resins, hardening agents, grouting coats and finish or sealing coats from a single manufacturer.

E. Pre-Installation Conference

1. Convene a meeting not less than thirty days prior to starting work.
2. Attendance:
   a. Contractor
   b. VA COR
   c. Manufacturer and Installer's Representative
3. Review the following:
   a. Environmental requirements
      1) Air and surface temperature
      2) Relative humidity
      3) Ventilation
      4) Dust and contaminates
   b. Protection of surfaces not scheduled to be coated
   c. Inspect and discus condition of substrate and other preparatory work performed
   d. Review and verify availability of material; installer’s personnel, equipment needed
   e. Design and pattern s and edge conditions.
   f. Performance of the coating with chemicals anticipated in the area receiving the resinous coating system
   g. Application and repair
   h. Field quality control
   i. Cleaning
   j. Protection of coating systems
   k. One-year inspection and maintenance
   l. Coordination with other work

1.5 MATERIAL PACKAGING DELIVERY AND STORAGE

A. Deliver materials to the site in original sealed packages or containers, clearly marked with the manufacturer's name or brand, type and color, production run number, date of manufacture and mixing/thinning instructions.

B. Protect materials from damage and contamination in storage or delivery, including moisture, heat, cold, direct sunlight, etc.

C. Maintain temperature of storage area between 60 and 80 degrees F (15 and 26 degrees C).

D. Keep containers sealed until ready for use.

E. Do not use materials beyond manufacturer’s shelf life limits.

F. Package materials in factory pre-weighed and in single, easy to manage batches sized for ease of handling and mixing proportions from entire package or packages.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Comply with resinous wall/ceiling manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous wall/ceiling applications.

1. Maintain material and substrate temperature between 65 and 85 degrees F (18 and 30 degrees C) during resinous wall/ceiling application and for not less than 24 hours after application.

B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous wall/ceiling application.

C. Close spaces to traffic during resinous wall/ceiling application and for not less than 24 hours after application, unless manufacturer recommends a longer period.

1.7 WARRANTY

A. Warranty: Manufacture shall furnish a single, written warranty covering the full assembly (including substrata) for both material and workmanship for an extended period of (3) full years from date of installation, or provide a joint and several warranty signed on a single document by manufacturer and applicator jointly and severally warranting the materials and workmanship for a period of (3) full years from date of installation. A sample warranty letter must be included with bid package or bid may be disqualified.

1.8 APPLICABLE PUBLICATIONS

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

B. ASTM International(ASTM):

D412-16.....Vulcanized Rubber and Thermoplastic Elastomers—Tension

D2240-15e1.....Rubber Property—Durometer Hardness

D4060-19.....Abrasion Resistance of Organic Coatings by the Taber Abrader

C531-18-.....Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes

C. Chemical Resistance in accordance ASTM D1308 - 02(2007) "Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes". ASTM International, West Conshohocken, PA, 2006, DOI: 10.1520/D1308-02R07, www.astm.org. No effect to the following exposures:

1. Acetic acid (5%)
2. Ammonium hydroxide (10%)
3. Citric Acid (50%)
4. Fatty Acid
5. Motor Oil, 20W
6. Hydrochloric acid (20%)
7. Sodium Chloride
8. Sodium Hypochlorite (10%)
9. Sodium Hydroxide (30%)
10. Sulfuric acid (25%)
11. Urine, Feces
12. Hydrogen peroxide (10%)

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION (RES-W1)

A. Epoxy resinous wall system includes: High performance, high solids, high gloss pigmented wall system consisting of two component epoxy primers, and base coats. Optional: aliphatic polyurethane sealer finish coat for higher UV stability, and chemical resistance. Formulated for long service, cures to a hard tile like finish.

B. System Characteristics.

1. Color and pattern: As indicated on drawings.
2. Wearing Surface: Smooth

3. Overall System Thickness: 10-15 mils.

C. System Components: Manufactures standard components that are compatible with each other including primer, sealer, and finish coats as standard with manufacture of resinous system and as follows:

1. Primer Formulation Description: Multi-component 100% solids epoxy.
2. Body Coat:
   a. Resin: Epoxy.
   b. Formulation Description: Two component 100% solids.
   c. Application Method: Dip and roll.
   d. Coats: One.
   e. Thickness: 10 mils (wet).
3. Sealer Finish Coat:
   a. Resin: epoxy
   b. Formulation Description: Two Component 100% solids
   c. Type: clear
   d. Finish: Gloss
   e. Number of coats: One or two
   f. Application Method: back roll nap roller.
   g. Optional 100% solids urethane for UV and increased chemical protection.

D. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction.

1. Flat Paints and Coatings: 50 grams/liter.
2. Nonflat Paints and Coatings: 150 grams/liter.
3. Primers, Sealers: 200 gram/liter.

2.2 SPECIAL WALL COATING SYSTEM.

A. Physical Properties of flooring system when tested as follows:

Property	Test	Value
Hardness	ASTM D2240	80-85
Abrasion Resistance	ASTM D4060	0.03 gm maximum weight loss
Fire Resistance of dry film	ASTM E84	Class A
Temperature Limitations	Continuous exposure Intermittent exposure	140˚F/60˚C 200˚F/93˚C

VOC		< 50 G/L
Bond Strength		100% to Substrate Failure

2.3 SYSTEM DESCRIPTION (RES-W2)

A. Multi-layer, liquid applied flexible urethane wall system for high abuse applications. The system is designed for use on vertical services to provide a seamless, smooth, tough surface that promotes a sanitary environment. The system consists of a two-component, urethane elastomeric urethane base coat and two topcoats of two-component waterborne polyurethane.

B. System Characteristics.

1. Color and pattern: As indicated on drawings.
2. Wearing Surface: Smooth
3. Overall System Thickness: 12-15 mils.

C. System Components: Manufactures standard components that are compatible with each other including primer, sealer, and finish coats as standard with manufacture of resinous system and as follows:

1. Primer Formulation Description: Multi-component 100% solids epoxy.
2. Formulation Description: Body Coat:
   a. Resin: Urethane.
   b. Formulation Description: Two component urethane membrane.
   c. Application Method: Roller.
   d. Coats: One
   e. Thickness: 10 mils (wet).
3. First Top Coat:
   a. Resin: Waterborne aliphatic.
   b. Formulation Description: Two Component, high solids.
   c. Type: Pigmented.
   d. Finish: Gloss.
   e. Number of coats: One.
   f. Application Method: back roll or spray apply.
4. Second Top Coat:
   a. Resin: Waterborne aliphatic.
   b. Formulation Description: Two Component high solids.
   c. Type: Pigmented.

d. Finish: Gloss.

e. Number of coats: One.

f. Application Method: back roll or spray apply.

g. Optional 100% solids urethane for UV and increased chemical protection.

D. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction.

1. Flat Paints and Coatings: 50 g/L.

2. Nonflat Paints and Coatings: 150 g/L.

3. Primers, Sealers: 200 g/L.

2.4 SPECIAL WALL COATING SYSTEM.

A. Physical Properties of flooring system when tested as follows:

Property	Test	Value
Hardness	ASTM D2240	70
Elongation	ASTM D412	200%
Tensile Strength	ASTM D412	1200 psi
Abrasion Resistance	ASTM D4060 (CS-17 Wheel)	0.03 gm maximum weight loss
Fire Resistance of dry film	ASTM E84	Class B Flame Spread 40 Smoked developed 115
Temperature Limitations	Continuous exposure Intermittent exposure	140˚F/60˚C 200˚F/93˚C
VOC		< 50 G/L
Bond Strength		100% to substrate failure

2.5 ACCESORY MATERIALS

A. Patching and Fill Material: Resinous product of or approved by resinous manufacturer for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. General: Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry, and neutral Ph substrate for resinous wall coating application.

B. Clean sub-surface of all contaminants.

C. Examine surfaces for defects that cannot be corrected by procedures specified herein.

D. Any wall board application must have a (1) one, (2) two, or (3) three finish level. With an appropriate spackle compound. Finish Level (4) four, or (5) five is not acceptable and result in wall system failures, due to gypsum mud poor cohesive strengths.

E. Concrete block walls (CMU) must be given sufficient time for the mortar to fully cure. Excess mortar and any residual laitance or debris must be removed by mechanical means prior to installing Stonglaze.

F. Formed or poured concrete walls must be prepared by mechanical means to remove any laitance or efflorescence and provide a sandpaper texture suitable for bonding.

G. Commencement of application implies acceptance of surface conditions.

3.2 PROJECT CONDITIONS

A. Maintain temperature of materials above 21 degrees C (70 degrees F), for 48 hours before installation.

B. Maintain temperature of rooms where work occurs, between 21 and 32 degrees C (70 and 90 degress F) for at least 48 hours, before, during, and 24 hours after installation. Maintain temperature at least 21 degrees C (70 degrees F) thereafter.

C. Do not install materials until building is permanently enclosed and wet construction is complete, dry, and cured.

D. Area free of other trades during and for a period of 24 hours after installation.

3.3 INSTALLATION REQUIREMENTS

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

B. Submit proposed installation deviation from this specification to the COR indicating the differences in the method of installation.

3.4 PREPARATION

A. General: Prepare and clean substrates according to manufacturer's written instructions for substrate indicated. Provide clean, dry, and neutral Ph substrate for resinous application.

B. Substrates: Provide sound surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible.

1. Prepare substrates as follows:
   a. Mechanically sand or hand grind if previously applied coating is present.
   b. Comply requirements of manufacturer's written instructions.
2. Repair damaged and deteriorated substrate according to manufacturer's written recommendations.
3. Verify that substrates are dry.

B. Resinous Materials: Mix components and prepare materials according to manufacturer's written instructions.

C. Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.

3.5 APPLICATION

A. General: Apply components of resinous wall system according to manufacturer's written instructions to produce a uniform, monolithic surface of thickness indicated.

1. Coordinate application of components to provide optimum adhesion of resinous system to substrate, and optimum inter-coat adhesion.
2. Cure resinous components according to manufacturer's written instructions. Prevent contamination during application and curing processes.

B. Apply Primer: over prepared substrate at manufacturer's recommended spreading rate.

C. Base coat(s): Apply according to manufacturer's written instructions and details including those for taping, mixing, priming, and troweling, sanding, and top coating.

D. Topcoat: Mix and roller apply the topcoat(s) with strict adherence to manufacturer's installation procedures and coverage rates.

3.6 CURING, PROTECTION AND CLEANING

A. Cure resinous materials in compliance with manufacturer's directions, taking care to prevent contamination during stages of application and prior to completion of curing process.

B. Close area of application for a minimum of 24 hours.

C. Protect resinous materials from damage and wear during construction operation.

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01-01-21

SECTION 10 14 00

SIGNAGE

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies interior signage for room numbers, directional signs exterior signage, code required signs and temporary signs.

B. This section specifies exterior signage.

1.2 RELATED WORK

A. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS: Sustainable Design Requirements.

B. Section 09 06 00, SCHEDULE FOR FINISHES: Color and Finish of Interior Signs.

C. Division 26, ELECTRICAL Lighted EXIT signs for egress purposes are specified under and Electrical Work.

1.3 QUALITY ASSURANCE

A. Manufacturer’s Qualifications: Provide signage that is the product of one manufacturer, who has provided signage as specified for a minimum of three (3) years. Submit manufacturer’s qualifications.

B. Installer’s Qualifications: Minimum three (3) years’ experience in the installation of signage of the type as specified in this Section. Submit installer’s qualifications.

1.4 SUBMITTALS

A. Submit in accordance with Section 01 33 00, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.

B. Sustainable Design Submittals, as described below:

1. Volatile organic compounds per volume as specified in PART 2 - PRODUCTS.

C. Interior Sign Samples: Sign panels and frames, with letters and symbols, for each sign type.

1. Sign Panel, 203 x 254 mm (8 x 10 inches), with letters.
2. Color samples of each color, 152 x 152 mm (6 x 6 inches. Show anticipated range of color and texture.
3. Sample of typeface, arrow and symbols in a typical full size layout.

D. Manufacturer's Literature:

1. Showing the methods and procedures proposed for the anchorage of the signage system to each surface type.
2. Manufacturer’s printed specifications and maintenance instructions.

E. Sign Location Plan, showing location, type and total number of signs required.

F. Shop Drawings: Scaled for manufacture and fabrication of sign types. Identify materials, show joints, welds, anchorage, accessory items, mounting and finishes.

G. Full size layout patterns for dimensional letters.

H. Manufacturer’s qualifications.

I. Installer’s qualifications.

1.5 DELIVERY AND STORAGE

A. Deliver materials to job in manufacturer's original sealed containers with brand name marked thereon. Protect materials from damage.

B. Package to prevent damage or deterioration during shipment, handling, storage and installation. Maintain protective covering in place and in good repair until removal is necessary.

C. Deliver signs only when the site and mounting services are ready for installation work to proceed.

D. Store products in dry condition inside enclosed facilities.

1.6 WARRANTY

A. Construction Warranty: Comply with FAR clause 52.246-21, “Warranty of Construction”.

1.7 APPLICABLE PUBLICATIONS

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

B. American Architectural Manufacturers Association (AAMA):
611-14.....Anodized Architectural Aluminum
2603-13.....Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels

C. American National Standards Institute (ANSI):
A117.1-09.....Accessible and Usable Buildings and Facilities

D. ASTM International (ASTM):

A36/A36M-19.....Carbon Structural Steel

A240/A240M-20.....Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

A666-15.....Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar

A1011/A1011M-18a.....Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength

B36/B36M-18.....Brass Plate, Sheet, Strip, and Rolled Bar

B152/B152M-19.....Copper Sheet, Strip, Plate, and Rolled Bar

B209-14.....Aluminum and Aluminum-Alloy Sheet and Plate

B209M-14.....Aluminum and Aluminum-Alloy Sheet and Plate (Metric)

B221-14.....Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes

B221M-13.....Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes (Metric)

C1036-16.....Flat Glass

C1048-18.....Heat-Treated Flat Glass-Kind HS, Kind FT Coated and Uncoated Glass

C1349-17.....Architectural Flat Glass Clad Polycarbonate

D1003-13.....Test Method for Haze and Luminous Transmittance of Transparent Plastics

D4802-16.....Poly(Methyl Methacrylate) Acrylic Plastic Sheet

E. Code of Federal Regulation (CFR):

40 CFR 59.....Determination of Volatile Matter Content, Water Content, Density Volume Solids, and Weight Solids of Surface Coating

F. Federal Specifications (Fed Spec):

MIL-PRF-8184F.....Plastic Sheet, Acrylic, Modified.

MIL-P-46144C.....Plastic Sheet, Polycarbonate

G. National Fire Protection Association (NFPA):

70-14.....National Electrical Code

PART 2 - PRODUCTS

2.1 SIGNAGE GENERAL

A. Provide signs of type, size and design shown on the construction documents.

B. Provide signs complete with lettering, framing and related components for a complete installation.

C. Provide graphics items as completed units produced by a single manufacturer, including necessary mounting accessories, fittings and fastenings.

D. Do not scale construction documents for dimensions. Verify dimensions and coordinate with field conditions. Notify Contracting Officer Representative (COR) of discrepancies or changes needed to satisfy the requirements of the construction documents.

2.2 INTERIOR SIGN MATERIALS

A. Aluminum:

1. Sheet and Plate: ASTM B209M (B209).
2. Extrusions and Tubing: ASTM B221M (B221).

B. Cast Acrylic Sheet: MIL-PRF-8184F; Type II, class 1, Water white non-glare optically clear. Matt finish water white clear acrylic shall not be acceptable.

C. Polycarbonate: MIL-P-46144C; Type I, class 1.

D. Vinyl: Premium grade 0.1 mm (0.004 inch) thick machine cut, having a pressure sensitive adhesive and integral colors.

E. Adhesives:

1. Adhesives for Field Application: Mildew-resistant, nonstaining adhesive for use with specific type of panels, sheets, or assemblies; and for substrate application; as recommended in writing by signage manufacturer.
2. Adhesives to have VOC content of 50 g/L or less when calculated according to 40 CFR 59, (EPA Method 24).

F. Typography: Comply with VA Signage Design Manual.

1. Type Style: Helvetica Medium and Helvetica Medium Condensed. Initial caps or all caps, as indicated in Sign Message Schedule .
2. Arrow: Comply with graphic standards in construction documents.
3. Letter spacing: Comply with graphic standards in construction documents.

4. Letter spacing: Comply with graphic standards in construction documents.
5. Provide text, arrows, and symbols in size, colors, typefaces and letter spacing shown in construction documents. Text shall be a true, clean, accurate reproduction of typeface(s). Text shown in construction documents is for layout purposes only; final text for signs is listed in Sign Message Schedule .

2.3 INTERIOR SIGN TYPES

A. Conform to the VA Signage Design Manual.

B. Provide sliding rail frame insert and frame curved frame component system.

C. Component System Signs:

1. Provide interior sign system as follows:
   a. Interchangeable system that allows for changes of graphic components of the installed sign, without changing sign in its entirety.
   b. Provide sign system comprised of following primary components: Rail Back: Horizontal rails, spaced to allow for uniform, modular sizing of sign types.
      1) Rail Insert: Mount to back of Copy Panels to allow for attachment to Rail Back.
      2) Copy Panels: Fabricate of ABS phopolymer acrylic aluminum stainless steel materials to allow for different graphic needs.
      3) End Caps: Interlock to Rail Back to enclose and secure changeable Copy Panels.
      4) Joiners and Accent Joiners: To connect separate Rail Backs together.
      5) Top Accent Bars: To provide decorative trim cap that encloses the top of sign.
   c. Provide rail back, rail insert and end caps in anodized extruded aluminum.
   d. Provide signs in system that are convertible in the field to allow for enlargement from one (1) size to another in height and width through use of joiners or accent joiners, which connect rail back panels together blindly, providing a butt joint between

copy panels. Connect accent joiners to rail backs with a visible 3 mm (1/8") horizontal rib, flush to the adjacent copy insert surfaces.

e. Provide sign configurations as indicated on construction documents that vary in width from 228 mm (9 inches) to 2032 mm (80 inches), and have height dimensions of 50 mm (2 inches), 76 mm (3 inches), 152 mm (6 inches), 228 mm (9 inches) and 305 mm (12 inches). Height that can be increased beyond 305 mm (12 inches), by repeating height module in full or in part.

2. Provide rail back functions as internal structural member of sign. Fabricate of 6063T5-extruded aluminum, anodized black.
   a. Fabricate to accept an extruded aluminum or plastic insert on either side, depending upon sign type.
   b. Provide components that are convertible in field to allow for connection to other rail back panels.
   c. Provide mounting devices including wall mounting for screw-on applications, wall mounting with pressure sensitive tape, freestanding mount, ceiling mount and other mounting devices as needed.
3. Provide rail insert functions as mounting device for copy panels on to the rail back. The rail insert mounts to the back of the copy panel with adhesive suitable for attaching particular copy insert material.
   a. Provide copy panels that slide or snap into the horizontal rail back.
4. Provide copy panels that accept various forms of copy and graphics, and attach to the rail back with the rail insert. Provide copy panels fabricated of ABS plastic with integral color or an acrylic lacquer finish photopolymer acrylic .
   a. Provide copy panels that are interchangeable by sliding horizontally from either side of sign, and to other signs in system of equal or greater width or height.
   b. Provide materials that are cleanable without use of special chemicals or cleaning solutions.
   c. Copy Panel Materials.

1) ABS Inserts: 2.3 mm (.090 inches) extruded ABS plastic core with .07 mm (.003 inches) acrylic cap bonded during extrusion/texturing process.
   a) Pressure bonded to extruded rail insert with adhesive.
   b) Background Color: Integral or painted in acrylic lacquer.
   c) Finished: Texture pattern.
2) Photopolymer Inserts: 3.2 mm (.125 inches) phenolic photo polymer with raised copy etched to 2.3 mm (.0937 inches), bonded to an ABS plastic or extruded aluminum insert with adhesive.
   a) a) Background Color: Painted, acrylic enamel.
3) Changeable Paper/ Insert Holder: Extruded insert holder with integral rail insert for connection with structural back panel in 6063T5 aluminum with a black anodized finish.
   a) Inserts into holder are paper with a clear 0.76 mm (.030 inches) textured cover.
   b) Background Color: Painted, acrylic lacquer.
4) Acrylic - 2 mm (.080 inches) non-glare acrylic.
   a) Pressure bonded to extruded rail insert using adhesive.
   b) Background Color: Painted in acrylic lacquer or acrylic enamel.
5) Extruded 6063T5 aluminum with a black anodized finish insert holder with integral rail insert for connection with structural back panel to hold 0.76 mm (.030 inches) textured polycarbonate insert and a sliding tile which mounts in the inset holder and slides horizontally.

5. End Caps: Extruded using 6063T5 aluminum with a black anodized finish. End caps interlock with rail back with clips to form an integral unit, enclosing and securing the changeable copy panels, without requiring tools for assembly.
   a. Interchangeable to each end of sign and to other signs in signage system of equal height.
   b. Provide mechanical fasteners that can be added to the end caps that will secure it to rail back to make sign tamper resistant.

6. Joiners: Extruded using 6063T5 aluminum with a black anodized finish. Rail joiners connect rail backs together blindly, providing a butt joint between copy inserts.
7. Accent Joiners: Extruded using 6063T5 aluminum with a mirror polished finish. Connect joiner and rail backs together with a visible 3 mm (.125 inches) horizontal rib, flush to the adjacent copy panel surfaces.
8. Top Accent Rail: Extruded rail using 6063T5 aluminum with a mirror polished finish that provides a 3.2 mm (.125 inches) high decorative trim cap. Cap butts flush to adjacent copy panel and encloses top of rail back and copy panel.
9. Typography:
   a. Vinyl First Surface Copy (non-tactile): Applied vinyl copy.
   b. Subsurface Copy Inserts: Textured 1 mm (.030 inches) clear polycarbonate face with subsurface applied vinyl copy.
      1) Spray face back with paint and laminated to extruded aluminum carrier insert.
   c. Integral Tactile Copy Inserts: Phenolic photopolymer etched with 2.3 mm (.0937 inches) raised copy.
   d. Silk-screened First Surface Copy (non-tactile): Injection molded or extruded ABS plastic Aluminum insert with first surface applied enamel silk-screened copy.

D. Tactile Sign:
1. Tactile sign made from a material that provides for letters, numbers and Braille to be integral with sign. Photopolymer etched metal, sandblasted phenolic or embossed material. Do not apply letters, numbers and Braille with adhesive.
2. Numbers, letters and Braille to be raised 0.8 mm (1/32 inches) from the background surface. The draft of the letters, numbers and Braille to be tapered, vertical and clean.
3. Braille Dots: Conform with ANSI A117.1 for Braille position and layout; (a) Dot base diameter: 1.5 mm (.059 inches) (b) Inter-dot spacing: 2.3 mm (.090 inches) (c) Horizontal separation between cells: 6.0 mm (.241 inches) (d) Vertical separation between cells: 10.0 mm (.395 inches)

4. Paint assembly specified color. After painting, apply white or other specified color to surface of the numbers and letters. Apply protective clear coat sealant to entire sign.
5. Finish: Eggshell, 11 to 19 degree on a 60 degree glossmeter.

E. Provide cork or felt on bottom or mounting bracket when sign is mounted on counter or desk.

F. For ceiling mounted signs, provide mounting hardware on the sign that allows for sign disconnection, removal, reinstallation, and reconnection.

G. Glass Door and Side Light Graphics:
1. Provide text and graphics as first surface applied stylus cut vinyl.
2. Provide typeface, color, and spacing, with each message or message group on a single quick release backing sheet.

H. Dimensional Letters:
1. Provide dimensional letters that are mill or laser cut acrylic in size and thickness indicated in construction documents.
2. Provide draft of letters perpendicular to letters face.
3. Fabricate letters with square corners, such as where a letter stem and bar intersect.
4. Paint letters with acrylic polyurethane.

I. Specialty Signs:
1. Small Freestanding Stanchion Sign: 57 mm (2.25 inches) polished aluminum tube mounted to weighted 356 mm (14 inches) diameter polished aluminum base. Sign bracket to hold a 6 mm (.25 inches)copy panel.
2. Freestanding Informational Sign: 57 mm (2.25 inches) polished aluminum tube vertical support mounted to a weighted 356 mm (14 inches) diameter 57 mm (2.25 inches) polished aluminum base. Provide rail back mechanically connected to vertical supports with copy panel attached to front and back.
3. Freestanding Informational Signs for Changeable Messages: 57 mm (2.25 inches) polished aluminum tube vertical support mounted to a weighted 365 mm (14 inches) 57 mm (2.25 inches) polished aluminum base. Provide rail back mechanically connected to vertical supports with hinged locking glass door. Provide interior surface with

grooved felt covered changeable letter board or vinyl impregnated tackboard.

J. Temporary Interior Signs:
   1. Fabricated from 50 kg (110 pound) matte finished white paper cut to 101 mm (4 inch) wide by 305 mm (12 inch) long.
      a. Punched 3.2 mm (.125 inch) hole with edge of hole spaced 13 mm (.5 inch) in from edge and centered on 101 mm (4 inch) side.
      b. Reinforce hole on both sides with suitable material that prevents tie from pulling through hole.
      c. Ties: Steel wire 0.3 mm (0.120 inch) thick attached to tag with twist leaving 152 mm (6 inch) long free ends.
   2. Mark architectural room number on sign, with broad felt marker in clearly legible numbers or letters that identify room, corridor or space as shown on construction documents.
   3. Install temporary signs to rooms that have a room, corridor or space number. Attach to door frame, door knob or door pull.
      a. Doors that do not require signs are: corridor doors in corridor with same number, folding doors or partitions, toilet doors, bathroom doors within and between rooms, closet doors within rooms, communicating doors in partitions between rooms with corridor entrance doors.
      b. Replace and missing, damaged or illegible signs.

2.4 FABRICATION

A. Design interior signage components to allow for expansion and contraction for a minimum material temperature range of 38 degrees C (100 degrees F), without causing buckling, excessive opening of joints or over stressing of adhesives, welds and fasteners.
B. Form work to required shapes and sizes, with true curve lines and angles. Provide necessary rebates, lugs and brackets for assembly of units. Provide concealed fasteners wherever possible.
C. Shop fabricate so far as practicable. Fasten joints flush to conceal reinforcement, or weld joints, where thickness or section permits.
D. Level and assemble contract surfaces of connected members so joints will be tight and practically unnoticeable, without applying filling compound.
E. Signs: Fabricate with fine, even texture to be flat and sound.

1. Maintain lines and miters sharp, arises unbroken, profiles accurate and ornament true to pattern.
2. Plane surfaces to be smooth, flat and without oil-canning, free of rack and twist.
3. Maximum variation from plane of surface plus or minus 0.3 mm (0.015 inches). Restore texture to filed or cut areas.

F. Finish extruded members to be free from extrusion marks. Fabricate square turns, sharp corners, and true curves.

G. Finish hollow signs with matching material on all faces, tops, bottoms and ends. Miter edge joints to give appearance of solid material.

H. Do not manufacture signs until final sign message schedule and location review has been completed by the COR and forwarded to contractor.

I. Drill holes for bolts and screws. Mill smooth exposed ends and edges with corners slightly rounded.

J. Form joints exposed to weather to exclude water.

K. Movable Parts, Including Hardware: Cleaned and adjusted to operate as designed without binding or deformation of members. Center doors and covers in opening or frame.

1. Align contact surfaces fit tight and even without forcing or warping components.

L. Pre-assemble items in shop to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for re-assembly and coordinated installation.

M. Prime painted surfaces as required. Apply finish coating of paint for complete coverage with no light or thin applications allowing substrate or primer to show.

1. Finish surface smooth, free of scratches, gouges, drips, bubbles, thickness variations, foreign matter and other imperfections.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Locate signs as shown on the construction documents or Sign Location Plans.

B. Where not otherwise indicated conform to the VA Signage Design Manual for installation requirements.

C. At each sign location there are no utility lines behind each sign location that will be affected by installation of signs.
   1. Correct and repair damage done to utilities during installation of signs at no additional cost to Government.
D. Provide inserts and anchoring devices which must be set in concrete or other material for installation of signs. Submit setting drawings, templates, instructions and directions for installation of anchorage devices, which may involve other trades.
E. Refer to Sign Message Schedule for mounting method. Mount signs in proper alignment, level and plumb according to the Sign Location Plan and the dimensions given on elevation and Sign Location Plans. When exact position, angle, height or location is not clear, contact COR for resolution.
F. When signs are installed on glass, provide blank glass back up to be placed on opposite side of glass exactly behind sign being installed. Provide blank glass back that is the same size as sign being installed.
G. Touch up exposed fasteners and connecting hardware to match color and finish of surrounding surface.
H. At completion of sign installation, clean exposed sign surfaces. Clean and repair adjoining or adjacent surfaces that became soiled or damaged as a result of installation of signs.

- - - END - - -

SECTION 10 26 00
WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies wall guards, handrail/wall guard combinations, corner guards and door/door frame protectors and high impact wall covering including stainless steel wall finish at the Decontamination, Prep and pack, Cool Down Room, Receiving and Dispatch and Cart Wash. .

1.2 RELATED WORK

A. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS: Sustainable Design Requirements.

B. Section 08 71 00, DOOR HARDWARE: Armor plates and kick plates not specified in this section.

C. Section 09 06 00, SCHEDULE FOR FINISHES: Color and texture of aluminum and resilient material.

1.3 QUALITY ASSURANCE

A. Manufacturer’s Qualifications: Manufacturer with a minimum of three (3) years’ experience in providing items of type specified.

1. Obtain wall and door protection from single manufacturer.

B. Installer’s Qualifications: Installers are to have a minimum of three (3) years’ experience in the installation of units required for this project.

1.4 SUBMITTALS

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

B. Sustainable Design Submittals, as described below:

1. 1. Volatile organic compounds per volume as specified in PART 2 - PRODUCTS.
2. For composite wood products, submit documentation indicating product contains no added urea formaldehyde.

C. Shop Drawings: show design and installation details.

D. Manufacturer's Literature and Data:

1. Handrail/Wall Guard Combinations.
2. Wall Guards.
3. Corner Guards.

4. Door/Door Frame Protectors.
5. High Impact Wall covering.
6. Stainless Steel Wall Finish.

E. Test Report: Showing that resilient material complies with specified fire and safety code requirements.

F. Manufacturer's qualifications.

G. Installer's qualifications.

H. Manufacturer's warranty.

1.5 DELIVERY AND STORAGE

A. Deliver materials to the site in original sealed packages or containers marked with the name and brand, or trademark of the manufacturer.

B. Protect from damage from handling and construction operations before, during and after installation.

C. Store in a dry environment of approximately 21 degrees C (70 degrees F) for at least 48 hours prior to installation.

1.6 WARRANTY

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

B. Manufacturer Warranty: Manufacturer shall warranty their wall and door protection for a minimum of five (5) years from date of installation and final acceptance by the Government. Submit manufacturer warranty.

1.7 APPLICABLE PUBLICATIONS

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

B. ASTM International (ASTM):

A240/A240M-20.....Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and For General Applications

B221-14.....Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

B221M-13.....Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)

D256-10(2018).....Determining the Izod Pendulum Impact Resistance of Plastics

D635-18.....Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position

E84-20.....Surface Burning Characteristics of Building Materials

C. Aluminum Association (AA):

DAF 45-09.....Designation System for Aluminum Finishes

D. American Architectural Manufacturers Association (AAMA):

611-14.....Voluntary Specification for Anodized Architectural Aluminum

E. Code of Federal Regulation (CFR):

40 CFR 59(2020) Subpart D National Volatile Organic Compound Emission Standards for Architectural Coatings

F. The National Association of Architectural Metal Manufacturers (NAAMM):

AMP 500-06.....Metal Finishes Manual

G. National Fire Protection Association (NFPA):

80-2019.....Standard for Fire Doors and Other Opening Protectives

H. SAE International (SAE):

J 1545-2014-10.....Instrumental Color Difference Measurement for Exterior Finishes, Textiles and Colored Trim.

I. Underwriters Laboratories Inc. (UL):

Annual Issue.....Building Materials Directory

PART 2 - PRODUCTS

2.1 MATERIALS

A. Stainless Steel: A240/A240M, Type 304.

B. Aluminum Extruded: ASTM B221M (B221), Alloy 6063, Temper T5 or T6. Provide aluminum alloy used for colored anodizing coating as required to produce specified color.

C. Resilient Material:

1. Provide resilient material consisting of high impact resistant extruded acrylic vinyl, polyvinyl chloride, or injection molded thermal plastic conforming to the following:

a. Minimum impact resistance of 960.8 N-m/m (18 feet-pounds/square inch) when tested in accordance with ASTM D256 (Izod impact, feet-pounds per inch notched).

b. Class 1 fire rating when tested in accordance with ASTM E84, having a maximum flame spread of 25 and a smoke developed rating of 450 or less.

c. Rated self-extinguishing when tested in accordance with ASTM D635.

d. Provide material labeled and tested by Underwriters Laboratories or other approved independent testing laboratory.

e. Provide resilient material for protection on fire rated doors and frames assemblies that is listed by the testing laboratory performing the tests.

f. Provide resilient material installed on fire rated wood/steel door and frame assemblies that have been tested on similar type assemblies. Test results of material tested on any other combination of door and frame assembly are not acceptable.

g. Provide integral color with colored components matched in accordance with SAE J 1545 to within plus or minus 1.0 on the CIE-LCH scales.

2.2 CORNER GUARDS

A. Resilient, Shock-Absorbing Corner Guards: Flush mounted type.

1. Concealed fastener corner guard formed from stainless steel material, minimum 1.98 mm (0.078-inch) thick, free floating on a continuous 1.52 mm (0.060-inch) thick extruded aluminum retainer. Retainer used for flush mounted type to act as a stop for adjacent wall finish material. Provide appropriate mounting hardware, cushions and base plates as required.
2. Profile: Minimum 150 mm (6 inch) long leg and 6 mm (1/4 inch) corner radius 76 mm.
3. Height: 1.22 m (4 feet) 2.43 m (8 feet) or as required to suit full height wall or wainscot.
4. Retainer Clips: Provide manufacturer’s standard impact-absorbing clips.
5. Provide factory fabricated end closure caps at top and bottom of surface mounted corner guards.
6. Flush mounted corner guards installed on any fire rated wall to be installed in a manner that maintains the fire rating of the wall.

Provide fire test of proposed corner guard system to verify compliance.

a. Where insulating materials are an integral part of the corner guard system, provide insulating materials furnished by the manufacturer of the corner guard system.

2.3 WALL GUARDS AND HANDRAILS

A. Resilient Wall Guards and Handrails:

1. Handrail/Wall Guard Combination:

a. Snap-on covers of resilient material, minimum 2 mm (0.078-inch) thick.

b. Free-floating on a continuous, extruded aluminum retainer, minimum 1.82 mm (0.072-inch) thick.

c. Anchor to wall at maximum 762 mm (30 inches) on center.

2. Wall Guards:

a. Snap-on covers of resilient material, minimum 2.54 mm (0.100-inch) thick. Free-floating over 51 mm (2 inch) wide aluminum retainer clips, minimum 2.28 mm (0.090-inch) thick, anchored to wall at maximum 610 mm (24 inches) on center, supporting a continuous aluminum retainer, minimum 1.57 mm (0.062-inch) thick free-floated over a continuous extruded aluminum retainer, minimum 2.03 mm (0.080-inch) thick anchored to wall at maximum 610 mm (24 inches) on center .

3. Provide handrails and wall guards with prefabricated end closure caps, inside and outside corners, concealed splices, cushions, mounting hardware and other accessories as required. End caps and corners to be field adjustable to assure close alignment with handrails and wall guards. Screw or bolt closure caps to aluminum retainer in a concealed manner.

B. Aluminum Wall Guards: Extruded aluminum, closed tubular bumper assembly mounted on wall brackets.

1. Provide wall bumper with factory fabricated end closure caps, and inside and outside corner assemblies, concealed splice plates, and other accessories standard with the manufacturer.

2. Fabricate tubular wall guards from material with a nominal wall thickness of 6.35 mm (0.250-inch), form grooves for and provide

two (2) strips of continuous polyvinyl chloride cushion bumper inserts.

3. Fabricate adjustable wall brackets from aluminum having a nominal wall thickness of 5.08 mm (0.20-inch). Fasten bumper to brackets with 6.35 mm (1/4-inch) diameter aluminum or stainless steel bolts with locknuts.

C. Stainless Steel Wall Guards: Construct wall guard, including brackets, of minimum 4.76 mm (0.1875-inch) thick stainless steel.

2.4 DOOR AND DOOR FRAME PROTECTION

A. Fabricate door and door frame protection items from vinyl acrylic or polyvinyl chloride resilient material, minimum 1.52 mm (0.060-inch) thick, for doors and 0.89 mm (0.035-inch) thick for door frames .

B. Provide adhesive as recommended by resilient material manufacturer.

2.5 STAINLESS STEEL WALL COVERING

A. Provide wall covering/panels consisting of stainless steel material.

B. Panel sizes to be 0.61 x 2.42 meter (2 x 8 feet) or sized to fit full height or wainscot wall conditions.

C. Submit fire rating and extinguishing test results for resilient material.

D. Submit statements attesting that the items comply with specified fire and safety code requirements.

E. Provide concealed fastener details as recommended by the wall covering manufacturer. Adhesives are prohibited.

2.6 FASTENERS AND ANCHORS

A. Provide fasteners and anchors as required for each specific type of installation.

B. Where type, size, spacing or method of fastening is not shown or specified in construction documents, submit shop drawings showing proposed installation details.

2.7 FINISH

A. Aluminum: In accordance with AA DAF-45.

1. Exposed aluminum: AAMA 611 AA-M12C22A31 chemically etched medium matte, with clear anodic coating, Class II Architectural, .01 mm (0.4 mil) thick. AAMA 611 AA-M12C22A32 chemically etched medium matte with integrally colored anodic coating, Class II Architectural .01 mm (0.4 mil) thick.

2. Concealed aluminum: Mill finish as fabricated, uniform in color and free from surface blemishes.

B. Stainless Steel: In accordance with NAAMM AMP 500 finish Number 4.

C. Resilient Material: Embossed textures and color in accordance with SAE J1545.

PART 3 - INSTALLATION

3.1 STAINLESS STEEL CORNER GUARDS

A. Mount guards flush on external corners of interior walls, partitions and columns as shown on construction documents.

B. Where corner guards are installed on walls, partitions or columns finished with plaster or ceramic tile, anchor corner guards as shown on construction documents.. Coat back surfaces of corner guards, where shown on construction documents, with a non-flammable, sound deadening material. Corner guards to overlap finish plaster surfaces.

3.2 RESILIENT WALL GUARDS HANDRAILS WALL GUARD HANDRAIL COMBINATION

A. Secure guards to walls with mounting cushions brackets and

A. fasteners in accordance with manufacturer's details and instructions.

3.3 STAINLESS STEEL WALL GUARDS

A. Space brackets at not more than 914 mm (3 feet) on centers and anchor to the wall in accordance with manufacturer's installation instructions.

3.4 DOOR, DOOR FRAME PROTECTION AND HIGH IMPACT WALL COVERING

A. Surfaces to receive protection to be clean, smooth and free of obstructions.

B. Install protectors after frames are in place but preceding installation of doors in accordance with approved shop drawings and manufacturer’s specific instructions.

C. Apply with adhesive in controlled environment according to manufacturer’s recommendations.

D. Protection installed on fire rated doors and frames to be installed according to NFPA 80 and installation procedures listed in UL Building Materials Directory; or, equal listing by other approved independent testing laboratory establishing the procedures.

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01-01-21

SECTION 10 28 00
TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 DESCRIPTION

A. SUMMARY:

1. Section Includes: Toilet and bath accessories at dressing rooms, toilets, baths, locker rooms and other areas indicated on drawings.

1.2 RELATED WORK

A. Section 09 06 00, SCHEDULE FOR FINISHES: Color of finishes.

B. Section 09 30 13, CERAMIC/PORCELAIN TILING: Ceramic Accessories.

1.3 APPLICABLE PUBLICATIONS

A. Comply with references to extent specified in this section.

B. American Society of Mechanical Engineers (ASME):

1. B18.6.4-98(R2005) Thread Forming and Thread Cutting Tapping Screws and Metallic Drive Screws inch.

C. American Welding Society (AWS):

D10.4-86(2000).....Welding Austenitic Chromium-Nickle Stainless Steel Piping and Tubing.

D. ASTM International (ASTM):

A269/A269M-15a(2019)....Seamless and Welded Austenitic Stainless Steel Tubing for General Service.

A312/A312M-19.....Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.

A653/A653M-20.....Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

A666-15.....Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

A1011/A1011M-18a.....Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.

B30-20.....Copper Alloys in Ingot Form.

B75/B75M-20.....Seamless Copper Tube.

B221-14.....Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

B221M-13.....Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).

B456-17.....Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.

B824-17.....General Requirements for Copper Alloy Castings.

C1036-16.....Flat Glass.

C1048-18.....Heat-Strengthened and Fully Tempered Flat Glass.

D635-18.....Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.

E. Federal Specifications (Fed. Spec.):

A-A-3002.....Mirror, Glass.

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

WW-P-541/8B(1).....Plumbing Fixtures (Accessories, Land Use).

F. National Architectural Metal Manufacturers(NAAMM):

AMP 500-06.....Metal Finishes Manual.

1.4 SUBMITTALS

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

B. Submittal Drawings:

1. Show size, configuration, and fabrication, anchorage and installation details.
2. Show mounting locations and heights.

C. Manufacturer's Literature and Data:

1. Description of each product.
2. Installation instructions.

D. Samples:

1. Full sized, complete assembly of each product specified.
2. Reviewed samples may be incorporated into project.

E. Certificates: Certify each product complies with specifications.

1. Soap dispensers: Certify soap dispensers are fabricated of material that will not be affected by liquid soap, aseptic detergents, and hexachlorophene solutions.

F. Qualifications: Substantiate qualifications comply with specifications.

1. Manufacturer with project experience list .

G. Operation and Maintenance Data:

1. Care instructions for each exposed finish product.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Regularly manufactures specified products.

1.6 DELIVERY

A. Deliver products in manufacturer's original sealed packaging.

B. Mark packaging, legibly. Indicate manufacturer's name or brand, type, color, production run number, and manufacture date.

C. Before installation, return or dispose of products within distorted, damaged, or opened packaging.

1.7 STORAGE AND HANDLING

A. Store products indoors in dry, weathertight facility.

B. Protect products from damage during handling and construction operations.

1.8 WARRANTY

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

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum: ASTM B221M (ASTM B221), Alloy 6063-T5 and Alloy 6463-T5.

B. Stainless Steel:

1. Plate Or Sheet: ASTM A666, Type 304, 0.8 mm (0.031 inch) thick unless otherwise specified.

2. Tubing: ASTM A269/A269M, Grade TP 304, seamless or welded.

3. Pipe: ASTM A312/A312M; Grade TP 304.

C. Steel Sheet: ASTM A653/A653M, zinc-coated (galvanized) coating designation G90.

D. Chrome Plating (Service Condition Number SC 2): ASTM B456.

E. Brass Castings: ASTM B30.

F. Copper:

1. Tubing: ASTM B75/B75M.

2. Castings: ASTM B824.

G. Glass:

1. ASTM C1036, Type 1, Class 1, Quality q2, for mirrors, and for mirror doors in medicine cabinets.

2.2 PRODUCTS - GENERAL

A. Basis of Design: Section 09 06 00, SCHEDULE FOR FINISHES.

B. Provide each product from one manufacturer.

2.3 PAPER TOWEL DISPENSERS

A. Surface mounted type with sloping top.

B. Dispensing capacity for 300 sheets of any type of paper toweling.

C. Fabricate of stainless steel.

D. Provide door with continuous hinge at bottom, and spring tension cam lock or tumbler lock, keyed alike, at top, and refill sight slot in front.

2.4 WASTE RECEPTACLES

A. Semi-recessed type, without doors. Fed. Spec. WW-P-541, Type II.

B. Fabricate of stainless steel.

C. Form face frame from one piece.

D. Provide removable waste receptacle of approximately 45 L (12 gal.) capacity, fabricated of stainless steel.

E. Waste receptacle key locked in place.

2.5 CLOTHES HOOKS, ROBE OR COAT

A. Fabricate hook units from chromium plated brass with satin finish, or stainless steel, using 6 mm (1/4 inch) minimum thick stock, with edges and corners rounded smooth to thickness of metal, or 3 mm (1/8 inch) minimum radius.

B. Fabricate each unit as a double hook on a single shaft, integral with or permanently fastened to wall flange, provided with concealed fastenings.

2.6 METAL FRAMED MIRRORS

A. Fed. Spec. A-A-3002 metal frame; stainless steel .

B. Mirror Glass:

1. Minimum 6 mm (1/4 inch) thick.
2. Set mirror in a protective vinyl glazing tape.

C. Frames:

1. Channel or angle shaped section with face of frame minimum 9 mm (3/8 inch) wide. Fabricate with square corners.
2. Metal Thickness 0.9 mm (0.035 inch).

3. Filler:
   a. Where mirrors are mounted on walls having ceramic tile wainscots not flush with wall above, provide fillers contoured to conceal void between back of mirror and wall surface.
   b. Fabricate fillers from same material and finish as mirror frame.

D. Back Plate:
1. Fabricate backplate for concealed wall hanging from zinc-coated, or cadmium plated 0.9 mm (0.036 inch) thick sheet steel, die cut to fit face of mirror frame.
2. Provide set screw type theft resistant concealed fastening system for mounting mirrors.

E. Mounting Bracket:
1. Designed to support mirror tight to wall.
2. Designed to retain mirror with concealed set screw fastenings.

2.7 FOOT OPERATED SOAP DISPENSER

A. Wall mounted, liquid soap dispenser, designed with adjustable needle valve allowing dispensing of two milliliters of liquid with each depression of foot pump.

B. Connect foot pump by 1800 mm (6 foot) air tube, to 1 liter (34 ounce) liquid container. Provide air intake tube with feature to prevent liquid from dripping after release of pedal.

C. Operate pump by slip resistant, rubber padded, pedal.

D. Provide complete unit not adversely affected by liquid soap, aseptic detergent, or hexachlorophene solutions.

E. Provide removable gummed label, attached to container, stating soap or detergent is acceptable in dispensers.
1. Form surface of soap tray with raised ridges or patterned dimples to provide gripping surface for soap bar, or provide flush soap tray with a retaining lip. Plastic soap trays or tray inserts are not acceptable.

2.8 MOP RACKS

A. Minimum 1016 mm (40 inches) long with five holders.

B. Clamps:
1. Minimum of 1.3 mm (0.05 inch) thick stainless steel bracket retaining channel with hard rubber serrated cam; pivot mounted to channel.

2. Clamps to hold handles from 13 mm (1/2 inch) minimum to 32 mm (1-1/4 inch) maximum diameter.

C. Support:

1. Minimum 1 mm (0.04 inch) thick stainless steel hat shape channel to hold clamps away from wall as indicated.
2. Drill wall flange for 3 mm (1/8 inch) fasteners above and below clamp locations.

D. Secure clamps to support with oval head machine screws or rivets into continuous reinforcing back of clamps.

2.9 STAINLESS STEEL SHELVES (TYPE 44)

A. Shelves:

1. Fabricate shelves of 1.2 mm (0.0478 inch) thick sheet to size and design indicated on Drawings.
2. Fabricate shelves of hollow metal type construction, forming a depressions indicated, with closed fronts, backs, ends and bottoms. Reinforce shelves with 1.2 mm (0.05 inch) thick sheet steel hat channel stiffeners, full depth, welded to underside of top at bracket locations.
3. Miter cuts, where made at corners of shelves, continuously welding.

B. Form brackets of 3 mm (1/8 inch) thick steel as shown. Drill brackets for 6 mm (1/4 inch) anchor bolts.

C. Weld or Screw brackets to shelves.

2.10 STAINLESS STEEL SHELVES (TYPES 45, 45C)

A. Fabricate shelves and brackets to design shown of 1.2 mm (0.05 inch) thick stainless steel.

B. Round and finish smooth projecting corners of shelves and edge corners of brackets. Drill brackets for 6 mm (1/4 inch) anchor bolts.

C. Screw or weld brackets to shelves.

2.11 FABRICATION - GENERAL

A. Welding, AWS D10.4.

B. Grind, dress, and finish welded joints to match finish of adjacent surface.

C. Form exposed surfaces from one sheet of stock, free of joints.

D. Provide steel anchors and components required for secure installation.

E. Form flat surfaces without distortion. Keep exposed surfaces free from scratches and dents. Reinforce doors to prevent warp or twist.

F. Isolate aluminum from dissimilar metals and from contact with building materials as required to prevent electrolysis and corrosion.

G. Hot-dip galvanized steel or stainless steel, anchors and fastening devices.

H. Shop assemble accessories and package with components, anchors, fittings, fasteners and keys.

I. Key items alike.

J. Provide templates and rough-in measurements.

K. Round and deburr edges of sheets to remove sharp edges.

2.12 FINISH

A. Stainless Steel: NAAMM AMP 500; No. 4 polished finish.

B. Aluminum Anodized Finish: NAAMM AMP 500.

1. Clear Anodized Finish: AA-C22A41; Class I Architectural, 0.018 mm (0.7 mil) thick.

C. Chromium Plating: ASTM B456, satin or bright as specified, Service Condition No. SC2.

2.13 ACCESSORIES

A. Fasteners:

1. Concealed Fasteners:

a. High Moisture Areas: Stainless steel.

b. Other Locations: Steel, hot-dipped galvanized.

2. Toggle Bolts: For use in hollow masonry or frame construction.

3. Sex bolts: For through bolting on thin panels.

4. Expansion Shields: Lead or plastic for solid masonry and concrete substrate as recommended by accessory manufacturer to suit application.

5. Screws:

a. ASME B18.6.4.

b. Fed. Spec. FF-S-107, Stainless steel Type A.

B. Adhesive: As recommended by manufacturer to suit application.

PART 3 - EXECUTION

3.1 PREPARATION

A. Examine and verify substrate suitability for product installation.

1. Verify blocking to support accessories is installed and located correctly.

B. Verify location of accessories with Contracting Officer's Representative.

C. Provide labor or prep as required for VA-furnished and contractor installed or VA-furnished and installed components.

3.2 INSTALLATION

A. Install products according to manufacturer's instructions and reviewed submittal drawings .

1. When manufacturer's instructions deviate from specifications, submit proposed resolution for Contracting Officer's Representative consideration.

B. Install grab bars according to ASTM F446 or as directed by the COR.

C. Set work accurately, in alignment and where indicated, parallel or perpendicular as required to line and plane of surface. Install accessories plumb, level, free of rack and twist.

D. Toggle bolt to steel anchorage plates in frame partitions and hollow masonry. Expansion bolt to concrete or solid masonry.

E. Install accessories to function as designed. Perform maintenance service without interference with performance of other devices.

F. Position and install dispensers, and other devices in countertops, clear of drawers, permitting ample clearance below countertop between devices, and ready access for maintenance.

G. Align mirrors, dispensers and other accessories even and level, when installed in battery.

H. Install accessories to prevent striking by other moving, items or interference with accessibility.

3.3 CLEANING

A. After installation, clean accessories according to manufacturer’s instructions.

3.4 PROTECTION

A. Protect accessories from damage until project completion.

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08-01-18

SECTION 10 44 13
FIRE EXTINGUISHER CABINETS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section covers recessed fire extinguisher cabinets.

1.2 RELATED WORK

A. Acrylic glazing: Section 08 80 00, GLAZING.

B. Field Painting: Section 09 91 00, PAINTING.

1.3 SUBMITTALS

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

B. Manufacturer's Literature and Data: Fire extinguisher cabinet including installation instruction and rough opening required.

1.4 APPLICATION PUBLICATIONS

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

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

D4802-15.....Poly (Methyl Methacrylate) Acrylic Plastic Sheet

PART 2 - PRODUCTS

2.1 FIRE EXTINGUISHER CABINET

A. Recessed type with flat trim of size and design shown.

2.2 FABRICATION

A. Form body of cabinet from 0.9 mm (0.0359 inch) thick sheet steel.

B. Fabricate door and trim from 1.2 mm (0.0478 inch) thick sheet steel with all face joints fully welded and ground smooth.

1. Glaze doors with 6 mm (1/4 inch) thick ASTM D4802, clear acrylic sheet, Category B-1, Finish 1.
2. Design doors to open 180 degrees.
3. Provide continuous hinge, pull handle, and adjustable roller catch.

2.3 FINISH

A. Finish interior of cabinet body with baked-on semigloss white enamel.

B. Finish door, frame with manufacturer's standard baked-on prime coat suitable for field painting.

PART 3 - EXECUTION

A. Install fire extinguisher cabinets in prepared openings and secure in accordance with manufacturer's instructions.

B. Install cabinet so that the extinguisher height within meets the requirements of NFPA 10

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SECTION 11 17 36

PACKAGE TRANSFER UNITS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies package transfer units and pressurized pass-through units used in lab/cleanroom spaces.

1.2 RELATED WORK

A. Section 08 80 00, GLAZING: Glazing and ballistic rated glazing.

B. Section 09 06 00, SCHEDULE FOR FINISHES: Color and texture of factory finish.

1.3 SUBMITTAL

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

B. Shop Drawings: Show material and finish, size of members, and details of construction, installation and anchorage:

1. Pressurized Pass-through window

C. Manufacturer's Literature and Data:

1. Pressurized Pass through window

D. Certificates: Letter from manufacturer indicating the products have been certified to meet the specified ratings.

1.4 DELIVERY

A. Deliver products to site in sealed packages of containers; labeled for identification with manufacturer's name, brand, and contents.

1.5 STORAGE

A. Store products in weathertight and dry storage facility.

B. Protect from damage from handling, weather and construction operations before, during and after installation in accordance with manufacturer's instructions.

1.6 PERFORMANCE REQUIREMENTS

A. Fabricate and install Forced Entry/Ballistic Resistant (FE/BR) package transfer assemblies to achieve indicated levels of resistance. Extend resistance to include anchorages, interfaces with adjoining substrates, and hardware. Security attacks shall be unable to penetrate through closed/locked assemblies in manner described; it is recognized that

such attacks may damage units beyond repair and reuse, requiring replacement of work by Government.

1.7 APPLICABLE PUBLICATIONS

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

B. ASTM International(ASTM):

A167-99(R2009).....Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

A1008/A1008M-20.....Steel, Sheet, Cold-Rolled, Carbon, Structural High Strength Low Alloy

B26/B26M-18e1.....Aluminum Alloy Sand Castings

B221-14.....Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes

C. American Society of Mechanical Engineers (ASME):

B18.6.4-98(R2005).....Thread Forming and Thread Cutting Tapping Screws

D. American Welding Society (AWS):

D9.1-06.....Sheet Metal Welding Code

E. National Association of Architectural Metal Manufacturers (NAAMM)

AMP 500-06.....Metal Finishes Manual

F. Federal Specifications (Fed. Spec):

A-A-1922A.....Shield, Expansion

G. Underwriters Laboratories, Inc. (UL):

752-11.....Bullet-Resisting Equipment.

H. Controlled Environment Testing Association (CETA)

PART 2 - PRODUCTS

2.1 MATERIALS

A. Stainless Steel: ASTM A167, Type 302B.

B. Fasteners:

1. Exposed Fasteners: Stainless steel or chromium plated brass, finish to match adjacent surface.
2. Concealed Fasteners: Steel, hot-dip galvanized.
3. Screws: ASME B18.6.4.
4. Expansion Shields: A-A-1922A as recommended by manufacturer for component and substrate for use in solid masonry or concrete.

2.2 PRODUCT REQUIREMENTS

A. Products meet, as a minimum, the requirements specified, and be a standard commercial product of a manufacturer regularly and presently manufacturing products specified.

2.3 PRESSURIZED PASS-THROUGH WINDOWS

A. Prefabricated type, of size and design shown with unit constructed of 16 & 20 ga type 304 stainless steel with w #4 finish. Provide in 24”.

1. Provide complete with:

a. Chamber area to be double wall construction

b. Interlocking door system shall be Electrical using electro-

b. magnetic locks (fail safe)

c. Provide collar to be connected to multi-fan system, 150 cfm-with a 3” exhaust.

d. Filter to be located at roof mounted fan downstream HEPA filter

e. Air to exhaust from chamber thru perforations in door of lower classified area

f. Welded one piece finishing trims for each side of Pass-Thru

g. Doors with stainless steel pin hinges, stainless steel latching handle, 1/4” clear safety glass glazing and EPDM gasket seal

h. 1ea Mag gage to monitor HEPA filter pressure

i. Red/Green door status lights

j. 2ea Support gussets 16ga stainless steel as required for size pass-through selected.

k. Provide seamless interior with radiused edges to prevent particulate from collecting in the corners and edges, designed specifically for aseptic applications.

l. HEPA filters shall be leak resistant meeting CETA test standards

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install product by experienced mechanics capable of installing item in accordance with drawings, specifications, and shop drawings.

B. Set work accurately, in alignment and where shown. Install plumb, level, free of rack and twist, and set parallel or perpendicular to required line and plane of surface.

C. Provide anchoring devices and fasteners necessary for securing each item to building construction.

1. Do not use power actuated drive pins.
2. Do not anchor to wood ground strips.

D. Touch up abraded and damaged areas of finish coat with paint furnished by the manufacturer.

E. Fit flanges of package transfer box tight against walls. Use shims where required for leveling.

F. Connect pass through to HVAC supply air and electrical system connections as required.

3.2 CLEANING AND ADJUSTING

A. After installation, clean items as recommended by the manufacturer and protect from damage until completion of the project.

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

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01-01-21

SECTION 12 31 00

MANUFACTURED METAL CASEWORK

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies metal casework, VA standard cabinets and related accessories, including base cabinets, wall cabinets, and full height cabinets.

1.2 RELATED WORK

A. Section 06 20 00, FINISH CARPENTRY: Custom Wood Casework.

B. Section 07 92 00, JOINT SEALANTS: Sealants.

C. Section 09 06 00, SCHEDULE OF FINISHES: Color of Casework Finish.

D. Section 09 22 16, NON-STRUCTURAL METAL FRAMING: Backing Plates for Wall Mounted Casework.

E. Section 12 36 00, COUNTERTOPS: Countertop Construction and Materials and Items Installed in Countertops.

F. Division 22, PLUMBING: Plumbing Requirements Related to Casework:

G. Division 26, ELECTRICAL: Electrical Lighting and Power Requirements Related to Casework.

1.3 QUALITY ASSURANCE

A. Approval by Contracting Officer Representative (COR) is required of manufacturer and installer based upon certification of qualifications specified.

B. Manufacturer’s Qualifications:

1. Manufacturer is regularly engaged in design and manufacture of metal of scope and type similar to requirements of this project for a period of not less than five (5) years.
2. Manufacturer has successfully completed at least three (3) projects of scope and type similar to requirements of this project.
3. Submit manufacturer’s qualifications and list of projects.

C. Installer Qualifications:

1. Installer has completed at least three (3) projects in least five (5) years in which these products were installed.
2. Submit installer qualifications.

1.4 SUBMITTALS

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

B. Certificates:

1. Manufacturer's Certificate of qualifications specified.
2. Certificate of installer’s qualifications specified.

C. Manufacturer's Literature and Data:

1. Brochures showing name and address of manufacturer, and catalog or model number of each item incorporated into the work.
2. Manufacturer's illustration and detailed description.
3. List of deviations from contract specifications.
4. Locks, each kind.

D. Shop Drawings (1/2 Full Scale):

1. Showing details of casework construction, including kinds of materials and finish, hardware, accessories and relation to finish of adjacent construction, including specially fabricated items or components.
2. Fastenings and method of installation.
3. Location of service connections and access.

E. Samples:

1. Metal plate, 152 mm (6 inch) square, showing chemical resistant finish, in each color.
2. One (1) complete casework assembly, including base and wall cabinet(s) with drawers and doors.
3. One (1) glazed sliding door with track and pertinent hardware. A complete cabinet may be submitted to fulfill this requirement.

F. Manufacturer’s warranty.

1.5 WARRANTY

A. Construction Warranty: Comply with FAR clause 52.246-21 “Warranty of Construction”.

B. Manufacturer Warranty: Manufacturer shall warranty their wood casework for a minimum of five (5) years from date of installation and final acceptance by the Government. Submit manufacturer warranty.

1.6 APPLICABLE PUBLICATIONS

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

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

A36/A36M-19.....Carbon Structural Steel

A240/A240M-20.....Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

A283/A283M-18.....Low and Intermediate Tensile Strength Carbon Steel Plates

A568/A568M-19a.....Steel, Sheet, Carbon and High-Strength, Low-Alloy Hot-Rolled and Cold-Rolled, General Requirements

A794/A794M-18.....Standard Specification for Commercial Steel (CS), Sheet, Carbon (0.16% Maximum to 0.25% Maximum) Cold Rolled

B456-17.....Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium

C1036-16.....Flat Glass

C1048-18.....Heat-Strengthened and Fully Tempered Flat Glass

C1172-19.....Laminated Architectural Flat Glass

C. American National Standard Institute:

Z97.1-2015.....Safety Glazing Material used In Buildings

D. Builders Hardware Manufacturers Association (BHMA):

A156.1-16.....Butts and Hinges

A156.5-20.....Auxiliary Locks and Associated Products

A156.9-15.....Cabinet Hardware

A156.11-19.....Cabinet Locks

A156.16-18.....Auxiliary Hardware

E. American Welding Society (AWS):

D1.1/D1.1M-20.....Structural Welding Code Steel

D1.3/D1.3M-18.....Structural Welding Code Sheet Steel

F. National Association of Architectural Metal Manufacturers (NAAMM):

AMP 500 Series.....Metal Finishes Manual

G. U.S. Department of Commerce, Product Standard (PS):
PS 1-09.....Construction and Industrial Plywood

H. Underwriters Laboratories Inc. (UL):
325-17.....Door, Drapery, Gate, Louver, and Window Operators and Systems
437-13.....Key Locks

I. Federal Specifications (Fed. Spec.):
A-A-55615.....Shield, Expansion; Nail Expansion (Wood Screw and Lag Bolt Self-Threading Anchors)

J. Scientific Equipment and Furniture Association (SEFA):
2.3-10.....Installation of Scientific Laboratory Furniture and Equipment

PART 2 - PRODUCTS

2.1 MATERIALS

A. Sheet Steel:
1. ASTM A794/A794M, cold rolled, Class 1 finish, stretcher leveled.
2. Other types of cold rolled steel meeting requirements of ASTM A568/A568M are acceptable for concealed parts.

B. Structural Steel: ASTM A283/A283M or ASTM A36/A36M.

C. Stainless Steel: ASTM A240/A240M, Type 302B.

D. Glass:
1. ASTM C1048 Kind FT Type I, Class 1, Quality q3.
2. For Doors: 6 mm (1/4 inch) thick; except where laminated glass is shown on construction documents.
3. For Shelves: 6 mm (1/4 inch) 9 mm (3/8 inch) thick.

E. Plywood:
1. Prod. Std. PS 1, seven ply, interior.
2. Where both sides are exposed, use Grade AA.
3. Grade AB for other uses.

F. Fasteners:
1. Exposed to View: Chrome plated steel or stainless steel, or finished to match adjacent surface.
2. Provide round head or countersunk fasteners where exposed in cabinets.
3. Expansion Bolts: Fed Spec. A-A-55615. Do not provide lead or plastic shields.

4. Nuts: Fed Spec FF-N-836. Type III, Style 15 where exposed.
5. Sex Bolts: Capable of supporting twice the load.

2.2 MANUFACTURED PRODUCTS

A. When two (2) or more units are required, use products of one (1) manufacturer.

B. Manufacturer of casework assemblies is to assume complete responsibility for the final assembled unit.

C. Provide products of a single manufacturer for parts which are alike.

2.3 CASEWORK FABRICATION

A. General:

1. Welding: Comply with AWS Standards D1.1/D1.1M and D1.3/D1.3M.
2. Reinforce with angles, channels, and gussets to support intended loads, notch tightly, fit and weld joints.
3. Constructed of sheet steel, except where reinforcing required.

B. Minimum Steel Thickness:

Thickness	Steel Description
0.89 mm (0.035 inch) (20 gage)	Drawer fronts, backs, bodies, closure plates or scribe and filler strips less than 75 mm (3 inches) wide, sloping top, shelf reinforcement channel and shelves. Toe space or casework soffits and ceilings under sloping tops.
1.20 mm (0.047 inch) (18 gage)	Base pedestals, casework top sides, back, and bottom panels, closure scribe and filler strips 75 mm (3 inches) or more. Reinforcement for drawers with locks. Tables legs, spreaders and stretchers, when fabricated of cold rolled tubing. Metal for desks; except legs and aprons. Door exterior and interior panels, flush or glazed. Cross rails of base units. Front bottom rails, back bottom rails; rails may be 1.49 mm (0.059 inch) (16 gage) thick. Uprights or posts. Top corner gussets.

Thickness	Steel Description
1.49 mm (0.059 inch) (16 gage)	Aprons, apron division, reinforcing gussets, table legs, desk legs and aprons, spreaders and stretchers when formed without welding. Toe base gussets, drawer slides, and other metal work. Front top rails and back rails except top back rails may be 1.2 mm (0.047 inch) (18 gage) thick.
1.88 mm (0.074 inch) (14 gage)	Drawer runners door tracks.
2.64 mm (0.104 inch) (12 gage)	Base unit bottom corner gussets and leg sockets.
3 mm (0.12 inch) (11 gage)	Reinforcement for hinge reinforcement inside doors and cabinets.

C. Casework Construction:

1. Welded assembly.
2. Fabricate with enclosed uprights or posts full height or width at front. Include sides, backs, bottoms, soffits, ceilings under sloping tops, headers and rail, assembled to form an integral unit.
3. Form sides to make rabbeted stile, 19 to 28 mm (3/4 to 1-1/8 inch) wide, closed by channel containing shelf adjustment slots.
4. Make bottom of walls units flush, double panel construction.
5. Make top and cross rails of "U" shaped channel.
6. Provide enclosed backs and bottoms in cabinets, including drawer units.
7. Provide finish panel on exposed cabinet backs.
8. Do not install screws and bolts in construction or assembly of casework, except to secure hardware, applied door stops, accessories, removable panels, and where casework is required to be fastened, end to end or back to back.
9. Fabricate casework, except benches, and desks with finished end panels.

10. Close flush exposed soffits of wall hung shelving, knee spaces in counters, and toe spaces at bases.
11. In base units with sinks provide one (1) piece, lowered backs.
12. In base units with doors provide removable backs.
13. Provide built-in raceways or tubular or channel shaped members of casework for installation of wiring and electric work.
    a. Mount junction boxes on rear of cabinets.
    b. Provide electric work in accordance with Division 26, ELECTRICAL.
14. Provide reinforcing for hardware.
15. Size Dimensions:
    a. Use dimensions shown on construction documents or within tolerances specified.
    b. Tolerance:

Type of Cabinet	Depth	Nominal Dim (mm (inch))	Plus Tolerance (mm (inch))	Minus Tolerance (mm (inch))
-	Depth	305 (12)	1 (25)	0 (0)
-	Width	-	0 (0)	1 (25)
Wall Hung Cabinet	Height	-	1 (25)	1 (25)
Counter Mounted Cabinet	Height	-	1 (25)	1 (25)
Floor Standing Cabinet	Height	-	1 (25)	0 (0)

    1) Full height cabinets shown on construction documents are to be the same height back to back.
    2) Manufacturer's Tolerance for the same Length, Depth or Height of Cabinet: Not to exceed 1.58 mm (0.0625 inches).

D. Base Pedestals:
1. Provide adjustable leveling bolts accessible through stainless steel plugs, or notch in the base concealed when resilient base is applied.

2. Except where flush metal base is shown on construction documents, provide toe space at front recessed 76 mm (3 inches).

E. Doors:

1. Hollow metal type, flush and glazed doors not less than 16 mm (5/8 inch) thick.
2. Fabricate flush metal doors of two (2) panels formed into pans with corners welded and ground smooth. Provide flush doors with a sound deadening core.
3. Fabricate glazed metal doors with reinforced frame and construct either from one (1) piece of steel, or have separate stiles and rails mitered and welded at corners, and welds ground smooth.
   a. Secure removable glazing members with screws to back of doors.
   b. Install glass in rubber or plastic glazing channels.
4. Provide sheet steel hinge reinforcement inside doors.
5. Sliding doors: Provide stops to prevent bypass.
6. Doors removable without use of tools except where equipped with locks.

F. Drawers:

1. Drawer fronts to be flush hollow metal type not less than 16 mm (5/8 inch) thick with sound deadening core. Fabricate of two (2) panels formed into pans. Weld and grind smooth corners of drawer fronts.
2. Form bodies from one (1) piece of steel, weld to drawer front.
3. Provide reinforcement for locks and provide rubber bumpers at both sides of drawer head to cushion closing.
4. Equip with roller suspension guides.

G. Sloping Tops:

1. Provide sloping tops for casework where shown on construction documents.
2. Where ceilings interfere with installation of sloping tops. Provide filler plates as specified.
3. Omit sloping tops or filler plates whenever a gypsum wall board bulkhead assembly is furred down to top face of casework.
4. Provide exposed ends of sloping tops with flush closures.
5. Fasten sloping tops with sheet metal screws inserted from cabinet interior; space fastener as recommended by manufacturer.

H. Shelves:
1. Capable of supporting an evenly distributed minimum load of 122 kg per square meter (25 pounds per square foot) without visible distortion.
2. Flange shelves down 19 mm (3/4 inch) on edges, with front and bearing edges flanged back 13 mm (1/2 inch).
3. For shelves over 1067 mm (42 inches) in length and over 305 mm (12 inches) in depth install 38 mm by 13 mm by 0.9 mm (1 1/2 x 1/2 x 0.0359 inch) thick sheet steel hat channel reinforcement welded to underside midway between front and back and extending full length of shelf.
4. Weld shelves to metal back and ends unless shown on construction documents as adjustable.
5. Provide means of positive locking shelf in position, and to permit adjustment without use of tools.
6. At pharmacy with sloping shelf, provide 13 mm (1/2 inch) wide clear acrylic plastic raised edge, 3 mm (1/8 inch) thick, secured to front edge of shelf.

I. Closures and Filler Strips at Pipe Spaces:
1. Flat steel strips or plates.
2. Openings less than 203 mm (8 inches) wide: 1.2 mm (0.047 inch) thick.
3. Openings more than 203 mm (8 inches wide 0.9 mm (0.359 inches) wide.

J. Frames:
1. Under counter Table and Bench Frames:
   a. Provide welded construction.
   b. Provide open frame type with aprons and legs when required.
   c. Aprons:
      1) Channels shaped welded at corners, with leg sockets and reinforcing triangular corner gussets welded in corners.
      2) Pierce sockets to receive leg bolts and notch gussets to receive legs.
      3) Upper flange perforated or slotted to receive screws at 200 mm (8 inch) centers, and back channels when installed against wall. Size slots for 6 mm (1/4 inch) anchor bolts.

4) Pierce aprons to receive drawer formation, rail at top of drawer opening. Install channel shaped apron division welded at ends, 762 mm 30 inches apart to front and back aprons, or at each side of drawer.
5) Fabricate metal components from sheet steel.
   a) Use 1.5 mm (0.0598 inch) thick sheet for gussets and channel aprons.
   b) Use 1.2 mm (0.0478 inch) thick sheet for other items.
6) At knee space, provide exposed metal sides and metal closure plate for soffit. Where shown on construction documents at knee space, provide exposed metal back secured with continuous angle closures at both side.

d. Legs:
   1) Cold rolled tubing or 1.5 mm (0.0598 inch) formed steel.
   2) Leveling-anchoring device at floor.
   3) Stud bolt at top for attachment to leg socket.

e. Leg Braces:
   1) Tables and benches not anchored to walls.
   2) Brace back against front legs near bottom with steel angle, channel or tubular braces.
   3) Fasten braces together with steel straps.

f. Leg Shoes:
   1) Fit laboratory casework legs at bottom with either stainless steel, aluminum, or chromium plated brass shoes, not less than 25 mm (1 inch) in height.
   2) Fit other legs with a movable molded vinyl shoe 100 mm (4 inches) high and coved at bottom.

2. Suspension Frame:
   a. Provide suspension system for independent suspension of interchangeable under-counter cabinets and of countertops. Provide for removal or exchange of under counter cabinets of various heights, widths and types, and for vertical adjustment of counter tops to heights indicated on construction documents.
   b. Suspension Frames: Fabricate of 32 mm (1-1/4 inch square) or 25 mm (1 inch) x 38 mm (1-1/2 inch) rectangular, 2.6 mm (0.104 inch; 12 gauge) steel tubing welded to form full

rectangle. Provide integral, adjustable leveling device in steel leg with non-marring foot cap.

c. Provide mounting channels and support frames to allow for pipe chases and service channels when required.

d. Cabinets to have a 1.49 mm (0.059 inch) steel shaped form welded across entire width of back to engage continuous slot in wall mounting channel. Provide two (2) fastening devices through case stile at the front to provide final positive latching and locking of case in position.

e. Paint construction materials that are exposed.

3. Wheeled Carrier:

a. Provide a wheeled carrier to facilitate installation, removal, and transport of interchangeable cases as part of the interchangeable laboratory furniture system.

2.4 ACCESSORIES

A. Card or Label Holders for Shelves:

1. Fabricate of 0.6 mm (0.0239 inch) thick steel approximately 125 mm (5 inches) long, or continuous where shown on construction documents, having top and bottom edges bent over on face and welded to shelf.

2. Finish exposed surfaces in same color as shelf.

B. Labels Holders for Doors and Drawers:

1. Cast or wrought brass or aluminum, 51 mm (2 inch) by 89 mm (3 1/2 inch).

2. Fasten to casework as recommended by manufacturer.

C. Shadow Boards:

1. Plywood of size and thickness shown on construction documents with exposed edges chamfered.

2. Secure boards to back of exterior metal doors and cabinet back with screws.

3. Use pivot top and bottom hinges on intermediate boards with pulls on each leaf.

4. Paint exposed surfaces of shadow boards two shop coats of white semi-gloss paint .

D. Dispensing Trays and Bins

1. Design trays and bins to fit cabinets where shown on construction documents.
2. Fabricate of steel, polypropylene, fiberglass reinforced polyester resin, or other suitable material.
3. Lock securely in place without the use of tools.
4. Fit at angle to provide gravity feed where shown on construction documents.
5. Dispensing Trays:
   a. Equip trays with two (2) longitudinal dividers adjustable to three (3) positions.
   b. Approximate dimensions: 152 mm (6 inches) in width 76 mm (3 inches) in depth, and length to suit cabinets depth furnished.
6. Dispensing Bins:
   a. Open front, except for retaining rim.
   b. Approximate dimensions: 152 mm (6 inches) in width, 127 mm (5 inches) in depth, and length to suit cabinets furnished.

2.5 HARDWARE

A. Factory installed.

B. Exposed hardware, except as specified otherwise, satin finished chromium plated brass or nickel plated brass or anodized aluminum.

C. Cabinet Locks:
   1. Where locks are shown on construction documents.
   2. Locked pair of hinged door over 915 mm (36 inches) high:
      a. ANSI/BHMA A156.5, similar to E0261, Key one (1) side.
      b. On active leaf use three (3) point locking device, consisting of two (2) steel rods and lever controlled cam at lock, to operate by lever having lock cylinder housed therein.
      c. On inactive leaf provide dummy lever of same design.
      d. Provide keeper holes for locking device rods and cam.
   3. Door and Drawer: ANSI/BHMA A156.11 cam locks. Provide one (1) type for each condition as follows:
      a. Drawer and Hinged Door up to 915 mm (36 inches) high: E07261.
      b. Drawer and Hinged Door: Pin-tumbler, cylinder type lock with not less than four (4) pins or a UL 437 rated wafer lock with brass working parts and case.
      c. Sliding Door: E07161.

4. Marking of Locks and Keys:
   a. Name of manufacturer, or trademark which can readily be identified legibly marked on each lock and key change number marked on exposed face of lock.
   b. Key change numbers stamped on keys.
   c. Key change numbers to provide sufficient information for manufacturer to replace key.

D. Cabinet Hardware: ANSI BHMA A156.9.
1. Door/Drawer Pulls: B02011.
   a. One (1) for drawers up to 584 mm (23 inches) wide.
   b. Two (2) for drawers over 584 mm (23 inches) wide.
   c. Sliding door flush pull, each door: B02201.
   d. Provide drawer and door pulls of a design that can be operated with a force of 22.2 N (5 pounds) or less, with one (1) hand and not require tight grasping, pinching or twisting of the wrist.
2. Door in seismic zones: B03352.
   a. Do not provide thumb latch on doors equipped with three (3) point locking device.
   b. Provide lever operated two (2) point latching device on paired doors over 915 mm (36 inches) high if three (3) point locking or latching device is not used.
3. Cabinet Door Catch:
   a. Install at bottom of wall cabinets, top of base cabinets and top and bottom of full height cabinet doors over 1220 mm (48 inches).
   b. Omit on doors with locks.
4. Drawer Slides:
   a. Provide B05051 for drawers over 152 mm (6 inches) deep.
   b. Provide B05052 for drawers 76 to 152 mm (3 to 6 inches) deep.
   c. Provide B05053 for drawers less than 76 mm (3 inches) deep.
5. Butt Hinges:
   a. B01351, minimum 1.8 mm (0.072 inch) thick chrome plated steel leaves.
   b. Minimum 3.5 mm (0.139 inch) diameter stainless steel pins.
   c. Full mortise type, five (5) knuckle design with 63 mm (2 1/2 inch) high leaves and hospital type tips.

d. Two (2) hinges per door except use three (3) hinges on doors 1220 mm (48 inches) and more in height. Use stainless steel leaves for tilting bin doors.

e. Do not weld hinges to doors or cabinets.

6. Pivot hinges: ANSI/BHMA A156.1 A875B.

7. Shelf Supports:

a. Install in casework where adjustable shelves are noted on construction documents.

b. Adjustable Shelf Standards: B04061 with shelf rest B04081.

c. Vertical Slotted Shelf Standard: B04102 with shelf brackets B04112 sized for shelf depth.

8. Sliding Doors:

a. Doors supported by two (2) ball bearing bronze or nylon rollers or sheaves riding on a stainless steel track.

b. Sliding Door Tracks: B07093. Plastic tracks not acceptable.

c. Doors restrained by a nylon, polyvinylchloride, or stainless steel guide at opposite end.

9. Auxiliary Hardware: ANSI A156.16.

10. Door silencers: LO3011 or LO3031.

a. Install two (2) rubber bumpers each door.

b. Silencers set near top and bottom of jamb.

11. Closet Bar: L03131 chrome finish of required length.

2.6 METAL FINISHES

A. Comply with NAAMM AMP 500 series and as specified.

B. Steel Cabinets including Closures and Filler Strips:

1. Acid resisting finish except hardware and stainless steel.

2. After fabrication of cabinet submerge in a degreasing bath, and thoroughly rinse to remove dirt and grease, and other foreign matter.

3. Apply non-metallic phosphate coating, then finish with baked-on acid resisting enamel not less than 1 mil (0.001 inch) thick.

4. Finish resistant to action of the following reagents when 0.5 cm^3 (10 drops) are applied to the surface and left open to the atmosphere for period of one (1) hour.

REAGENTS	
Hydrochloric Acid 37 percent	Ethyl Alcohol

REAGENTS	
Phosphoric Acid 75 percent	Methylethyl Keytone
Sulfuric Acid 25 percent	Acetone
Glacial Acetic Acid	Ethyl Acetate
Sodium Hydroxide 10 percent	Ethyl Ether
Sodium Hydroxide (concentrated)	Carbon Tetrachloride
Hydrogen Peroxide 5 percent	Xylene
Formaldehyde 37 percent	Phenol 85 Percent

5. Color of finish is specified in Section 09 06 00, SCHEDULE FOR FINISHES.

C. Brass:
1. U.S. Standard Finish No. 26 for hardware items.
2. Other brass items: ASTM B456, chromium plated finish meeting requirements for Service Condition SCI.

D. Aluminum: Chemically etched medium matte, clear anodic coating, Class II, Architectural, 0.4 mils (0.0004 inches) thick.

E. Stainless Steel: Mechanical finish No. 4 on sheet except No. 7 on tubing.

2.7 VA STANDARD CABINETS:

A. Laboratory and Hospital Casework, including metal casework of the following types:
1. Wall Cabinet, Metal, 5B (VA Standard Detail SD123100-01).

2.8 PRODUCTS OF OTHER COMPONENTS DIRECTLY RELATED TO CASEWORK

A. Refer to Section 07 92 00, JOINT SEALANTS for work related to sealants used in conjunction with joints of countertops, casework systems, and adjacent materials.

B. Refer to Section 09 65 13, RESILIENT BASE AND ACCESSORIES for work related to rubber base adhered to casework systems.

C. Refer to Section 09 22 16, NON-STRUCTURAL METAL FRAMING for backing plates used in conjunction with wall assemblies for the attachment of casework systems.

D. Refer to Section 12 36 11, COUNTERTOPS for work related to plastic laminate, acid-resistant plastic laminate, metal, molded resin, wood, and methyl methacrylic polymer countertops and/or shelving used in conjunction with casework systems. When countertop materials are

provided by the casework manufacturer, they are to include the following features:

1. Capable of being suspended from vertical support rails or horizontal wall strips or service modules.
2. Provided with rounded corners and impact resistant material on exposed edges.
3. Capable of being easily relocated and installed without tools.
4. Capable of being suspended and easily changed under counter mounted storage units.
5. Provide leveling adjustment capability so units can be brought into a level position.
6. Secured using fasteners. Show detail on shop drawings.

E. Refer to Section 12 36 11, COUNTERTOPS for work related to and integral with countertop systems such as pegboards, funnel and graduate racks.

F. Refer to Division 22, PLUMBING for the following work related to casework systems:

1. Sinks, faucets and other plumbing service fixtures, venting, and piping systems.
2. Compressed air, gas, vacuum and piping systems.

G. Refer to Division 26, ELECTRICAL for the following work related to casework systems:

1. Connections and wiring devices.
2. Connections and lighting fixtures except when factory installed by the manufacturer.

PART 3 - EXECUTION

3.1 COORDINATION

A. Begin only after work of other trades is complete, including wall and floor finish completed, ceilings installed, light fixtures and diffusers installed and connected, and area free of trash and debris.

B. Verify location and size of mechanical and electrical services as required and perform cutting of components of work installed by other trades.

C. Verify reinforcement of walls and partitions for support and anchorage of casework.

D. Coordinate with other Divisions and Sections of the specification for work related to installation of casework systems to avoid interference and completion of service connections.

3.2 INSTALLATION

A. Install casework in accordance with manufacturer’s written instructions and per SEFA 2.3 recommendations .
   1. Install in available space; arranged for safe and convenient operation and maintenance.
   2. Align cabinets for flush joints except where shown otherwise on construction documents.
   3. Install with bottom of wall cabinets in alignment and tops of base cabinets aligned level, plumb, true, and straight to a tolerance of 3.2 mm in 2438 mm (1/8 inch in 96 inches).
   4. Install corner cabinets with hinges on corner side with filler or spacers sufficient to allow opening of drawers.

B. Support Rails:
   1. Install true to horizontal at heights shown on construction documents; maximum tolerance for uneven floors is plus or minus 13 mm (1/2 inch).
   2. Shim as necessary to accommodate variations in wall surface not exceeding 5 mm (3/16 inch) at fastener.

C. Wall Strips:
   1. Install true to vertical and spaced as shown on construction documents.
   2. Align slots to assure that hanging units will be level.

D. Plug Buttons:
   1. Install plug buttons in predrilled or prepunched perforations not used.
   2. Use chromium plate plug buttons or buttons finish to match adjacent surfaces.

E. Seal junctures of casework systems with mildew-resistant silicone sealants as specified in Section 07 92 00, JOINT SEALANTS.

3.3 CLOSURES AND FILLER PLATES

A. Close openings larger than 6 mm (1/4 inch) wide between cabinets and adjacent walls with flat, steel closure strips, scribed to required contours, or machined formed steel fillers with returns, and secured

with sheet metal screws to tubular or channel members of units, or bolts where exposed on inside.

B. Where ceilings interfere with installation of sloping tops, omit sloping tops and provide flat steel filler plates.

C. Secure filler plates to casework top members, unless shown otherwise on construction documents.

D. Secure filler plates more than 152 mm (6 inches) in width top edge to a continuous 25 x 25 mm (1 x 1 inch) 0.889 mm (1/16 inch) thick steel formed steel angle with screws.

E. Anchor angle to ceiling with toggle bolts.

F. Install closure strips at exposed ends of pipe space and offset opening into concealed space.

G. Finish closure strips and fillers with same finishes as cabinets.

3.4 FASTENINGS AND ANCHORAGE

A. Do not anchor to wood ground strips.

B. Provide hat shape metal spacers where fasteners span gaps or spaces.

C. Use 6 mm (1/4 inch) diameter toggle or expansion bolts, or other appropriate size and type fastening device for securing casework to walls or floor. Use expansion bolts shields having holding power beyond tensile and shear strength of bolt and breaking strength of bolt head.

D. Use 6 mm (1/4 inch) diameter hex bolts for securing cabinets together.

E. Use 6 mm (1/4 inch) by minimum 38 mm (1-1/2 inch) length lag bolt anchorage to wood blocking for concealed fasteners.

F. Use not less than No. 12 or 14 wood screws with not less than 38 mm (1 1/2 inch) penetration into wood blocking.

G. Space fastening devices 305 mm (12 inches) on center with minimum of three (3) fasteners in 915 or 1219 mm (3 or 4 foot) unit width.

H. Anchor floor mounted cabinets with a minimum of four (4) bolts through corner gussets. Anchor bolts may be combined with or separate from leveling device.

I. Secure cabinets in alignment with hex bolts or other internal fastener devices removable from interior of cabinets without special tools. Do not use fastener devices which require removal of tops for access.

J. Where units abut end to end, anchor together at top and bottom of sides at front and back. Where units are back to back, anchor backs together at corners with hex bolts placed inconspicuously inside casework.

K. Where type, size, or spacing of fastenings is not shown or specified on construction documents, show on shop drawings proposed fastenings and method of installation.

3.5 ADJUSTMENTS

A. Adjust equipment to insure proper alignment and operation.

B. Replace or repair damaged or improperly operating materials, components or equipment.

3.6 CLEANING

A. Immediately following installation, clean each item, removing finger marks, soil and foreign matter resulting from work of this section.

B. Remove from job site trash, debris and packing materials resulting from work of this section.

C. Leave installed areas clean of dust and debris resulting from work of this section.

3.7 INSTRUCTIONS

A. Provide operational and cleaning manuals and verbal instructions in accordance with Article INSTRUCTIONS, SECTION 01 00 00, GENERAL REQUIREMENTS.

B. Provide in service training both prior to and after facility opening. Coordinate in service activities with COR.

C. Commencing at least seven (7) days prior to opening of facility, provide one (1) 4-hour day of on-site orientation and technical instruction on use and cleaning procedures application of products and systems specified herein.

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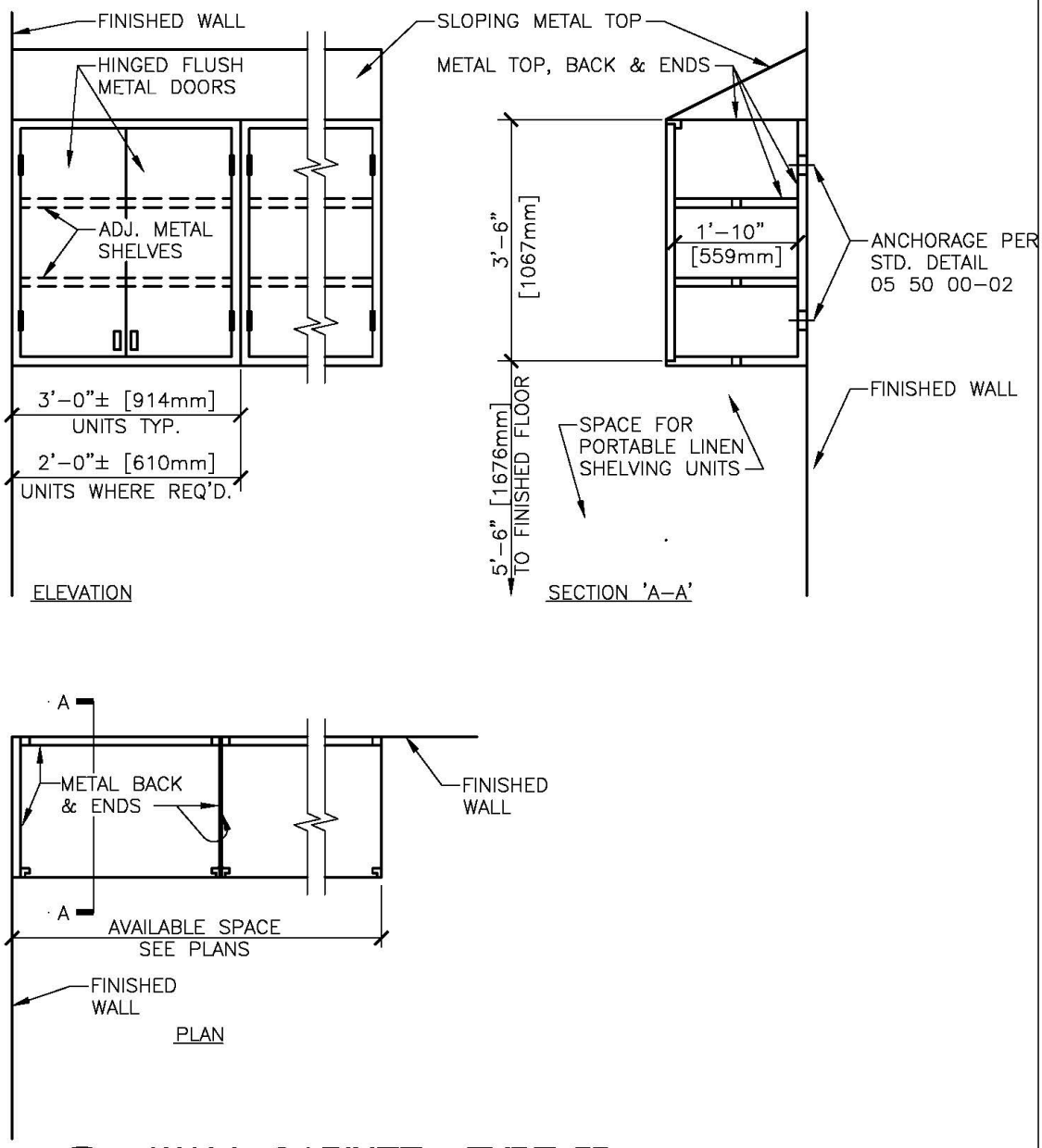

WALL CABINET - TYPE 5B

NTS

Department of Veterans Affairs

DETAIL TITLE / WALL CABINET - TYPE 5B

SCALE :NONE

DATE ISSUED: DECEMBER 2008 CAD DETAIL NO.: SD123100-01.DWG

11-01-23

SECTION 12 36 00
COUNTERTOPS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies casework countertops with integral accessories.

1.2 RELATED WORK

A. Color and patterns of plastic laminate: SECTION 09 06 00, SCHEDULE FOR FINISHES.

B. DIVISION 22, PLUMBING.

C. DIVISION 26, ELECTRICAL.

D. Equipment Reference Manual for SECTION 12 36 00, COUNTERTOPS.

1.3 SUBMITTALS

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

B. Shop Drawings

1. Show dimensions of section and method of assembly.
2. Show details of construction at a scale of ½ inch to a foot.

C. Samples:

1. 150 mm (6 inch) square samples each top.
2. Front edge, back splash, end splash and core with surface material and booking.

1.4 APPLICABLE PUBLICATIONS

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

B. American Hardboard Association (AHA):

A135.4-95.....Basic Hardboard

C. Composite Panel Association (CPA):

A208.1-09.....Particleboard

D. American Society of Mechanical Engineers (ASME):

A112.18.1-12.....Plumbing Supply Fittings

A112.1.2-12.....Air Gaps in Plumbing System

A112.19.3-08(R2004).....Stainless Steel Plumbing Fixtures (Designed for Residential Use)

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

A167-99 (R2009).....Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip

A1008-10.....Steel, Sheet, Cold-Rolled, Carbon, Structural, High Strength, Low Alloy

D256-10.....Pendulum Impact Resistance of Plastic

D570-98(R2005).....Water Absorption of Plastics

D638-10.....Tensile Properties of Plastics

D785-08.....Rockwell Hardness of Plastics and Electrical Insulating Materials

D790-10.....Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

D4690-99(2005).....Urea-Formaldehyde Resin Adhesives

F. Federal Specifications (FS):

A-A-1936.....Adhesive, Contact, Neoprene Rubber

G. U.S. Department of Commerce, Product Standards (PS):

PS 1-95.....Construction and Industrial Plywood

H. National Electrical Manufacturers Association (NEMA):

LD 3-05.....High Pressure Decorative Laminates

PART 2 - PRODUCTS

2.1 MATERIALS

A. Molded Resin:

1. Non-glare epoxy resin or furan resin compounded and cured for minimum physical properties specified:

Property	Result	Test
Flexural strength	70 MPa (10,000 psi)	ASTM D790
Rockwell hardness	105	ASTM D785
Water absorption, 14 hours (weight)	.01%	ASTM D570

2. Material of uniform mixture throughout.

B. Stainless Steel: ASTM A167, Type 304.

C. Sheet Steel: ASTM A1008, cold rolled, Class 1 finish, stretcher leveled.

D. Particleboard: CPA A208.1, Grade 2-M-2.

E. Adhesive

1. For wood products: ASTM D4690, unextended urea resin or unextended melamine resin, phenol resin, or resorcinol resin.
2. For Field Joints:
   a. Epoxy type, resistant to chemicals as specified for plastic laminate laboratory surfaces.
   b. Fungi resistant: ASTM G-21, rating of 0.

F. Fasteners:
1. Metals used for welding same metal as materials joined.
2. Use studs, bolts, spaces, threaded rods with nuts or screws suitable for materials being joined with metal splice plates, channels or other supporting shape.

G. Solid Polymer Material:
1. Filled Methyl Methacrylic Polymer.
2. Performance properties required:

Property	Result	Test
Elongation	0.3% min.	ASTM D638
Hardness	90 Rockwell M	ASTM D785
Gloss (60^0 Gordon)	5-20	NEMA LD3.1
Color stability	No change	NEMA LD3 except 200 hour
Abrasion resistance	No loss of pattern Max wear depth 0.0762 mm (0.003 in) - 10000 cycles	NEMA LD3
Water absorption weight (5 max)	24 hours 0.9	ASTM D-570
Izod impact	14 N·m/m (0.25 ft-lb/in)	ASTM D256 (Method A)
Impact resistance	No fracture	NEMA LD-3 900 mm (36") drop 1 kg (2 lb.) ball
Boiling water surface resistance	No visible change	NEMA LD3
High temperature resistance	Slight surface dulling	NEMA LD3

3. Cast into sheet form and bowl form.
4. Color throughout with subtle veining through thickness.

5. Joint adhesive and sealer: Manufacturers silicone adhesive and sealant for joining methyl methacrylic polymer sheet.
6. Bio-based products will be preferred.

H. Laminar Flow Control Device
1. 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.
2. Flow Control Restrictor:
a. Capable of restricting flow of 7.5 to 8.5 Lpm (2.0 to 2.2 gpm) for sinks provided in paragraph 2.2D.
b. Compensates for pressure fluctuation maintaining flow rate specified above within 10 percent between 175 and 550 kPa (25 and 80 psi).
c. Operates by expansion and contraction, eliminates mineral/sediment building up with self clearing action, and is capable of easy manual cleaning.

2.2 COUNTERTOPS

A. Fabricate in largest sections practicable.
B. Fabricate with joints flush on top surface.
C. Fabricate countertops to overhang front of cabinets and end of assemblies 25 mm (one inch) except where against walls or cabinets.
D. Provide 1 mm (0.039 inch) thick metal plate connectors or fastening devices (except epoxy resin tops).
E. Join edges in a chemical resistant waterproof cement or epoxy cement, except weld metal tops.
F. Fabricate with end splashes where against walls or cabinets.
G. Splash Backs and End Splashes:
1. Not less than 19 mm (3/4 inch) thick.
2. Height 100 mm (4 inches) unless noted otherwise.
3. Laboratories and pharmacy heights or where fixtures or outlets occur: Not less than 150 mm (6 inches) unless noted otherwise.
4. Fabricate epoxy splash back in maximum lengths practical of the same material.
H. Drill or cutout for sinks, and penetrations.
1. Accurately cut for size of penetration.

2. Cutout for VL 81 photographic enlarger cabinet.
   a. Finish cutout to fit flush with vertical side of cabinet, allowing adjustable shelf to fit into cutout space of cabinet at counter top level. Finish cutout surface as an exposed edge.
   b. Provide braces under enlarger space to support not less than 45 kg (100 pounds) centered on opening side along backsplash.

I. Metal Counter Tops:
1. Fabricate up to 3600 mm (12 feet) long in one piece, including nosing, backs and ends.
2. When counter tops exceed 3600 mm (12 feet) in length accurately fitted field joints are acceptable.
3. Finish thickness at edges 32 mm (1-1/4 inch).
4. Reinforced with minimum 1.5 mm (0.0598 inch) thick hat channel stiffeners, minimum of two stiffeners for units without sinks and three stiffeners for units with sinks welded or soldered to underside of top full length, except at sink openings.
5. Apply sound deadening material on underside.
6. Flange edges of tops down 32 mm (1-1/4 inch) and reinforce with concealed hardwood or with a steel frame.
7. Grind welds smooth and finished on exposed surfaces to match finish specified.
8. Stainless Steel Counter or Sink Tops:
   a. Where noted stainless steel except where specified for nourishment unit, unit kitchen, and medicine cabinet.
   b. Use 1.5 mm (0.0598 inch) thick stainless steel.
   c. Depth of splash backs and splash ends 25 mm (one inch) and turned down at least 13 mm (1/2 inch) at wall. Where faucets are located in splash backs, fabricate depth of splash backs 50 mm (2 inches) with provision made to receive required fixture.
   d. Where sinks occur fabricate top with 5 mm (3/16 inch) marine edge and fit flush with adjacent tops of other materials.
   e. Weld sink flush to counter top and finish to appear seamless.

J. Molded Resin Tops:
1. Molded resin with drip groove cut on underside of overhanging edge.
2. Finish thickness of top minimum 25 mm (1 inch).
3. Joints: Epoxy Type.

4. Secure reagent shelves to counter tops with fasteners from underside and seal seam.

K. Laboratory Shelf 200 mm (8 inches) deep: Fabricate of 27 mm (1-1/16 inch) thick hardwood. Finish with black acid resisting enamel.

L. Laboratory Shelf with Funnel and Graduate Rack 300 mm (12 inches) deep shelf: Fabricate of 27 mm (1-1/16 inch) thick hardwood. Finish with black acid resisting enamel.

M. Laboratory Shelf 254 mm (10 inch deep): Fabricate of corrosion resisting steel.

N. Countertop products shall comply with following standards for biobased materials:

Material Type	Percent by Weight
Composite Panel	89 percent biobased material
Hardwood	89 percent biobased material
Particleboard	89 percent biobased material
Plywood	89 percent biobased material

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

PART 3 - EXECUTION

3.1 INSTALLATION

A. Before installing countertops verify that wall surfaces have been finished as specified and that mechanical and electrical service locations are as required.

B. Secure countertops to supporting rails of cabinets with metal fastening devices, or screws through pierced slots in rails.

1. Where type, size or spacing of fastenings is not shown or specified, submit shop drawings showing proposed fastenings and method of installation.
2. Use round head bolts or screws.
3. Use epoxy or silicone to fasten the epoxy resin countertops to the cabinets.
4. Use wood or sheet metal screws for wood or plastic laminate tops; minimum penetration into top 16 mm (5/8 inch), screw size No 8, or 10.

C. Rubber Moldings:

1. Where shown install molding with butt joints in horizontal runs and mitered joints at corners where ceramic tile occurs omit molding.
2. Fasten molding to wall and to splashbacks and splashends with adhesive.

3.2 PROTECTION AND CLEANING

A. Tightly cover and protect against dirt, water, and chemical or mechanical injury.

B. Clean at completion of work.

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SECTION 13 05 41

SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS

PART 1 - GENERAL

1.1 DESCRIPTION:

A. Provide seismic restraint in accordance with the requirements of the drawings, VA Handbook H18-8: Seismic Design Requirements and this specification in order to maintain the integrity of non-structural components and equipment of the building so that they remain safe and functional in case of seismic event.

B. The design of seismic restraints of non-structural components to resist seismic load shall be based on Seismic Design parameters indicated below in accordance with VA H-18-8 in conjunction with ASCE 7 and ASCE 41, as specified in H-18-8 Section 4.0, for existing building retrofit projects. Specific requirements for Critical and Essential facilities are covered in Section 4.0 of H-18-8, including applying Ip = 1.5 for all nonstructural components in Critical facilities.

1. International Building Code 2018 Edition
2. American Society of Civil Engineers Seismic Evaluation and Retrofit of Existing Buildings ASCE 41-17.
3. American Society of Civil Engineers Minimum Design Loads and Associated Criteria for Buildings and Other Structures (ASCE 7)7-16
4. Facility Occupancy Category per VA H-18-8: Critical Facility
5. Site Class: D; Building Risk Category: IV
6. Mapped MCE_R 0.2 s period Spectral Response Acceleration Parameter (Ss): 1.62
7. Mapped MCE_R 1.0 s period Spectral Response Acceleration Parameter (S1): 0.37
8. Short period Spectral Response Acceleration Parameter (Sds): 0.99
9. Short period Spectral Response Acceleration Parameter (Sd1): 0.5
10. Building Seismic Design Category: D
11. Components Importance Factors (Ip): 1.5

C. Definitions: Non-structural building components are components or systems that are not part of the building’s structural system whether inside or outside, above or below grade. Non-structural components of

buildings include but are not limited to (Refer to VA H-18-8, ASCE 7 and ASCE 41 for additional examples):

1. Architectural Elements: Facades that are not part of the structural system and its shear resistant elements; cornices and other architectural projections and parapets that do not function structurally; glazing; nonbearing partitions; suspended ceilings; stairs isolated from the basic structure; cabinets; bookshelves; medical equipment; and storage racks, etc.
2. Electrical Elements: Power and lighting systems; substations; switchgear and switchboards; auxiliary engine-generator sets; transfer switches; motor control centers; motor generators; selector and controller panels; fire protection and alarm systems; special life support systems; and telephone and communication systems, etc.
3. Mechanical Elements: Heating, ventilating, and air-conditioning systems; medical gas systems; plumbing systems; sprinkler systems; pneumatic systems; boiler/chiller/utility plant/other equipment and components, etc.
4. Transportation Elements: Mechanical, electrical and structural elements for transport systems, i.e., elevators and dumbwaiters, including hoisting equipment and counterweights.

1.2 RELATED WORK:

A. Acoustical Ceilings: Section 09 51 00 ACOUSTICAL CEILINGS

B. Interior Lighting: Section 26 51 00, INTERIOR LIGHTING

1.3 QUALITY CONTROL:

A. Shop-Drawing Preparation:

1. Non-structural seismic restraint systems shop drawings and delegated design calculations shall be prepared by a professional structural engineer with a minimum of 5 years' experience in the design and detailing of seismic force restraints. The professional structural engineer shall be registered in the state where the project is located and submit qualifications with list of projects illustrating compliance with the experience requirement of this section.
2. Submit design tables and information used for the design-force levels, stamped and signed by a professional structural engineer registered in the State where project is located.

B. Coordination:

1. Do not install seismic restraints until seismic restraint submittals are approved by the Contracting Officers Representative (COR).
2. Coordinate trapezes or other multi-pipe hanger systems prior to submission of shop drawings for review.

C. Seismic Certification:
In structures assigned to Seismic Design Category C, D, E, or F, permanent equipment and components are to have Special Seismic Certification in accordance with requirements of section 13.2.2 of ASCE 7, including those required in existing buildings within Section 13.7.1.3.3, 13.7.7.3.3 and 13.7.8.3.3 of ASCE 41, except for equipment and components that are considered inherently rugged as listed in Section 4.2.2 of VA H18-8, and shall comply with section 13.2.6 of ASCE 7.

1.4 SUBMITTALS:

A. Submit a complete and coordinated set of bracing and signed and sealed anchorage drawings and calculations for all non-structural elements requiring seismic restraint by the delegated professional structural engineer mentioned in Section 1.3.A.1 for review prior to installation including:
1. Description, layout, and location of all items to be anchored or braced with anchorage or brace points noted and dimensioned.
2. Details of all anchorage and bracing at large scale with all members, parts brackets shown, together with all connections, bolts, welds etc. clearly identified and specified. Details shall be coordinated with all project conditions and trades prior to shop drawing submission for review.
3. Complete calculations including but not limited to seismic design criteria, computer model input and output, seismic design forces and capacities, design tables and information used for all proprietary design elements such as post installed anchors, stamped and signed by a professional structural engineer specified in section 1.3 A.1.
4. For all post installed anchorages submit the appropriate International Code Council Engineering Service (ICC-ES) evaluation reports, California’s Office of Statewide Health Planning and Development(OSHPD) pre-approvals, or lab test reports verifying compliance with OSHPD Interpretation of Regulations 28-6.

5. Delegated professional structural engineer qualifications.

B. Submit for review prior to installation, the following for seismic protection of piping in addition to items noted in Section 1.4.A:
   1. Single-line piping diagrams on a floor-by-floor basis. Show all suspended piping for a given floor on the same plain.
   2. Type of pipe (Copper, steel, cast iron, insulated, non-insulated, etc.).
   3. Pipe contents.
   4. Structural framing for the seismic and gravity support and the main superstructure for which the bracing and or anchorage is attached.
   5. Location of all gravity load pipe supports and spacing requirements.
   6. Numerical value of gravity load reactions.
   7. Location of all seismic bracing.
   8. Numerical value of applied seismic brace loads.
   9. Type of connection (Vertical support, vertical support with seismic brace etc.).
   10. Seismic brace reaction type (tension or compression): Details illustrating all support and bracing components, methods of connections, and specific anchors to be used.

C. Submit for review prior to installation, the following items for seismic protection of suspended ductwork and suspended electrical and communication cables, in addition to items noted in Section 1.4.A:
   1. Details illustrating all support and bracing components, methods of connection, and specific anchors to be used.
   2. Numerical value of applied gravity and seismic loads and seismic loads acting on support and bracing components.
   3. Maximum spacing of hangers and bracing.

1.5 APPLICABLE PUBLICATIONS:

A. The Publications listed below (including amendments, addenda revisions, supplements and errata) form a part of this specification to the extent referenced. The publications are referenced in text by basic designation only.

B. ASTM International (ASTM):
   A36/A36M-19.....Standard Specification for Carbon Structural Steel

A53/A53M-18.....Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

A307-14e1.....Standard Specifications for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength

A325-14.....Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

A325M-14.....Standard Specification for High-Strength Bolts for Structural Steel Joints [Metric]

A490-14a.....Standard Specification for Heat-Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength

A490M-14a.....Standard Specification for High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints [Metric]

A500/A500M-18.....Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

A501/A501M-14.....Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing

A615/A615M-20.....Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement

A992/A992M-11(2015).....Standard Specification for Steel for Structural Shapes for Use in Building Framing

A996/A996M-16.....Standard Specification for Rail Steel and Axle Steel Deformed Bars for Concrete Reinforcement

E488/E488M-18.....Standard Test Methods for Strength of Anchors in Concrete Elements

C. American Society of Civil Engineers

1. Minimum Design Loads and Associated Criteria for Buildings and Other Structures (ASCE 7) Edition as indicated in section 1.1 B of this specification. Associated Criteria for Buildings and Other Structures (ASCE 7): 7-16

D. International Building Code (IBC) Edition as indicated in Section 1.1 B of this specification.

E. VA Handbook H18-8 Seismic Design Requirements, VA H-18-8, November 2019(REVISED MAY 1,2020)

F. National Uniform Seismic Installation Guidelines (NUSIG)

G. Sheet Metal and Air Conditioning Contractors National Association

H. (SMACNA): Seismic Restraint Manual - Guidelines for Mechanical Systems, 3RD EDITION 2008 and Addendum

1.6 REGULATORY REQUIREMENT:

A. IBC as shown in Section 1.1 B of this specification.

B. Exceptions: The omission of seismic restraints shall be allowed only in accordance with VA H18-8, ASCE 7 and ASCE 41.

PART 2 - PRODUCTS

2.1 STEEL:

A. Structural Steel: ASTM A36 A36M A992 .

B. Structural Tubing: ASTM A500, Grade B.

C. Structural Tubing: ASTM A501.

D. Steel Pipe: ASTM A53/A53M, Grade B.

E. Bolts & Nuts: ASTM A307 A325 A325M A490 A490M .

PART 3 - EXECUTION

3.1 CONSTRUCTION, GENERAL:

A. Provide equipment supports and anchoring devices to withstand the seismic design forces, so that when seismic design forces are applied, the equipment cannot displace, overturn, or become inoperable.

B. Provide anchorages in conformance with recommendations of the equipment manufacturer and as shown on approved shop drawings and calculations.

C. Construct seismic restraints and anchorage to allow for thermal expansion.

D. Testing Before Final Inspection:

1. Test 10-percent of anchors in masonry and concrete per ASTM E488, and ACI 355.2 to determine that they meet the required load capacity. If any anchor fails to meet the required load, test the next 20 consecutive anchors, which are required to have zero failure, before resuming the 10-percent testing frequency.

2. Before scheduling Final Inspection, submit a report on this testing indicating the number and location of testing, and what anchor-loads were obtained.
3. Construct seismic restraints and anchorages to not interfere with other trades or damage existing or in-situ elements of the constructed building.

3.2 EQUIPMENT RESTRAINT AND BRACING:

A. See drawings for equipment to be restrained or braced.

3.3 MECHANICAL DUCTWORK AND PIPING; BOILER PLANT STACKS AND BREACHING; ELECTRICAL BUSWAYS, CONDUITS, AND CABLE TRAYS; AND TELECOMMUNICATION WIRES AND CABLE TRAYS

A. Support and brace mechanical ductwork and piping; electrical busways, conduits and cable trays; and telecommunication wires and cable trays including boiler plant stacks and breeching to resist directional forces (lateral, longitudinal and vertical).
B. Brace duct and breeching branches with a minimum of 1 brace per branch.
C. Provide supports and anchoring so that, upon application of seismic forces, piping remains fully connected as operable systems which will not displace sufficiently to damage adjacent or connecting equipment, or building members.
D. Piping Connections: Provide flexible connections where pipes connect to equipment. Make the connections capable of accommodating relative differential movements between the pipe and equipment under conditions of earthquake shaking.

3.4 PARTITIONS

A. In buildings with flexible structural frames, anchor partitions to only structural element, such as a floor slab, and separate such partition by a physical gap from all other structural elements.
B. Properly anchor masonry walls to the structure for restraint, so as to carry lateral loads imposed due to earthquake along with their own weight and other lateral forces.

3.5 CEILINGS AND LIGHTING FIXTURES

A. At intervals required to meet the seismic demand forces, laterally brace suspended ceilings against lateral and vertical movements, and provide with a physical separation at the walls.

B. Independently support and laterally brace all lighting fixtures. Refer to applicable portion of lighting specification, Section 26 51 00, INTERIOR LIGHTING.

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SECTION 21 13 13
WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Design, installation and testing shall be in accordance with NFPA 13.

B. Modification of the existing sprinkler system as indicated on the drawings and as further required by these specifications.

1.2 RELATED WORK

A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Section 07 84 00, FIRESTOPPING.

C. Section 09 91 00, PAINTING.

D. Section 28 31 00, FIRE DETECTION AND ALARM.

1.3 DESIGN CRITERIA

A. Design Basis Information: Provide design, materials, equipment, installation, inspection, and testing of the automatic sprinkler system in accordance with the requirements of NFPA 13.

1. Perform hydraulic calculations in accordance with NFPA 13 utilizing the Area/Density method. Do not restrict design area reductions permitted for using quick response sprinklers throughout by the required use of standard response sprinklers in the areas identified in this section.

2. Sprinkler Protection: Sprinkler hazard classifications shall be in accordance with NFPA 13. The hazard classification examples of uses and conditions identified in the Annex of NFPA 13 shall be mandatory for areas not listed below. Request clarification from the Government for any hazard classification not identified. To determining spacing and sizing, apply the following coverage classifications:

   a. Light Hazard Occupancies: PPE ANTEROOM, DECOMTAMINATION, CART WASH, RECEIVING/DISPATCH, STERILIZERS, COOLDOWN, PREP AND ASSEMBLY.

   b. Ordinary Hazard Group 1 Occupancies: HAC ROOMS, AND STORAGE ROOM.

3. Hydraulic Calculations: Calculated demand including hose stream requirements shall fall no less than 10 percent below the available water supply curve.

4. Water Supply: Base water supply on hydrant flow test report data performed by Summit Fire and Security on April 10, 2024, and fire pump test report data of:
   a. Flow Test - 820 GPM @ 20 PSI
   b. Pump Test – 754GPM @ 128 PSI.
5. Zoning:
   a. Utilize the existing sprinkler zones and zone control assemblies.

1.4 SUBMITTALS

A. Submit as one package in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. Prepare detailed working drawings that are signed by a NICET Level III or Level IV Sprinkler Technician or stamped by a Registered Professional Engineer licensed in the field of Fire Protection Engineering. As the Government review is for technical adequacy only, the installer remains responsible for correcting any conflicts with other trades and building construction that arise during installation. Partial submittals will not be accepted. Material submittals shall be approved prior to the purchase or delivery to the job site. Suitably bind submittals in notebooks or binders and provide an index referencing the appropriate specification section. In addition to the hard copies, provide submittal items in Paragraphs 1.4(A)1 through 1.4(A)5 electronically in pdf format on a compact disc or as directed by the COR. Submittals shall include, but not be limited to, the following:

1. Qualifications:
   a. Provide a copy of the installing contractors fire sprinkler and state contractor’s license.
   b. Provide a copy of the NICET certification for the NICET Level III or Level IV Sprinkler Technician who prepared and signed the detailed working drawings unless the drawings are stamped by a Registered Professional Engineer licensed in the field of Fire Protection Engineering.
   c. Provide documentation showing that the installer has been actively and successfully engaged in the installation of commercial automatic sprinkler systems for the past ten years.
2. Drawings: Submit detailed 1:100 (1/8 inch) scale (minimum) working drawings conforming to the Plans and Calculations chapter of NFPA 13. Drawings shall include graphical scales that allow the user to

determine lengths when the drawings are reduced in size. Include a plan showing the piping to the water supply test location.

3. Manufacturer's Data Sheets: Provide data sheets for all materials and equipment proposed for use on the system. Include listing information and installation instructions in data sheets. Where data sheets describe items in addition to those proposed to be used for the system, clearly identify the proposed items on the sheet.
4. Calculation Sheets:
   a. Submit hydraulic calculation sheets in tabular form conforming to the requirements and recommendations of the Plans and Calculations chapter of NFPA 13.
5. Final Document Submittals: Provide as-built drawings, testing and maintenance instructions in accordance with the requirements in Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. In addition, submittals shall include, but not be limited to, the following:
   a. A complete set of as-built drawings showing the installed system with the specific interconnections between the system switches and the fire alarm equipment. Provide a complete set in the formats as follows. Submit items 2 and 3 below on a compact disc or as directed by the COR.
      1) One full size (or size as directed by the COR) printed copy.
      2) One complete set in electronic pdf format.
      3) One complete set in AutoCAD format or a format as directed by the COR.
   b. Material and Testing Certificate: Upon completion of the sprinkler system installation or any partial section of the system, including testing and flushing, provide a copy of a completed Material and Testing Certificate as indicated in NFPA 13. Certificates shall be provided to document all parts of the installation.
   c. Operations and Maintenance Manuals that include step-by-step procedures required for system startup, operation, shutdown, and routine maintenance and testing. The manuals shall include the manufacturer's name, model number, parts list, and tools that should be kept in stock by the owner for routine maintenance, including the name of a local supplier, simplified wiring and

controls diagrams, troubleshooting guide, and recommended service organization, including address and telephone number, for each item of equipment.

d. One paper copy of the Material and Testing Certificates and the Operations and Maintenance Manuals above shall be provided in a binder. In addition, these materials shall be provided in pdf format on a compact disc or as directed by the COR.

e. Provide one additional copy of the Operations and Maintenance Manual covering the system in a flexible protective cover and mount in an accessible location adjacent to the riser or as directed by the COR.

1.5 QUALITY ASSURANCE

A. Installer Reliability: The installer shall possess a valid State of Pennsylvania fire sprinkler contractor's license. The installer shall have been actively and successfully engaged in the installation of commercial automatic sprinkler systems for the past ten years.

B. Materials and Equipment: All equipment and devices shall be of a make and type listed by UL or approved by FM, or other nationally recognized testing laboratory for the specific purpose for which it is used. All materials, devices, and equipment shall be approved by the VA. All materials and equipment shall be free from defect. All materials and equipment shall be new unless specifically indicated otherwise on the contract drawings.

1.6 APPLICABLE PUBLICATIONS

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

B. National Fire Protection Association (NFPA):

13-2022.....Installation of Sprinkler Systems

25-2023.....Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems

101-2024.....Life Safety Code

170-2021.....Fire Safety Symbols

C. Underwriters Laboratories, Inc. (UL):

Fire Protection Equipment Directory (2011)

D. Factory Mutual Engineering Corporation (FM):

Approval Guide

PART 2 - PRODUCTS

2.1 PIPING & FITTINGS

A. Piping and fittings for sprinkler systems shall be in accordance with NFPA 13.

1. Plain-end pipe fittings with locking lugs or shear bolts are not permitted.
2. Piping sizes 50 mm (2 inches) and smaller shall be black steel Schedule 40 with threaded end connections.
3. Piping sizes 65 mm (2 ½ inches) and larger shall be black steel Schedule 10 with grooved connections. Grooves in Schedule 10 piping shall be rolled grooved only.
4. Use nonferrous piping in MRI Scanning Rooms.
5. Plastic piping shall not be permitted except for drain piping.
6. Flexible sprinkler hose shall be FM Approved and limited to hose with threaded end fittings with a minimum inside diameter or 1-inch and a maximum length of 6-feet.

2.2 SPRINKLERS

A. Temperature Ratings: In accordance with NFPA 13 except that sprinklers in elevator shafts and elevator machine rooms shall be no less than intermediate temperature rated and sprinklers in generator rooms shall be no less than high temperature rated.

B. Provide sprinkler guards in accordance with NFPA 13 and when the elevation of the sprinkler head is less than 7 feet 6 inches above finished floor. The sprinkler guard shall be UL listed or FM approved for use with the corresponding sprinkler.

2.3 PIPE HANGERS, SUPPORTS AND RESTRAINT OF SYSTEM PIPING

A. Pipe hangers, supports, and restraint of system piping shall be in accordance with NFPA 13.

2.4 WALL, FLOOR AND CEILING PLATES

A. Provide chrome plated steel escutcheon plates.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be accomplished by the licensed contractor. Provide a qualified technician, experienced in the installation and operation of the type of system being installed, to supervise the installation and testing of the system.

B. Installation of Piping: Accurately cut pipe to measurements established by the installer and work into place without springing or forcing. In any situation where bending of the pipe is required, use a standard pipe-bending template. Concealed piping in spaces that have finished ceilings. In stairways, locate piping as near to the ceiling as possible to prevent tampering by unauthorized personnel and to provide a minimum headroom clearance of 2250 mm (seven feet six inches). Piping shall not obstruct the minimum means of egress clearances required by NFPA 101. Pipe hangers, supports, and restraint of system piping shall be installed accordance with NFPA 13.

C. Welding: Conform to the requirements and recommendations of NFPA 13.

D. Drains: Provide drips and drains, including low point drains, in accordance with NFPA 13. Pipe drains to discharge at safe points outside of the building or to sight cones attached to drains of adequate size to readily carry the full flow from each drain under maximum pressure. Do not provide a direct drain connection to sewer system or discharge into sinks. Install drips and drains where necessary and required by NFPA 13. The drain piping shall not be restricted or reduced and shall be of the same diameter as the drain collector.

E. Affix cutout disks, which are created by cutting holes in the walls of pipe for flow switches and non-threaded pipe connections to the respective waterflow switch or pipe connection near to the pipe from where they were cut.

F. Provide escutcheon plates for exposed piping passing through walls, floors or ceilings.

G. Sleeves: Provide for pipes passing through masonry or concrete. Provide space between the pipe and the sleeve in accordance with NFPA 13. Seal this space with a UL Listed through penetration fire stop material in accordance with Section 07 84 00, FIRESTOPPING. Where core drilling is used in lieu of sleeves, also seal space. Seal penetrations of walls, floors and ceilings of other types of construction, in accordance with Section 07 84 00, FIRESTOPPING.

H. Firestopping shall be provided for all penetrations of fire resistance rated construction. Firestopping shall comply with Section 07 84 00, FIRESTOPPING.

I. MRI Suite: Provide no more than one penetration of the MRI shield enclosure.

J. Painting of Pipe: In finished areas where walls and ceilings have been painted, paint primed surfaces with two coats of paint to match adjacent surfaces, except paint valves and operating accessories with two coats of gloss red enamel. Exercise care to avoid painting sprinklers. Painting of sprinkler systems above suspended ceilings and in crawl spaces is not required. Painting shall comply with Section 09 91 00, PAINTING. Any painted sprinkler shall be replaced with a new sprinkler.

K. Repairs: Repair damage to the building or equipment resulting from the installation of the sprinkler system by the installer at no additional expense to the Government.

L. Interruption of Service: There shall be no interruption of the existing sprinkler protection, water, electric, or fire alarm services without prior permission of the Contracting Officer. Contractor shall develop an interim fire protection program where interruptions involve occupied spaces. Request in writing at least one week prior to the planned interruption.

3.2 INSPECTION AND TEST

A. Preliminary Testing: Flush newly installed systems prior to performing hydrostatic tests in order to remove any debris which may have been left as well as ensuring piping is unobstructed. Hydrostatically test system, including the fire department connections, as specified in NFPA 13, in the presence of the Contracting Officers Representative (COR) or his designated representative. Test and flush underground water line prior to performing these hydrostatic tests.

B. Final Inspection and Testing: Subject system to tests in accordance with NFPA 13, and when all necessary corrections have been accomplished, advise COR to schedule a final inspection and test. Connection to the fire alarm system shall have been in service for at least ten days prior to the final inspection, with adjustments made to prevent false alarms. Furnish all instruments, labor and materials required for the tests and provide the services of the installation foreman or other competent representative of the installer to perform the tests. Correct deficiencies and retest system as necessary, prior

to the final acceptance. Include the operation of all features of the systems under normal operations in test

3.3 INSTRUCTIONS

A. Furnish the services of a competent instructor for not less than two hours for instructing personnel in the operation and maintenance of the system, on the dates requested by the COR.

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SECTION 22 05 11
COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 DESCRIPTION

A. The requirements of this Section will apply to all sections of Division 22.

B. Definitions:

1. Exposed: Piping and equipment exposed to view in finished rooms.
2. Exterior: Piping and equipment exposed to weather be it temperature, humidity, precipitation, wind or solar radiation.

C. Abbreviations/Acronyms:

1. ABS: Acrylonitrile Butadiene Styrene
2. AC: Alternating Current
3. ACR: Air Conditioning and Refrigeration
4. A/E: Architect/Engineer
5. AFF: Above Finish Floor
6. AFG: Above Finish Grade
7. AI: Analog Input
8. AISI: American Iron and Steel Institute
9. AO: Analog Output
10. ASHRAE: American Society of Heating Refrigeration, Air Conditioning Engineers
11. ASJ: All Service Jacket
12. ASME: American Society of Mechanical Engineers
13. ASPE: American Society of Plumbing Engineers
14. AWG: American Wire Gauge
15. BACnet: Building Automation and Control Network
16. BAg: Silver-Copper-Zinc Brazing Alloy
17. BAS: Building Automation System
18. BCuP: Silver-Copper-Phosphorus Brazing Alloy
19. bhp: Brake Horsepower
20. Btu: British Thermal Unit
21. Btu/h: British Thermal Unit per Hour
22. BSG: Borosilicate Glass Pipe
23. C: Celsius
24. CA: Compressed Air

25. CD: Compact Disk
26. CDA: Copper Development Association
27. CGA: Compressed Gas Association
28. CFM: Cubic Feet per Minute
29. CI: Cast Iron
30. CLR: Color
31. CO: Contracting Officer
32. COR: Contracting Officer’s Representative
33. CPVC: Chlorinated Polyvinyl Chloride
34. CR: Chloroprene
35. CRS: Corrosion Resistant Steel
36. CWP: Cold Working Pressure
37. CxA: Commissioning Agent
38. dB: Decibels
39. db(A): Decibels (A weighted)
40. DCW: Domestic Cold Water
41. DDC: Direct Digital Control
42. DFU: Drainage Fixture Units
43. DHW: Domestic Hot Water
44. DHWR: Domestic Hot Water Return
45. DHWS: Domestic How Water Supply
46. DI: Digital Input
47. DI: Deionized Water
48. DISS: Diameter Index Safety System
49. DN: Diameter Nominal
50. DO: Digital Output
51. DOE: Department of Energy
52. DVD: Digital Video Disc
53. DWG: Drawing
54. DWH: Domestic Water Heater
55. DWS: Domestic Water Supply
56. DWV: Drainage, Waste and Vent
57. ECC: Engineering Control Center
58. EL: Elevation
59. EMCS: Energy Monitoring and Control System
60. EPA: Environmental Protection Agency

61. EPACT: Energy Policy Act
62. EPDM: Ethylene Propylene Diene Monomer
63. EPT: Ethylene Propylene Terpolymer
64. ETO: Ethylene Oxide
65. F: Fahrenheit
66. FAR: Federal Acquisition Regulations
67. FD: Floor Drain
68. FDC: Fire Department (Hose) Connection
69. FED: Federal
70. FG: Fiberglass
71. FNPT: Female National Pipe Thread
72. FOR: Fuel Oil Return
73. FOS: Fuel Oil Supply
74. FOV: Fuel Oil Vent
75. FPM: Fluoroelastomer Polymer
76. FSK: Foil-Scrim-Kraft Facing
77. FSS: VA Construction & Facilities Management, Facility Standards Service
78. FU: Fixture Units
79. GAL: Gallon
80. GCO: Grade Cleanouts
81. GPD: Gallons per Day
82. GPH: Gallons per Hour
83. GPM: Gallons per Minute
84. HDPE: High Density Polyethylene
85. HEFP: Healthcare Environment and Facilities Program (replacement for OCAMES)
86. HEX: Heat Exchanger
87. Hg: Mercury
88. HOA: Hands-Off-Automatic
89. HP: Horsepower
90. HVE: High Volume Evacuation
91. Hz: Hertz
92. ID: Inside Diameter
93. IE: Invert Elevation
94. INV: Invert

95. IPC: International Plumbing Code
96. IPS: Iron Pipe Size
97. IW: Indirect Waste
98. IWH: Instantaneous Water Heater
99. Kg: Kilogram
100. kPa: Kilopascal
101. KW: Kilowatt
102. KWH: Kilowatt Hour
103. lb: Pound
104. lbs/hr: Pounds per Hour
105. LNG: Liquid Natural Gas
106. L/min: Liters per Minute
107. LOX: Liquid Oxygen
108. L/s: Liters per Second
109. m: Meter
110. MA: Medical Air
111. MAWP: Maximum Allowable Working Pressure
112. MAX: Maximum
113. MBH: 1000 Btu per Hour
114. MED: Medical
115. MER: Mechanical Equipment Room
116. MFG: Manufacturer
117. mg: Milligram
118. mg/L: Milligrams per Liter
119. ml: Milliliter
120. mm: Millimeter
121. MIN: Minimum
122. MV: Medical Vacuum
123. N2: Nitrogen
124. N20: Nitrogen Oxide
125. NC: Normally Closed
126. NF: Oil Free Dry (Nitrogen)
127. NG: Natural Gas
128. NIC: Not in Contract
129. NO: Normally Open
130. NOM: Nominal

131. NPTF: National Pipe Thread Female
132. NPS: Nominal Pipe Size
133. NPT: Nominal Pipe Thread
134. NTS: Not to Scale
135. O2: Oxygen
136. OC: On Center
137. OD: Outside Diameter
138. OSD: Open Sight Drain
139. OS&Y: Outside Stem and Yoke
140. PA: Pascal
141. PBPU: Prefabricated Bedside Patient Units
142. PD: Pressure Drop or Difference
143. PDI: Plumbing and Drainage Institute
144. PH: Power of Hydrogen
145. PID: Proportional-Integral-Differential
146. PLC: Programmable Logic Controllers
147. PP: Polypropylene
148. ppb: Parts per Billion
149. ppm: Parts per Million
150. PSI: Pounds per Square Inch
151. PSIA: Pounds per Square Inch Atmosphere
152. PSIG: Pounds per Square Inch Gauge
153. PTFE: Polytetrafluoroethylene
154. PVC: Polyvinyl Chloride
155. PVDF: Polyvinylidene Fluoride
156. RAD: Radians
157. RO: Reverse Osmosis
158. RPM: Revolutions Per Minute
159. RTD: Resistance Temperature Detectors
160. RTRP: Reinforced Thermosetting Resin Pipe
161. SAN: Sanitary Sewer
162. SCFM: Standard Cubic Feet per Minute
163. SDI: Silt Density Index
164. SMACNA: Sheet Metal and Air Conditioning Contractors National Association
165. SPEC: Specification

166. SPS: Sterile Processing Services
167. SQFT/SF: Square Feet
168. SS: Stainless Steel
169. STD: Standard
170. SUS: Saybolt Universal Second
171. SWP: Steam Working Pressure
172. TD: Temperature Difference
173. TDH: Total Dynamic Head
174. TEFC: Totally Enclosed Fan-Cooled
175. TEMP: Temperature
176. TFE: Tetrafluoroethylene
177. THERM: 100,000 Btu
178. THHN: Thermoplastic High-Heat Resistant Nylon Coated Wire
179. THWN: Thermoplastic Heat & Water Resistant Nylon Coated Wire
180. TIL: Technical Information Library https://www.cfm.va.gov/til/
181. T/P: Temperature and Pressure
182. TYP: Typical
183. USDA: U.S. Department of Agriculture
184. V: Vent
185. V: Volt
186. VA: Veterans Administration
187. VA CFM: VA Construction & Facilities Management
188. VA CFM CSS: VA Construction & Facilities Management, Consulting Support Service
189. VAC: Vacuum
190. VAC: Voltage in Alternating Current
191. VAMC: Veterans Administration Medical Center
192. VHA OCAMES: This has been replaced by HEFP.
193. VSD: Variable Speed Drive
194. VTR: Vent through Roof
195. W: Waste
196. WAGD: Waste Anesthesia Gas Disposal
197. WC: Water Closet
198. WG: Water Gauge
199. WOG: Water, Oil, Gas
200. WPD: Water Pressure Drop

201. WSFU: Water Supply Fixture Units

1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.

B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT.

D. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

E. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

F. Section 07 84 00, FIRESTOPPING.

G. Section 07 92 00, JOINT SEALANTS.

H. Section 09 91 00, PAINTING.

I. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

J. Section 22 07 11, PLUMBING INSULATION.

K. Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

L. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

M. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

N. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES.

1.3 APPLICABLE PUBLICATIONS

A. The publications listed below will form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Where conflicts occur these specifications and the VHA standard will govern.

B. American Society of Mechanical Engineers (ASME):

B31.1-2013.....Power Piping

ASME Boiler and Pressure Vessel Code -

BPVC Section IX-2019.... Welding, Brazing, and Fusing Qualifications

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

A36/A36M-2019.....Standard Specification for Carbon Structural Steel

A575-96(2013)e1.....Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades

E84-2013a.....Standard Test Method for Surface Burning Characteristics of Building Materials

E119-2012a.....Standard Test Methods for Fire Tests of Building Construction and Materials

D. International Code Council, (ICC):

IBC-2018.....International Building Code

IPC-2018.....International Plumbing Code

E. Manufacturers Standardization Society (MSS) of the Valve and Fittings Industry, Inc:

SP-58-2018.....Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application and Installation

F. Military Specifications (MIL):

P-21035B.....Paint High Zinc Dust Content, Galvanizing Repair (Metric)

G. National Electrical Manufacturers Association (NEMA):

MG 1-2016.....Motors and Generators

H. National Fire Protection Association (NFPA):

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

54-2018.....National Fuel Gas Code

70-2020.....National Electrical Code (NEC)

99-2018.....Healthcare Facilities Code

I. NSF International (NSF):

5-2019.....Water Heaters, Hot Water Supply Boilers, and Heat Recovery Equipment

14-2019.....Plastic Piping System Components and Related Materials

61-2019.....Drinking Water System Components – Health Effects

372-2016.....Drinking Water System Components – Lead Content

J. Department of Veterans Affairs (VA):

PG-18-102014(R18).....Plumbing Design Manual

PG-18-13-2017(R18).....Barrier Free Design Guide

1.4 SUBMITTALS

A. Submittals, including number of required copies, will be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

B. Information and material submitted under this section will be marked "SUBMITTED UNDER SECTION 22 05 11, COMMON WORK RESULTS FOR PLUMBING", with applicable paragraph identification.

C. If the project is phased, contractors will submit complete phasing plan/schedule with manpower levels prior to commencing work. The phasing plan will be detailed enough to provide milestones in the process that can be verified.

D. Contractor will make all necessary field measurements and investigations to assure that the equipment and assemblies will meet contract requirements, and all equipment that requires regular maintenance, calibration, etc are accessable from the floor or permanent work platform. It is the Contractor’s responsibility to ensure all submittals meet the VA specifications and requirements and it is assumed by the VA that all submittals do meet the VA specifications unless the Contractor has requested a variance in writing and approved by COR prior to the submittal. If at any time during the project it is found that any item does not meet the VA specifications and there was no variance approval the Contractor will correct at no additional cost or time to the Government even if a submittal was approved.

E. If equipment is submitted which differs in arrangement from that shown, provide documentation proving equivalent performance, design standards and drawings that show the rearrangement of all associated systems. Additionally, any impacts on ancillary equipment or services such as foundations, piping, and electrical will be the Contractor’s responsibility to design, supply, and install at no additional cost or time to the Government. VA approval will be given only if all features of the equipment and associated systems, including accessibility, are equivalent to that required by the contract.

F. Prior to submitting shop drawings for approval, Contractor will certify in writing that manufacturers of all major items of equipment have each reviewed drawings and specifications, and have jointly coordinated and properly integrated their equipment and controls to provide a complete and efficient installation.

G. Submittals and shop drawings for interdependent items, containing applicable descriptive information, will be furnished together and

complete in a group. Coordinate and properly integrate materials and equipment in each group to provide a completely compatible and efficient installation. Final review and approvals will be made only by groups.

H. Manufacturer's Literature and Data including: Manufacturer’s literature will be submitted under the pertinent section rather than under this section.
   1. Electric motor data and variable speed drive data will 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.

I. Coordination/Shop Drawings:
   1. Submit complete consolidated and coordinated shop drawings for all new systems, and for existing systems that are in the same areas.
   2. The coordination/shop drawings will include plan views, elevations and sections of all systems and will be on a scale of not less than 1:32 (3/8-inch equal to 1 foot). Clearly identify and dimension the proposed locations of the principal items of equipment. The drawings will clearly show locations and adequate clearance for all equipment, piping, valves, control panels and other items. Show the access means for all items requiring access for operations and maintenance. Provide detailed coordination/shop drawings of all piping and duct systems. The drawings should include all lockout/tagout points for all energy/hazard sources for each piece of equipment. Coordinate lockout/tagout procedures and practices with local VA requirements.
   3. Do not install equipment foundations, equipment or piping until coordination/shop drawings have been approved.
   4. In addition, for plumbing systems, provide details of the following:
      a. Mechanical equipment rooms.
      b. Hangers, inserts, supports, and bracing.
      c. Pipe sleeves.

d. Duct or equipment penetrations of floors, walls, ceilings, or roofs.

J. Rigging Plan: Provide documentation of the capacity and weight of the rigging and equipment intended to be used. The plan will include the path of travel of the load, the staging area and intended access, and qualifications of the operator and signal person.

K. Plumbing Maintenance Data and Operating Instructions:

1. Maintenance and operating manuals in accordance with Section 01 00 00, GENERAL REQUIREMENTS, Article, INSTRUCTIONS, for systems and equipment.
2. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replacement parts, and troubleshooting guide:
   a. Include complete list indicating all components of the systems.
   b. Include complete diagrams of the internal wiring for each item of equipment.
   c. Diagrams will have their terminals identified to facilitate installation, operation and maintenance.
3. Provide a listing of recommended replacement parts for keeping in stock supply, including sources of supply, for equipment. Include in the listing belts for equipment: Belt manufacturer, model number, size and style, and distinguished whether of multiple belt sets.

L. Provide copies of approved plumbing equipment submittals to the TAB Subcontractor.

M. 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.

N. Submit training plans, trainer qualifications and instructor qualifications in accordance with the requirements of Section 22 08 00 COMMISSIONING OF PLUMBING SYSTEMS.

1.5 QUALITY ASSURANCE

A. Mechanical, electrical, and associated systems will be safe, reliable, efficient, durable, easily and safely operable and maintainable, easily and safely accessible, and in compliance with applicable codes as specified. The systems will be comprised of high quality institutional-

class and industrial-class products of manufacturers that are experienced specialists in the required product lines. All construction firms and personnel will be experienced and qualified specialists in industrial and institutional plumbing.

B. Products Criteria:

1. Standard Products: Material and equipment will 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, will 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 will be permanent service organizations, authorized and trained by manufacturers of the equipment supplied, located within 160 km (100 miles) of the project. These organizations will come to the site and provide acceptable service to restore operations within 4 hours of receipt of notification by phone, e-mail or fax in event of an emergency, such as the shut-down of equipment; or within 24 hours in a non-emergency. Names, mail and e-mail addresses and phone numbers of service organizations providing service under these conditions for (as applicable to the project): pumps, compressors, water heaters, critical instrumentation, computer workstation and programming will be submitted for project record and inserted into the operations and maintenance manual.
3. All items furnished will 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 will conform to the referenced codes and standards as required by the specifications. Local codes and amendments enforced by the local code official will be enforced, if required by local authorities such as the natural gas supplier. If the local codes are more stringent, then the local code will apply. Any conflicts will 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 will be of the same manufacturer and model number, or if different models are required they will be of the same manufacturer and identical to the greatest extent possible (i.e., same model series).
6. Assembled Units: Performance and warranty of all components that make up an assembled unit will be the responsibility of the manufacturer of the completed assembly.
7. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark will be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.
8. Asbestos products or equipment or materials containing asbestos is prohibited.
9. Bio-Based Materials: For products designated by the USDA’s bio-based Bio-Preferred Program, provide products that meet or exceed USDA recommendations for bio-based content, so long as products meet all performance requirements in this specifications section. For more information regarding the product categories covered by the Bio-Preferred Program, visit http://www.biopreferred.gov.

C. Welding: Before any welding is performed, Contractor will submit a certificate certifying that welders comply with the following requirements:
1. Qualify welding processes and operators for piping according to ASME BPVC, Section IX, "Welding and Brazing Qualifications". Provide proof of current certification to CO.
2. Comply with provisions of ASME B31 series "Code for Pressure Piping".
3. Certify that each welder and welding operator has passed American Welding Society (AWS) qualification tests for the welding processes involved, and that certification is current.
4. All welds will be stamped according to the provisions of the AWS or ASME as required herein and by the association code.

D. Manufacturer's Recommendations: Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of

these recommendations will be furnished to the COR prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.

E. Execution (Installation, Construction) Quality:

1. All items will be applied and installed in accordance with manufacturer's written instructions. Conflicts between the manufacturer's instructions and the contract documents will be referred to the COR for resolution. Printed copies or electronic files of manufacturer’s installation instructions will 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, will be easily and safely accessible by persons standing at floor level, or standing on permanent platforms, without the use of portable ladders. Examples of these items include but are not limited to: all types of valves, filters and strainers, transmitters, and control devices. Prior to commencing installation work, refer conflicts between this requirement and contract documents to COR for resolution. Failure of the Contractor to resolve or call attention to any discrepancies or deficiencies to the COR will result in the Contractor correcting at no additional cost or time to the Government.
3. Complete layout drawings will be required by Paragraph, SUBMITTALS. Construction work will not start on any system until the layout drawings have been approved by VA.
4. Installer Qualifications: Installer will be licensed and will provide evidence of the successful completion of at least five projects of equal or greater size and complexity. Provide tradesmen skilled in the appropriate trade.
5. Workmanship/craftsmanship will be of the highest quality and standards. The VA reserves the right to reject any work based on poor quality of workmanship this work will be removed and done again at no additional cost or time to the Government.

F. Upon request by Government, provide lists of previous installations for selected items of equipment. Include contact persons who will serve as references, with current telephone numbers and e-mail addresses.

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

H. Plumbing Systems: IPC, International Plumbing Code. Unless otherwise required herein, perform plumbing work in accordance with the latest version of the IPC. For IPC codes referenced in the contract documents, advisory provisions will be considered mandatory, the word "should" will be interpreted as "will". Reference to the "code official" or "owner" will be interpreted to mean the COR.

I. Cleanliness of Piping and Equipment Systems:

1. Care will 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 will be removed.
2. Piping systems will be flushed, blown or pigged as necessary to deliver clean systems.
3. The interior of all tanks will be cleaned prior to delivery and beneficial use by the Government. All piping will be tested in accordance with the specifications and the International Plumbing Code (IPC). All filters, strainers, fixture faucets will be flushed of debris prior to final acceptance.
4. Contractor will 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 will remain in the custody of the Contractor until phased acceptance, whether or not the Government has reimbursed the Contractor for the equipment and material. The Contractor is solely responsible for the protection of such equipment and material against any damage or theft.
2. Damaged equipment will be replaced with an identical unit as determined and directed by the COR. Such replacement will be at no additional cost or additional time to the Government.
3. Interiors of new equipment and piping systems will be protected against entry of foreign matter. Both inside and outside will be cleaned before painting or placing equipment in operation.

4. Existing equipment and piping being worked on by the Contractor will be under the custody and responsibility of the Contractor and will be protected as required for new work.
5. Protect plastic piping and tanks from ultraviolet light (sunlight) while in pre-construction. Plastic piping and tanks will not be installed exposed to sunlight without metal jacketing to block ultraviolet rays.

1.7 AS-BUILT DOCUMENTATION

A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.

B. Submit operation and maintenance data updated to include submittal review comments, VA approved substitutions and construction revisions will be in electronic version on CD or DVD. All aspects of system operation and maintenance procedures, including applicable piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation will be included in the operation and maintenance manual. The operations and maintenance manual will include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices will be included. A List of recommended spare parts (manufacturer, model number, and quantity) will be furnished. Information explaining any special knowledge or tools the owner will be required to employ will be inserted into the As-Built documentation.

C. The installing Contractor will maintain as-built drawings of each completed phase for verification; and, will provide the complete set at the time of final systems certification testing. Should the installing Contractor engage the testing company to provide as-built or any portion thereof, it will not be deemed a conflict of interest or breach of the 'third party testing company' requirement. Provide record drawings as follows:

1. Red-lined, hand-marked drawings are to be provided, with one paper copy and a scanned PDF version of the hand-marked drawings provided on CD or DVD.

D. The as-built drawings will indicate the location and type of all lockout/tagout points for all energy sources for all equipment and pumps to include breaker location and numbers, valve tag numbers, etc.

Coordinate lockout/tagout procedures and practices with local VA requirements.

E. Certification documentation will be provided to COR 21 working days prior to submitting the request for final inspection. The documentation will include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and provide documentation/certification that all results of tests were within limits specified. Test results will contain written sequence of test procedure with written test results annotated at each step along with the expected outcome or setpoint. The results will include all readings, including but not limited to data on device (make, model and performance characteristics_), normal pressures, switch ranges, trip points, amp readings, and calibration data to include equipment serial numbers or individual identifications, etc.

1.8 JOB CONDITIONS – WORK IN EXISTING BUILDING

A. Building Operation: Government employees will be continuously operating and managing all facilities, including temporary facilities that serve the VAMC.

B. Maintenance of Service: Schedule all work to permit continuous service as required by the VAMC.

C. Steam and Condensate Service Interruptions: Limited steam and condensate service interruptions, as required for interconnections of new and existing systems, will be permitted by the COR during periods when the demands are not critical to the operation of the VAMC. These non-critical periods are limited to between 8 pm and 5 am in the appropriate off-season (if applicable). Provide at least 10 working days advance notice to the COR. The request will include a detailed plan on the proposed shutdown and the intended work to be done along with manpower levels. All equipment and materials must be onsite and verified with plan 10 work days prior to the shutdown or it will need to be rescheduled.

D. Phasing of Work: Comply with all requirements shown on contract documents. Contractor will submit a complete detailed phasing plan/schedule with manpower levels prior to commencing work. The phasing plan will be detailed enough to provide milestones in the process that can be verified.

E. Building Working Environment: Maintain the architectural and structural integrity of the building and the working environment at all times. Maintain the interior of building at 18 degrees C (65 degrees F) minimum. Limit the opening of doors, windows or other access openings to brief periods as necessary for rigging purposes. Storm water or ground water leakage is prohibited. Provide daily clean-up of construction and demolition debris on all floor surfaces and on all equipment being operated by VA. Maintain all egress routes and safety systems/devices.

F. Acceptance of Work for Government Operation: As new equipment, systems and facilities are made available for operation and these items are deemed of beneficial use to the Government, inspections and tests will be performed. Based on the inspections, a list of contract deficiencies will be issued to the Contractor. After correction of deficiencies as necessary for beneficial use, the Contracting Officer will process necessary acceptance and the equipment will then be under the control and operation of Government personnel.

PART 2 - PRODUCTS

2.1 MATERIALS FOR VARIOUS SERVICES

A. Non-pressure PVC pipe will contain a minimum of 25 percent recycled content. Steel pipe will contain a minimum of 25 percent recycled content.

B. Plastic pipe, fittings and solvent cement will meet NSF 14 and will bear the NSF seal “NSF-PW”. Polypropylene pipe and fittings will comply with NSF 14 and NSF 61. Solder or flux containing lead will not be used with copper pipe.

C. Material or equipment containing a weighted average of greater than 0.25 percent lead will not be used in any potable water system intended for human consumption and will 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 will 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 will be maximized to reduce spare part requirements.

B. Manufacturers of equipment assemblies that include components made by others will 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 will be products of a single manufacturer.
3. Components will be compatible with each other and with the total assembly for intended service.
4. Contractor will guarantee performance of assemblies of components and will 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 will 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, will be the same make and model.

2.3 COMPATIBILITY OF RELATED EQUIPMENT

A. Equipment and materials installed will 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 will be fully guarded by a sheet steel guard, covering coupling and shaft but not bearings. Material will be minimum 16-gauge sheet steel; ends will 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 will have moving parts protected from personal injury.

2.5 LIFTING ATTACHMENTS

A. Equipment will be provided with suitable lifting attachments to enable equipment to be lifted in its normal position. Lifting attachments will 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 will conform to the requirements of 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 will be provided. Premium efficient motors will be provided. Unless otherwise specified for a particular application, electric motors will 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 at no additional cost or time to the Government.
2. Assemblies of motors, starters, and controls and interlocks on factory assembled and wired devices will be in accordance with the requirements of this specification.
3. Wire and cable materials specified in the electrical division of the specifications will be modified as follows:
   a. Wiring material located where temperatures can exceed 71° C (160° F) will 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, will be NFPA 70 designation THWN.
   c. Shielded conductors or wiring in separate conduits for all instrumentation and control systems will be provided where recommended by manufacturer of equipment.
4. Motor sizes will be selected so that the motors do not operate into the service factor at maximum required loads on the driven equipment. Motors on pumps will be sized for non-overloading at all points on the pump performance curves.

5. Motors utilized with variable frequency drives will 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, will conform to efficiency and power factor requirements 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" will 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 will have two separate windings. A time delay (20 seconds minimum) relay will be provided for switching from high to low speed.

F. Rating: Rating will 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 will not exceed nameplate rating without service factor.

G. Insulation Resistance: Not less than one-half meg-ohm between stator conductors and frame will be measured at the time of final inspection.

2.7 VARIABLE SPEED MOTOR CONTROLLERS

A. Refer to Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS for specifications.

B. The combination of controller and motor will be provided by the respective pump manufacturer and will be rated for 100 percent output performance. Multiple units of the same class of equipment, i.e. pumps, will be product of a single manufacturer.

C. Motors will be premium efficient type, "invertor duty", and be approved by the motor controller manufacturer. The controller-motor combination will be guaranteed to provide full motor nameplate horsepower in variable frequency operation. Both driving and driven motor sheaves will be fixed pitch.

D. Controller will not add any current or voltage transients to the input AC power distribution system, DDC controls, sensitive medical equipment, etc., nor will be affected from other devices on the AC power system.

2.8 EQUIPMENT AND MATERIALS IDENTIFICATION

A. Use symbols, nomenclature and equipment numbers specified, shown in the drawings, or shown in the maintenance manuals. Coordinate equipment and valve identification with local VAMC shops. In addition, provide bar code identification nameplate for all equipment which will allow the equipment identification code to be scanned into the system for maintenance and inventory tracking. Identification for piping is specified in Section 09 91 00, PAINTING.

B. Interior (Indoor) Equipment: Engraved nameplates, with letters not less than 7 mm (3/16 inch) high of brass with black-filled letters, or rigid black plastic with white letters specified in Section 09 91 00, PAINTING will be permanently fastened to the equipment. Unit components such as water heaters, tanks, coils, filters, etc. will 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 will 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 will be provided with valve tags and listed on a valve list (Fixture stops not included).
2. Valve tags: Engraved black filled numbers and letters not less than 15 mm (1/2 inch) high for number designation, and not less than 8 mm (1/4 inch) for service designation on 19 gauge, 40 mm (1-1/2 inches) round brass disc, attached with brass "S" hook or brass chain.
3. Valve lists: Valve lists will 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) will show valve tag number, valve function and area of control for each service or system. The valve list will be in a punched 3-ring binder notebook. An additional copy of the valve list

will be mounted in picture frames for mounting to a wall. COR will instruct Contractor where frames will be mounted.

4. A detailed plan for each floor of the building indicating the location and valve number for each valve will be provided in the 3-ring binder notebook. Each valve location will 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) and Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS. Submittals based on the International Building Code (IBC) and Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS requirements, or the following paragraphs of this Section will be stamped and signed by a professional engineer registered in the state where the project is located. The Support system of suspended equipment over 227 kg (500 pounds) will be submitted for approval of the COR in all cases. See the above specifications for lateral force design requirements.

B. Type Numbers Specified: For materials, design, manufacture, selection, application, and installation refer to MSS SP-58.

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. 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 will provide 40 mm (1-1/2 inches) minimum of adjustment and incorporate locknuts. All-thread rods are acceptable.

F. Multiple (Trapeze) Hangers: Galvanized, cold formed, lipped steel channel horizontal member, not less than 43 mm by 43 mm (1-5/8 inches by 1-5/8 inches), 2.7 mm (No. 12 gauge), designed to accept special spring held, hardened steel nuts.
   1. Allowable hanger load: Manufacturers rating less 91kg (200 pounds).
   2. Guide individual pipes on the horizontal member of every other trapeze hanger with 8 mm (1/4 inch) U-bolt fabricated from steel rod. Provide Type 40 insulation shield, secured by two 15 mm (1/2 inch) galvanized steel bands, or insulated calcium silicate shield for insulated piping at each hanger.

G. 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 will 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 1 inch beyond steel support or clamp. Spring Supports (Expansion and contraction of vertical piping):
   1) Movement up to 20 mm (3/4 inch): Type 51 or 52 variable spring unit with integral turn buckle and load indicator.
   2) Movement more than 20 mm (3/4 inch): Type 54 or 55 constant support unit with integral adjusting nut, turn buckle and travel position indicator.
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 gauge) minimum.

H. 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 will 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 will have insulation that extends a minimum of 25 mm (1 inch) past the sheet metal.
   b. The insulated calcium silicate shield will support the maximum allowable water filled span as indicated in MSS SP-58. To support the load, the shields will 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.

I. 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 will be installed for all pipe other than rectangular blocked out floor openings for risers in mechanical bays.

B. Pipe penetration sleeve materials will comply with all firestopping requirements for each penetration.

C. To prevent accidental liquid spills from passing to a lower level, provide the following:
   1. For sleeves: Extend sleeve 25 mm (1 inch) above finished floor and provide sealant for watertight joint.
   2. For blocked out floor openings: Provide 40 mm (1-1/2 inch) angle set in silicone adhesive around opening.
   3. For drilled penetrations: Provide 40 mm (1-1/2 inch) angle ring or square set in silicone adhesive around penetration.

D. Penetrations are prohibited through beams or ribs, but may be installed in concrete beam flanges, with structural engineer prior approval. Any deviation from these requirements must receive prior approval of COR.

E. Sheet metal, plastic, or moisture resistant fiber sleeves will 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 will be provided for pipe passing through exterior walls below grade. The space between the sleeve and pipe will be made watertight with a modular or link rubber seal. The link seal will be applied at both ends of the sleeve.

G. Galvanized steel or an alternate black iron pipe with asphalt coating sleeves will be for pipe passing through concrete beam flanges, except where brass pipe sleeves are called for. A galvanized steel sleeve will be provided for pipe passing through floor of mechanical rooms, laundry work rooms, and animal rooms above basement. Except in mechanical rooms, sleeves will be connected with a floor plate.

H. Brass Pipe Sleeves will be provided for pipe passing through quarry tile, terrazzo or ceramic tile floors. The sleeve will be connected with a floor plate.

I. Sleeve clearance through floors, walls, partitions, and beam flanges will be 25 mm (1 inch) greater in diameter than external diameter of pipe. Sleeve for pipe with insulation will be large enough to accommodate the insulation plus 25 mm (1 inch) in diameter. Interior openings will be caulked tight with firestopping material and sealant to prevent the spread of fire, smoke, water and gases.

J. Sealant and Adhesives: Will be as specified in Section 07 92 00, JOINT SEALANTS. Bio-based materials will be utilized when possible.

K. Pipe passing through roof will be installed through a 4.9 kg per square meter copper flashing with an integral skirt or flange. Skirt or flange will 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 will be provided with a clamping flange. The annular space between the sleeve and pipe will 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 will 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 will be used where insulation ends on exposed water supply pipe drop from overhead. A watertight joint will be provided in spaces where brass or steel pipe sleeves are specified.

2.15 ASBESTOS

A. Materials containing asbestos are prohibited.

PART 3 - EXECUTION

3.1 ARRANGEMENT AND INSTALLATION OF EQUIPMENT AND PIPING

A. Location of piping, sleeves, inserts, hangers, and equipment, access provisions will be coordinated with the work of all trades. Piping, sleeves, inserts, hangers, and equipment will be located clear of windows, doors, openings, light outlets, and other services and utilities. Equipment layout drawings will be prepared to coordinate proper location and personnel access of all facilities. The drawings will be submitted for review.

B. Manufacturer's published recommendations will be followed for installation methods not otherwise specified.

C. Operating Personnel Access and Observation Provisions: All equipment and systems will be arranged to provide clear view and easy access, without use of portable ladders, for maintenance, testing and operation

of all devices including, but not limited to: all equipment items, valves, backflow preventers, filters, strainers, transmitters, sensors, meters and control devices. All gauges and indicators will be clearly visible by personnel standing on the floor or on permanent platforms. Maintenance and operating space and access provisions that are shown in the drawings will not be changed nor reduced.

D. Structural systems necessary for pipe and equipment support will be coordinated to permit proper installation.

E. Location of pipe sleeves, trenches and chases will be accurately coordinated with equipment and piping locations.

F. Cutting Holes:

1. Holes will be located to avoid interference with structural members such as beams or grade beams. Holes will 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 will be referred to COR for approval.
2. Waterproof membrane will not be penetrated. Pipe floor penetration block outs will be provided outside the extents of the waterproof membrane.
3. Holes through concrete and masonry will be cut by rotary core drill. Pneumatic hammer, impact electric, and hand or manual hammer type drill will not be allowed, except as permitted by COR where working area space is limited.

G. Minor Piping: Generally, small diameter pipe runs from drips and drains, water cooling, and other services are not shown but must be provided.

H. Protection and Cleaning:

1. Equipment and materials will 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, will 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 will be tightly covered against dirt or mechanical injury. At completion of all work thoroughly clean fixtures, exposed materials and equipment.

I. Concrete and Grout: Concrete and shrink compensating grout 25 MPa (3000 psig) minimum, will be used for all pad or floor mounted equipment.

J. Gauges, thermometers, valves and other devices will be installed with due regard for ease in reading or operating and maintaining said devices. Thermometers and gauges will be located and positioned to be easily read by operator or staff standing on floor or walkway provided. Servicing will not require dismantling adjacent equipment or pipe work.

K. Interconnection of Controls and Instruments: Electrical interconnection is generally not shown but will be provided. This includes interconnections of sensors, transmitters, transducers, control devices, control and instrumentation panels, alarms, instruments and computer workstations. Comply with NFPA 70.

L. Domestic cold and hot water systems interface with the HVAC control system for the temperature, pressure and flow monitoring requirements to mitigate legionella. See the HVAC control points list and Section 23 09 23, DIRECT DIGITAL CONTROL SYSTEM FOR HVAC.

M. 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.

N. Work in Animal Research Areas: Seal all pipe penetrations with silicone sealant to prevent entrance of insects.

O. Work in bathrooms, restrooms, housekeeping closets: All pipe penetrations behind escutcheons will be sealed with plumbers’ putty.

P. Switchgear Drip Protection: Every effort will 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 will be provided in low point of casement pipe.

Q. Inaccessible Equipment:

1. Where the Government determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment will 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 will be provided to maintain continuity of operation of existing facilities.

B. The Contractor will provide all required facilities in accordance with the requirements of phased construction and maintenance of service. All piping and equipment will be properly supported, sloped to drain, operate without excessive stress, and will be insulated where injury can occur to personnel by contact with operating facilities. The requirements of paragraph 3.1 will apply.

3.3 RIGGING

A. Openings in building structures will 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 will be closed when not required for rigging operations to maintain proper environment in the facility for Government operation and maintenance of service.

D. Contractor will provide all facilities required to deliver specified equipment and place on foundations. Attachments to structures for

rigging purposes and support of equipment on structures will be Contractor's full responsibility.

E. Contractor will check all clearances, weight limitations and will provide a rigging plan designed by a Registered Professional Engineer. All modifications to structures, including reinforcement thereof, will be at Contractor's cost, time and responsibility.

F. Rigging plan and methods will 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 will 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 will not be permitted. Rusty products will be replaced.

C. Hanger rods will 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 will 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 will 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 will be anchored and doweled

to resist forces under operating and seismic conditions (if applicable) without excessive displacement or structural failure.

2. Bases and supports will not be located and installed until equipment mounted thereon has been approved. Bases will be sized to match equipment mounted thereon plus 50 mm (2 inch) excess on all edges. Structural drawings will be reviewed for additional requirements. Bases will be neatly finished and smoothed, will have chamfered edges at the top, and will be suitable for painting.
3. All equipment will be shimmed, leveled, firmly anchored, and grouted with epoxy grout. Anchor bolts will 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.
4. For seismic anchoring, refer to Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

3.5 LUBRICATION

A. All equipment and devices requiring lubrication will be lubricated prior to initial operation. All devices and equipment will be field checked for proper lubrication.

B. All devices and equipment will be equipped with required lubrication fittings. A minimum of 1 liter (1 quart) of oil and 0.45 kg (1 pound) of grease of manufacturer's recommended grade and type for each different application will be provided. All materials will be delivered to COR in unopened containers that are properly identified as to application.

C. A separate grease gun with attachments for applicable fittings will be provided for each type of grease applied.

D. All lubrication points will be accessible without disassembling equipment, except to remove access plates.

E. All lubrication points will be extended to one side of the equipment.

3.6 PLUMBING SYSTEMS DEMOLITION

A. Rigging access, other than indicated in the drawings, will be provided after approval for structural integrity by the COR. Such access will be provided at no additional cost or time to the Government. Where work is in an operating plant, approved protection from dust and debris will 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 will be maintained. The plant will 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 will be confined to the immediate area concerned; maintain cleanliness and wet down demolished materials to eliminate dust. Dust and debris will not be permitted to accumulate in the area to the detriment of plant operation. All flame cutting will be performed to maintain the fire safety integrity of this plant. Adequate fire extinguishing facilities will be available at all times. All work will be performed in accordance with recognized fire protection standards including NFPA 51B. Inspections will be made by personnel of the VAMC, and the Contractor will 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 will 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 will 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 will be maintained. Reference will 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 gauges and thermometers with wells will remain Government property and will be removed and delivered to COR and stored as directed. The Contractor will remove all other material and equipment, devices and demolition debris under these plans and specifications. Such material will be removed from Government property expeditiously and will 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 will be thoroughly cleaned and painted. Refer to Section 09 91 00, PAINTING.

B. In addition, the following special conditions apply:

1. Cleaning will be thorough. Solvents, cleaning materials and methods recommended by the manufacturers will be used for the specific tasks. All rust will be removed prior to painting and from surfaces to remain unpainted. Scratches, scuffs, and abrasions will be repaired prior to applying prime and finish coats.
2. The following Material and Equipment will NOT be painted:
   a. Motors, controllers, control switches, and safety switches.
   b. Control and interlock devices.
   c. Regulators.
   d. Pressure reducing valves.
   e. Control valves and thermostatic elements.
   f. Lubrication devices and grease fittings.
   g. Copper, brass, aluminum, stainless steel and bronze surfaces.
   h. Valve stems and rotating shafts.
   i. Pressure gauges and thermometers.
   j. Glass.
   k. Name plates.
3. Control and instrument panels will be cleaned and damaged surfaces repaired. Touch-up painting will 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 will be cleaned, and will 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 will be a smooth, even-colored, even-textured factory finish on all items. The entire piece of equipment will be repainted, if necessary, to achieve this. Lead based paints will not be used.

3.8 IDENTIFICATION SIGNS

A. Laminated plastic signs, with engraved lettering not less than 7 mm (3/16 inch) high, will be provided that designates equipment function, for all equipment, switches, motor controllers, relays, meters, control devices, including automatic control valves. Nomenclature and identification symbols will 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 will 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 will be performed as described in the equipment specifications. Vibration within specified tolerance will be verified prior to extended operation. Temporary use of equipment is specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, TEMPORARY USE OF MECHANICAL AND ELECTRICAL EQUIPMENT.

B. The CxA will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the Contracting Officer’s Representative and CxA.

3.10 OPERATING AND PERFORMANCE TESTS

A. Prior to the final inspection, all required tests will 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 will be requested in writing to COR for approval.

D. Perform tests as required for commissioning provisions in accordance with Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS and Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

3.11 OPERATION AND MAINTENANCE MANUALS

A. All new and temporary equipment and all elements of each assembly will be included.

B. Data sheet on each device listing model, size, capacity, pressure, speed, horsepower, impeller size, and other information will be included.

C. Manufacturer’s installation, maintenance, repair, and operation instructions for each device will be included. Assembly drawings and parts lists will also be included. A summary of operating precautions and reasons for precautions will be included in the Operations and Maintenance Manual.

D. Lubrication instructions, type and quantity of lubricant will be included.

E. Schematic diagrams and wiring diagrams of all control systems corrected to include all field modifications will be included.

F. Set points of all interlock devices will be listed.

G. Trouble-shooting guide for the control system troubleshooting will be inserted into the Operations and Maintenance Manual.

H. The control system sequence of operation corrected with submittal review comments will be inserted into the Operations and Maintenance Manual.

I. Emergency procedures for shutdown and startup of equipment and systems.

3.12 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.

3.13 DEMONSTRATION AND TRAINING

A. Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

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SECTION 22 05 19

METERS AND GAUGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section describes the requirements for water meters and gauges primarily used for troubleshooting the system and to indicate system performance.

B. A complete listing of common acronyms and abbreviations are included in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

C. Components intended to be connected to BAS shall be furnished under Section 23 09 23 DIRECT DIGITAL CONTROL SYSTEMS FOR HVAC for installation under this section.

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.

D. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

E. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

F. Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS. Requirements for commissioning, systems readiness checklist, and training.

G. Section 23 09 23, DIRECT DIGITAL CONTROL SYSTEMS FOR HAVC.

1.3 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Where conflicts occur these specifications and the VHA standard will govern.

B. American Society of Mechanical Engineers (ASME):

B40.100-2013.....Pressure Gauges and Gauge Attachments

B40.200-2008.....Thermometers, Direct Reading and Remote Reading

C. American Water Works Association (AWWA):

C700-2015.....Cold Water Meters, Displacement Type, Bronze Main Case

C701-2015.....Cold Water Meters-Turbine Type, for Customer Service

C702-20115.....Cold Water Meters - Compound Type

C707-2010 (R2016).....Encoder-Type Remote-Registration Systems for Cold-Water Meters

D. Institute of Electrical and Electronics Engineers (IEEE):

C2-2017.....National Electrical Safety Code (NESC)

E. International Code Council (ICC):

IPC-2018.....International Plumbing Code

F. National Fire Protection Association (NFPA):

70-2020.....National Electrical Code (NEC)

G. NSF International (NSF):

61-2019.....Drinking Water System Components - Health Effects

372-2016.....Drinking Water System Components - Lead Content

1.4 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 22 05 19, METERS AND GAUGES FOR PLUMBING PIPING", with applicable paragraph identification.

C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.

1. Water Meter.
2. Pressure Gauges.
3. Thermometers.
4. Product certificates for each type of meter and gauge.
5. BACnet communication protocol.

D. Complete operating and maintenance manual shall including wiring diagrams, technical data sheets, information for ordering replaceable parts, and troubleshooting guide:

1. Include complete list indicating all components of the system.
2. Include complete diagrams of the internal wiring for each item of equipment.

3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

E. Completed System Readiness Checklist provided by the CxA and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

F. Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

1.5 AS-BUILT DOCUMENTATION

Comply with requirements in Paragraph "AS-BUILT DOCUMENTATION" of Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

PART 2 - PRODUCTS

2.1 TURBINE WATER METER

A. The water meter shall be Turbine type, Class II, in-line, horizontal axis, and fully conform to AWWA C701. The meter Register shall indicate flow in liters (U.S. gallons).

B. The water meter shall be rated for use at temperatures ranging from -40 degrees C (-40 degrees F) and 70 degrees C (158 degrees F) and operate at a working pressure of 1035 kPa (150 psig).

C. The turbine case shall be constructed of cast bronze.

D. The register box rings and lid shall be made of cast copper alloy containing not less than 75 percent copper. Forged or die cast copper alloy containing not less than 75 percent copper or a suitable synthetic polymer.

E. The flow measuring turbine shall be made of a suitable synthetic polymer with specific gravity approximately equal to that of water. The measuring turbine shall have sufficient dimensional stability to retain operating clearances at the full range of working temperatures.

F. All external case closures, such as rings, clamps, screws, bolts, cap bolts, nuts and washers shall be designed for easy removal following lengthy service.

G. The turbine meter shall have flanged ends and supplied with companion flanges, gaskets, and with bolts and nuts. The companion flanges shall be made of cast iron.

H. The meter shall register plus or minus 3 percent of the water actually passing through it at any rate of flow within the normal test flow limits specified in AWWA 701.

I. The water meter shall conform to NSF 61 and NSF 372.

2.2 WATER METER STRAINER

A. All meters shall be fitted with a factory installed integral strainer or bronze inlet strainer with top access. The strainer shall conform to AWWA C702.

B. The water meter strainer shall conform to NSF 61 and NSF 372.

2.3 WATER METER PROGRAMMING

A. All meters 50 mm or DN 50 (2 inches) and greater shall be programmable with software supplied by the meter manufacturer.

B. The software shall have a Microsoft based interface and operate on the latest Windows operating system. The software shall allow the user to configure the meter, troubleshoot the meter, query and display meter parameters, and configure data and stored values.

C. The meter firmware shall be upgradeable through one of the communication ports without removing the unit from service.

D. The meter shall include output for analog 4-20 milliamp signals and binary output.

E. The meter shall have two dry contact relays outputs for alarm or control functions.

2.4 WATER METER COMMUNICATION PROTOCOL

A. The meter shall use a native BACnet Ethernet communication protocol supporting HTTP. The communications shall be protected against surges induced on its communications channels.

2.5 REMOTE READOUT REGISTER

A. All meters shall be equipped with a remote readout register in accordance with AWWA C707.

2.6 PRESSURE GAUGES FOR WATER AND SEWAGE 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) gauge.

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 gauge for water domestic use shall conform to NSF 61 and NSF 372.

2.7 THERMOMETERS

A. Thermometers shall be straight stem, metal case, red liquid-filled thermometer, approximately 175 mm (7 inches) high, 4 degrees C to 100 degrees C (40 degrees F to 212 degrees F). Thermometers shall comply with ASME B40.200.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Direct mounted pressure gauges shall be installed in piping tees with pressure gauge located on pipe at the most readable position.

B. Valves and snubbers shall be installed in piping for each pressure gauge.

C. Test plugs shall be installed on the inlet and outlet pipes of all heat exchangers or water heaters serving more than one plumbing fixture.

D. Pressure gauges shall be installed where indicated in the drawings and at the following locations:

1. Building water service entrance into building.
2. Inlet and outlet of each pressure reducing valve.
3. Suction and discharge of each domestic water pump or re-circulating hot water return pump.

E. Water meter installation shall conform to AWWA C700, AWWA C701, and AWWA C702. Electrical installations shall conform to IEEE C2, NFPA 70, and to the requirements specified herein. New materials shall be provided.

F. Remote readout register shall be mounted at the location indicated in the drawings or as directed by the COR.

G. 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.

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

I. Install portable water temperature, pressure and flow meters provided under Section 23 09 23 DIRECT DIGITAL CONTROL SYSTEMS FOR HVAC.

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.

3.3 STARTUP AND TESTING

A. Perform tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.

B. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.

C. The CxA will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and CxA. Provide a minimum notice of 10 working days prior to startup and testing.

3.4 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

B. Components provided under this section of the specification will be tested as part of a larger system.

3.5 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer’s technical representative for 4 hours to instruct each VA personnel responsible in operation and maintenance of the system.

B. Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

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SECTION 22 05 23

GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section describes the requirements for general-duty valves for domestic water and sewer systems.

B. A complete listing of common acronyms and abbreviations are included in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.

B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.

C. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

D. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

E. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

F. Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

1.3 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Where conflicts occur these specifications and the VHA standard will govern.

B. American Society of Mechanical Engineers (ASME):

A112.14.1-2003.....Backwater Valves

C. American Society of Sanitary Engineering (ASSE):

1001-2017.....Performance Requirements for Atmospheric Type Vacuum Breakers

1003-2009.....Performance Requirements for Water Pressure Reducing Valves for Domestic Water Distribution Systems

1011-2017.....Performance Requirements for Hose Connection Vacuum Breakers

1013-2011.....Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Principle Fire Protection Backflow Preventers

1015-2011.....Performance Requirements for Double Check Backflow Prevention Assemblies and Double Check Fire Protection Backflow Prevention Assemblies

1017-2009.....Performance Requirements for Temperature Actuated Mixing Valves for Hot Water Distribution Systems

1020-2004.....Performance Requirements for Pressure Vacuum Breaker Assembly

1035-2008.....Performance Requirements for Laboratory Faucet Backflow Preventers

1069-2005.....Performance Requirements for Automatic Temperature Control Mixing Valves

1070-2015.....Performance Requirements for Water Temperature Limiting Devices

1071-2012.....Performance Requirements for Temperature Actuated Mixing Valves for Plumbed Emergency Equipment

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

A126-2004(R2019).....Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings

A276/A276M-2017.....Standard Specification for Stainless Steel Bars and Shapes

A536-1984(R2019e).....Standard Specification for Ductile Iron Castings

B62-2017.....Standard Specification for Composition Bronze or Ounce Metal Castings

B584-2014.....Standard Specification for Copper Alloy Sand Castings for General Applications

E. International Code Council (ICC):

IPC-2018.....International Plumbing Code

F. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS):

SP-25-2018.....Standard Marking Systems for Valves, Fittings, Flanges and Unions

SP-67-2017.....Butterfly Valves

SP-70-2011.....Gray Iron Gate Valves, Flanged and Threaded Ends

SP-71-2018.....Gray Iron Swing Check Valves, Flanged and Threaded Ends

SP-80-2019.....Bronze Gate, Globe, Angle, and Check Valves

SP-85-2011.....Gray Iron Globe & Angle Valves, Flanged and Threaded Ends

SP-110-2010.....Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

G. National Environmental Balancing Bureau (NEBB):

8th Edition 2015 Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems

H. NSF International (NSF):

61-2019.....Drinking Water System Components – Health Effects

372-2016.....Drinking Water System Components – Lead Content

I. University of Southern California Foundation for Cross Connection Control and Hydraulic Research (USC FCCCHR):

10th Edition.....Manual of Cross-Connection Control

1.4 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 22 05 23, GENERAL-DUTY VALVES FOR PLUMBING PIPING", with applicable paragraph identification.

C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.

1. Ball Valves.
2. 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. Chainwheels.
11. Thermostatic Mixing Valves.

D. Test and Balance reports for balancing valves.

E. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replaceable parts and troubleshooting guide:
   1. Include complete list indicating all components of the systems.
   2. Include complete diagrams of the internal wiring for each item of equipment.
   3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.
   4. Piping diagrams of thermostatic mixing valves to be installed.

F. Completed System Readiness Checklist provided by the CxA and completed by the Contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

G. Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Valves shall be prepared for shipping as follows:
   1. Protect internal parts against rust and corrosion.
   2. Protect threads, flange faces, grooves, and weld ends.
   3. Set angle, gate, and globe valves closed to prevent rattling.
   4. Set ball and plug valves open to minimize exposure of functional surfaces.
   5. Set butterfly valves closed or slightly open.
   6. Block check valves in either closed or open position.

B. Valves shall be prepared for storage as follows:
   1. Maintain valve end protection.
   2. Store valves indoors and maintain at higher than ambient dew point temperature.

C. A sling shall be used for large valves. The sling shall be rigged to avoid damage to exposed parts. Hand wheels or stems shall not be used as lifting or rigging points.

1.6 AS BUILT DOCUMENTATION

A. Comply with requirements in Paragraph "AS-BUILT DOCUMENTATION" of Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

PART 2 - PRODUCTS

2.1 VALVES, GENERAL

A. Asbestos packing and gaskets are prohibited.

B. Bronze valves shall be made with dezincification resistant materials. Bronze valves made with copper alloy (brass) containing greater than 15 percent zinc shall not be permitted.

C. Valves in insulated piping shall have 50 mm or DN50 (2 inch) stem extensions and extended handles of non-thermal conductive material that allows operating the valve without breaking the vapor seal or disturbing the insulation. Memory stops shall be fully adjustable after insulation is applied.

D. Exposed Valves over 65 mm or DN65 (2-1/2 inches) installed at an elevation over 3.6 m (12 feet) shall have a chain-wheel attachment to valve hand-wheel, stem, or other actuator.

E. All valves used to supply potable water shall meet the requirements of NSF 61 and NSF 372.

F. Bio-Based Materials: For products designated by the USDA's bio-based Bio-Preferred Program, provide products that meet or exceed USDA recommendations for bio-based content, so long as products meet all performance requirements in this specifications section. For more information regarding the product categories covered by the Bio-Preferred Program, visit http://www.biopreferred.gov.

G. Refer to Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS for additional sustainable design requirements.

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. 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 greater:
   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 greater.
   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, EPDM 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 MANUAL BALANCING VALVES

A. Hot Water Re-circulating, 75 mm or DN75 (3 inches) and smaller manual balancing valve shall be of bronze body, brass ball construction with

glass and carbon filled TFE seat rings and designed for positive shutoff. The manual balancing valve shall have differential pressure read-out ports across the valve seat area. The read out ports shall be fitted with internal EPT inserts and check valves. The valve body shall have 8 mm or DN8 NPT (1/4 inch NPT) tapped drain and purge port. The valves shall have memory stops that allow the valve to close for service and then reopened to set point without disturbing the balance position. All valves shall have calibrated nameplates to assure specific valve settings.

B. Greater 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 THERMOSTATIC BALANCING VALVES

A. Thermostatic recirculation balancing valves for domestic hot water and domestic cold water application. Thermostatically controlled, spring actuated automatic balancing valve to very recirculation flow to maintain constant return temperatures. Stainless steel body, spring and brass or stainless steel thermal actuator and actuator carrier. Provide with threaded inlet, integral outlet union and stainless steel check valve. PTFE seat seal ring and EPDM body seal.

2.5 CHECK VALVES

A. 75 mm or DN75 (3 inches) and smaller shall be Class 125, bronze swing check valves with non-metallic disc suitable for type of service. The check valve shall meet MSS SP-80 Type 4 standard. The check valve shall have a CWP rating of 1380 kPa (200 psig). The check valve shall have a Y pattern horizontal body design with bronze body material conforming to ASTM B62, solder joints, and PTFE or TFE disc.

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

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.

2.6 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. Greater 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.

2.7 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 greater: 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 gauge shall be installed on the inlet and outlet of the valve.

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/A276M. The seat disc shall be the elastomer type suited for water service. The checks and the relief valve shall be accessible for maintenance without removing the device from the line. An epoxy coated wye type strainer with flanged connections shall be installed on the inlet. Reduced pressure backflow preventers shall be installed in the following applications.

1. Sterilizers.
2. Reverse Osmosis Water Systems.
3. Medical equipment.
4. Process equipment.

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. Detergent system.
2. Service sinks (integral with faucet only).

D. The hose connection vacuum breaker shall be ASSE listed 1011. The main body shall be cast brass with stainless steel working parts. The diaphragm and disc shall be the elastomer type suited for water service. The device shall permit the attachment of portable hoses to hose thread outlets. Hose connection vacuum breakers shall be installed in the following locations requiring non-continuous pressure:

1. Hose bibbs and wall hydrants.

E. The 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. 1. Lawn Irrigation.

F. 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/A276M. 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.

2.9 CHAINWHEELS

A. Valve chain wheel assembly with sprocket rim brackets and chain shall be constructed according to the following:

1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
2. Attachment: For connection to butterfly valve stem.
3. Sprocket rim with chain guides: Ductile or cast iron of type and size required for valve with zinc coating.
4. Chain: Hot dipped galvanized steel of size required to fit sprocket rim.

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.
   6. Valve Finish: Chrome plated.
   7. Cabinet: Factory-fabricated, stainless steel, for recessed or surface mounting and with hinged, stainless-steel door.
   8. Thermometers shall be provided to indicate mixed water temperature.
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 gauges and thermometer.
   3. Large-Flow Parallel: Master thermostatic water mixing valve and downstream pressure regulator with pressure gauges 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 gauge on inlet and outlet.
   7. Component Pressure Ratings: 861 kPa (125 psig) minimum, unless otherwise indicated.
   8. Cabinet: Factory-fabricated, stainless steel, for recessed or surface mounting and with hinged, stainless-steel door.
   9. Connections: Soldered or threaded union inlets and outlet.
   10. 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. Cabinet: Factory-fabricated, stainless steel, for recessed or surface mounting and with hinged, stainless-steel door.
7. Thermometers shall be provided to indicate mixed water temperature.
8. Upon cold water supply failure the hot water flow shall automatically be reduced to 0.5 gpm maximum.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Valve interior shall be examined for cleanliness, freedom from foreign matter, and corrosion. Special packing materials shall be removed, such as blocks, used to prevent disc movement during shipping and handling.

B. Valves shall be operated in positions from fully open to fully closed. Guides and seats shall be examined and made accessible by such operations.

C. Threads on valve and mating pipe shall be examined for form and cleanliness.

D. Mating flange faces shall be examined for conditions that might cause leakage. Bolting shall be checked for proper size, length, and material. Gaskets shall be verified for proper size and that its material composition is suitable for service and free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Valves shall be located for easy access and shall be provide with separate support. Valves shall be accessible with access doors when installed inside partitions or above hard ceilings.

C. Valves shall be installed in horizontal piping with stem at or above center of pipe.

D. Valves shall be installed in a position to allow full stem movement.

E. Install chain wheels on operators for butterfly, gate, and globe valves NPS 100 mm or DN100 (4 inches) and greater and installed greater than 3.0 m (10 feet) above floor. Chains shall be extended to 1524 mm (60 inches) above finished floor.

F. Check valves shall be installed for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level and on top of valve.

G. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that shall be sources of contamination. Comply with authorities having jurisdiction. Locate backflow preventers in same room as connected equipment or system.

1. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or

equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are prohibited for this application.

H. Install pressure gauges on outlet of backflow preventers.

I. Do not install bypass piping around backflow preventers.

J. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets.
   1. Install thermometers if specified.
   2. Install cabinet-type units recessed in or surface mounted on wall as specified.

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

L. Install thermostatic balancing valves with inlet strainer and inlet and outlet isolation valves.

3.3 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
   1. Calibrated balancing valves.
   2. Master, thermostatic, water mixing valves.
   3. Manifold, thermostatic, water-mixing-valve assemblies.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit.

3.4 ADJUSTING

A. Valve packing shall be adjusted or replaced after piping systems have been tested and put into service but before final adjusting and balancing. Valves shall be replaced if persistent leaking occurs.

B. Set field-adjustable flow set points of balancing valves and record data. Ensure recorded data represents actual measured or observed conditions. Permanently mark settings of valves and other adjustment devices allowing settings to be restored. Set and lock memory stops. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

D. Testing and adjusting of balancing valves shall be performed by an independent NEBB Accredited Test and Balance Contractor. A final settings and flow report shall be submitted to the VA Contracting Officer's Representative (COR).

3.5 STARTUP AND TESTING

A. Perform tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.

B. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.

C. The CxA will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and CxA. Provide a minimum notice of 10 working days prior to startup and testing.

3.6 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

B. Components provided under this section of the specification will be tested as part of a larger system.

3.7 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer's technical representative for 4 hours to instruct each VA personnel responsible in operation and maintenance of the system.

B. Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

- - E N D - - -

SECTION 22 07 11
PLUMBING INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Field applied insulation for thermal efficiency and condensation control for the following:
   1. Plumbing piping and equipment.
   2. Re-insulation of plumbing piping and equipment after asbestos abatement and or replacement of any part of existing insulation system (insulation, vapor retarder jacket, protective coverings/jacket) damaged during construction.

B. Definitions:
   1. ASJ: All Service Jacket, Kraft paper, white finish facing or jacket.
   2. Air conditioned space: Space having air temperature and/or humidity controlled by mechanical equipment.
   3. All insulation systems installed within supply, return, exhaust, relief and ventilation air plenums shall be limited to uninhabited crawl spaces, areas above a ceiling or below the floor, attic spaces, interiors of air conditioned or heating ducts, and mechanical equipment rooms shall be noncombustible or shall be listed and labeled as having a flame spread indexes of not more than 25 and a smoke-developed index of not more than 50 when tested in accordance with ASTM E84 or UL 723. Note: ICC IMC, Section 602.2.1.
   4. Cold: Equipment or piping handling media at design temperature of 15 degrees C (60 degrees F) or below.
   5. Concealed: Piping above ceilings and in chases, interstitial space, and pipe spaces.
   6. Exposed: Piping and equipment exposed to view in finished areas including mechanical equipment rooms or exposed to outdoor weather. Shafts, chases, interstitial spaces, unfinished attics, crawl spaces and pipe basements are not considered finished areas.
   7. FSK: Foil-scrim-Kraft facing.
   8. Hot: Plumbing equipment or piping handling media above 40 degrees C (104 degrees F).
   9. Density: kg/m^3 - kilograms per cubic meter (Pcf - pounds per cubic foot).

10. Thermal conductance: Heat flow rate through materials.
    a. Flat surface: Watts per square meter (BTU per hour per square foot).
    b. Pipe or Cylinder: Watts per linear meter (BTU per hour per linear foot) for a given outside diameter.
11. Thermal Conductivity (k): Watts per meter, per degree K (BTU - inch thickness, per hour, per square foot, per degree F temperature difference).
12. Vapor Retarder (Vapor Barrier): A material which retards the transmission (migration) of water vapor. Performance of the vapor retarder is rated in terms of permeance (perms). For the purpose of this specification, vapor retarders/vapor barriers shall have a maximum published permeance of .02 perms.
13. HWR: Hot water recirculating.
14. CW: Cold water.
15. SW: Soft water.
16. HW: Hot water.
17. PVDC: Polyvinylidene chloride vapor retarder jacketing, white.

1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.
B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
C. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS: Insulation material and insulation production method.
D. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.
E. Section 07 84 00, FIRESTOPPING: Mineral fiber and bond breaker behind sealant.
F. 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.
G. Section 22 05 19, METERS AND GAGES FOR PLUMBING PIPING: Hot and cold water piping.
H. Section 22 05 23, GENERAL-DUTY VALVES FOR PLUMBING PIPING: Hot and cold water piping.
I. Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

1.3 APPLICABLE PUBLICATIONS

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

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

B209-2014.....Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

C411-2011.....Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation

C449-2007 (R2013).....Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement

C450-2008 (R2014).....Standard Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging

Adjunct to C450.....Compilation of Tables that Provide Recommended Dimensions for Prefab and Field Thermal Insulating Covers, etc.

C533-2013.....Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation

C534/C534M-2014.....Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form

C547-2015.....Standard Specification for Mineral Fiber Pipe Insulation

C552-2014.....Standard Specification for Cellular Glass Thermal Insulation

C553-2013.....Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications

C680-2014.....Standard Practice for Estimate of the Heat Gain or Loss and the Surface Temperatures of Insulated Flat, Cylindrical, and Spherical Systems by Use of Computer Programs

C612-2014.....Standard Specification for Mineral Fiber Block and Board Thermal Insulation

C1126-2014.....Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation

C1136-2012.....Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation

C1710-2011.....Standard Guide for Installation of Flexible Closed Cell Preformed Insulation in Tube and Sheet Form

D1668/D1668M-1997a (2014)e1 Standard Specification for Glass Fabrics (Woven and Treated) for Roofing and Waterproofing

E84-2015a.....Standard Test Method for Surface Burning Characteristics of Building Materials

E2231-2015.....Standard Practice for Specimen Preparation and Mounting of Pipe and Duct Insulation to Assess Surface Burning Characteristics

C. Federal Specifications (Fed. Spec.):

L-P-535E-1979.....Plastic Sheet (Sheeting): Plastic Strip; Poly (Vinyl Chloride) and Poly (Vinyl Chloride - Vinyl Acetate), Rigid.

D. International Code Council, (ICC):

IMC-2012.....International Mechanical Code

E. Military Specifications (Mil. Spec.):

MIL-A-3316C (2)-1990....Adhesives, Fire-Resistant, Thermal Insulation

MIL-A-24179A (2)-1987...Adhesive, Flexible Unicellular-Plastic Thermal Insulation

MIL-PRF-19565C (1)-1988.Coating Compounds, Thermal Insulation, Fire-and Water-Resistant, Vapor-Barrier

MIL-C-20079H-1987.....Cloth, Glass; Tape, Textile Glass; and Thread, Glass and Wire-Reinforced Glass

F. National Fire Protection Association (NFPA):

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

G. Underwriters Laboratories, Inc (UL):

723-2008 (R2013).....Standard for Test for Surface Burning Characteristics of Building Materials

1887-2004 (R2013).....Standard for Fire Test of Plastic Sprinkler Pipe for Visible Flame and Smoke Characteristics

H. 3E Plus® version 4.1 Insulation Thickness Computer Program: Available from NAIMA with free download; https:insulationinstitute.org/tools-resources/

1.4 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 22 07 11, PLUMBING INSULATION", with applicable paragraph identification.

C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.

D. Shop Drawings:

1. All information, clearly presented, shall be included to determine compliance with drawings and specifications and ASTM Designation, Federal and Military specifications.
   a. Insulation materials: Specify each type used and state surface burning characteristics.
   b. Insulation facings and jackets: Each type used and state surface burning characteristics.
   c. Insulation accessory materials: Each type used.
   d. Manufacturer's installation and fitting fabrication instructions for flexible unicellular insulation shall follow the guidelines in accordance with ASTM C1710.
   e. Make reference to applicable specification paragraph numbers for coordination.

f. All insulation fittings (exception flexible unicellular insulation) shall be fabricated in accordance with ASTM C450 and the referenced Adjunct to ASTM C450.

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 ____ provided on compact disk or DVD. Should the installing contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement.

D. Certification documentation shall be provided prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and certification that all results of tests were within limits specified.

1.7 STORAGE AND HANDLING OF MATERIAL

A. Store materials in clean and dry environment, pipe insulation jackets shall be clean and unmarred. Place adhesives in original containers. Maintain ambient temperatures and conditions as required by printed instructions of manufacturers of adhesives, mastics and finishing cements.

PART 2 - PRODUCTS

2.1 MINERAL FIBER OR FIBER GLASS

A. ASTM C612 (Board, Block), Class 1 or 2, density 48 kg/m^3 (nominal 3 pcf), k = 0.037 (.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/m^3 (nominal 1 pcf), k = 0.045 (0.31) Class B-5, Density 32 kg/m^3 (nominal 2 pcf), k = 0.04 (0.27) at 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/m^3 (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 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.

2.6 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/ ft3)	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

2.7 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. Weatherproof 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.

2.8 PIPE COVERING PROTECTION SADDLES

A. Cold pipe support: Premolded pipe insulation 180 degrees (half-shells) on bottom half of pipe at supports. Material shall be cellular glass insulation of the same thickness as adjacent insulation.

Nominal Pipe Size and Accessories Material (Insert Blocks)	
Nominal Pipe Size mm (inches)	**Insert Blocks mm (inches)**
Up through 125 (5)	150 (6) long
150 (6)	150 (6) long
200 (8), 250 (10), 300 (12)	225 (9) long
350 (14), 400 (16)	300 (12) long
450 through 600 (18 through 24)	350 (14) long

B. Warm or hot pipe supports: Premolded pipe insulation (180-degree half-shells) on bottom half of pipe at supports. Material shall be high density cellular glass or calcium silicate. Insulation at supports shall have same thickness as adjacent insulation.

2.9 ADHESIVE, MASTIC, CEMENT

A. Mil. Spec. MIL-A-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.

2.10 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.

2.11 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.

2.12 FIRESTOPPING MATERIAL

A. Other than pipe insulation, refer to Section 07 84 00, FIRESTOPPING.

2.13 FLAME AND SMOKE

A. Unless shown otherwise all assembled systems shall meet flame spread 25 and smoke developed 50 rating as developed under ASTM 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. 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).

D. 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).

E. 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.

F. 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.

G. 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.

H. 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.

I. 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.

J. 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.

K. Elbows, flanges and other fittings shall be insulated with the same material as is used on the pipe straights.

L. 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

M. Provide vapor barrier systems as follows:
   1. 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.

N. 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.

O. 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, trowelled 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 washdown 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 located above basement floor from ice making and film developing equipment and air handling units, from equipment (including trap) to main vertical waste pipe.
   c. Reagent grade water piping.
   d. 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.

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)	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)	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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11-1-16

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 -----

05-01-21

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 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

D. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

E. Section 07 84 00, FIRESTOPPING.

F. Section 07 92 00, JOINT SEALANTS.

G. Section 09 91 00, PAINTING.

H. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Seismic Restraint.

I. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

J. Section 22 07 11, PLUMBING INSULATION.

K. SECTION 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

1.3 APPLICABLE PUBLICATIONS

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

B. American Society of Mechanical Engineers (ASME):

A13.1-2007 (R2013).....Scheme for Identification of Piping Systems

B16.3-2011.....Malleable Iron Threaded Fittings: Classes 150 and 300

B16.9-2012.....Factory-Made Wrought Buttwelding Fittings

B16.11-2011.....Forged Fittings, Socket-Welding and Threaded

B16.12-2009 (R2014).....Cast Iron Threaded Drainage Fittings

B16.15-2013 .....Cast Copper Alloy Threaded Fittings: Classes 125 and 250

B16.18-2012.....Cast Copper Alloy Solder Joint Pressure Fittings

B16.22-2013.....Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings

B16.24-2011.....Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 600, 900, 1500, and 2500

ASME Boiler and Pressure Vessel Code -

BPVC Section IX-2015....Welding, Brazing, and Fusing Qualifications

C. American Society of Sanitary Engineers (ASSE):

1010-2004.....Performance Requirements for Water Hammer Arresters

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

A47/A47M-1999 (R2014)...Standard Specification for Ferritic Malleable Iron Castings

A53/A53M-2012.....Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

A183-2014.....Standard Specification for Carbon Steel Track Bolts and Nuts

A269/A269M-2014e1.....Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service

A312/A312M-2015.....Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes

A403/A403M-2014.....Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings

A536-1984 (R2014).....Standard Specification for Ductile Iron Castings

A733-2013.....Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples

B32-2008 (R2014).....Standard Specification for Solder Metal

B43-2014.....Standard Specification for Seamless Red Brass Pipe, Standard Sizes

B61-2008 (R2013).....Standard Specification for Steam or Valve Bronze Castings

B62-2009.....Standard Specification for Composition Bronze or Ounce Metal Castings

B75/B75M-2011.....Standard Specification for Seamless Copper Tube

B88-2014.....Standard Specification for Seamless Copper Water Tube

B584-2014.....Standard Specification for Copper Alloy Sand Castings for General Applications

B687-1999 (R2011).....Standard Specification for Brass, Copper, and Chromium-Plated Pipe Nipples

C919-2012.....Standard Practice for Use of Sealants in Acoustical Applications

D1785-2012.....Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

D2000-2012.....Standard Classification System for Rubber Products in Automotive Applications

D2564-2012.....Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems

D2657-2007.....Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings

D2855-1996 (R2010).....Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings

D4101-2014.....Standard Specification for Polypropylene Injection and Extrusion Materials

E1120-2008.....Standard Specification for Liquid Chlorine

E1229-2008.....Standard Specification for Calcium Hypochlorite

F2389-2010.....Standard Specification for Pressure-rated Polypropylene (PP) Piping Systems

F2620-2013.....Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings

F2769-2014.....Standard Specification for Polyethylene of Raised Temperature (PE-RT) Plastic Hot and Cold-Water Tubing and Distribution Systems

E. American Water Works Association (AWWA):

C110-2012.....Ductile-Iron and Gray-Iron Fittings

C151-2009.....Ductile Iron Pipe, Centrifugally Cast

C153-2011.....Ductile-Iron Compact Fittings

C203-2008.....Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied

C213-2007.....Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines

C651-2014.....Disinfecting Water Mains

F. American Welding Society (AWS):

A5.8M/A5.8-2011-AMD1....Specification for Filler Metals for Brazing and Braze Welding

G. International Code Council (ICC):

IPC-2012.....International Plumbing Code

H. Manufacturers Specification Society (MSS):

SP-58-2009.....Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation

SP-72-2010a.....Ball Valves with Flanged or Butt-Welding Ends for General Service

SP-110-2010.....Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

I. NSF International (NSF):

14-2015.....Plastics Piping System Components and Related Materials

61-2014a.....Drinking Water System Components – Health Effects

372-2011.....Drinking Water System Components – Lead Content

J. Plumbing and Drainage Institute (PDI):

PDI-WH 201-2010.....Water Hammer Arrestors

K. Department of Veterans Affairs:

H-18-8-2013.....Seismic Design Handbook

H-18-10.....Plumbing Design Manual

1.4 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 22 11 00, FACILITY WATER DISTRIBUTIONS", with applicable paragraph identification.

C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.

1. All items listed in Part 2 - Products.

D. Complete operating and maintenance manuals including wiring diagrams, technical data sheets and information for ordering replacement parts:

1. Include complete list indicating all components of the systems.
2. Include complete diagrams of the internal wiring for each item of equipment.
3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

E. Completed System Readiness Checklist provided by the CxA and completed by the Contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

F. Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

1.5 QUALITY ASSURANCE

A. A certificate shall be submitted prior to welding of steel piping showing the Welder's certification. The certificate shall be current and no more than one year old. Welder's qualifications shall be in accordance with ASME BPVC Section IX.

B. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be by the same manufacturer as the groove components.

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

D. Bio-Based Materials: For products designated by the USDA's Bio-Preferred Program, provide products that meet or exceed USDA recommendations for bio-based content, so long as products meet all performance requirements in this specifications section. For more information regarding the product categories covered by the Bio-Preferred Program, visit http:www.biopreferred.gov.

1.6 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. All aspects of system operation and maintenance procedures, including piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices shall be included. A list of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.

C. The installing contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. As-built drawings are to be provided, and a copy of them in Auto-CAD version ____ provided on compact disk or DVD. Should the installing contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement.

D. Certification documentation shall be provided to COR 10 working days prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing

work for the testing agency on this project, detailed procedures followed for all tests, and certificate if applicable that all results of tests were within limits specified. If a certificate is not available, all documentation shall be on the Certifier's letterhead.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Material or equipment containing a weighted average of greater than 0.25 percent lead are prohibited in any potable water system intended for human consumption and shall be certified in accordance with NSF 61 or NSF 372. Endpoint devices used to dispense water for drinking shall meet the requirements of NSF 61, Section 9.

B. Plastic pipe, fittings, and solvent cement shall meet NSF 14 and shall be NSF listed for the service intended.

2.2 ABOVE GROUND (INTERIOR) WATER PIPING

A. Pipe: Copper tube, ASTM B88, Type K or L, drawn. For pipe 150 mm (6 inches) and larger, stainless steel, ASTM A312, schedule 10 40 shall be used.

B. Fittings for Copper Tube:

1. Wrought copper or bronze castings conforming to ASME B16.18 and B16.22. Unions shall be bronze, MSS SP-72, MSS SP-110, solder or braze joints. Use 95/5 tin and antimony for all soldered joints.
2. Grooved fittings, 50 to 150 mm (2 to 6 inch) wrought copper ASTM B75/B75M C12200, 125 to 150 mm (5 to 6 inch) bronze casting ASTM B584, C84400. Mechanical grooved couplings, 2070 kPa (300 psig) minimum ductile iron, ASTM A536 Grade 448-310-12 (Grade 65-45-12), or malleable iron, ASTM A47/A47M Grade 22410 (Grade 32510) housing, with EPDM gasket, steel track head bolts, ASTM A183, coated with copper colored alkyd enamel.
3. Mechanical press-connect fittings for copper pipe and tube **<u>are prohibited</u>**. See Plumbing Design Manual for additional information.
4. 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.

5. Flanged fittings, bronze, class 150, solder-joint ends conforming to ASME B16.24.

C. Fittings for Stainless Steel:

1. Stainless steel butt-welded fittings, Type 316, Schedule 10, conforming to ASME B16.9.
2. Grooved fittings, stainless steel, Type 316, Schedule 40, conforming to ASTM A403/A403M. Segmentally fabricated fittings are not allowed. Mechanical grooved couplings, ductile iron, 4138 kPa (600 psig), ASTM A536 Grade 448-310-12 (Grade 65-45-12), or malleable iron, ASTM A47/A47M Grade 22410 (Grade 32510) housing, with EPDM gasket, steel track head bolts, ASTM A183, coated with copper colored alkyd enamel.

D. Adapters: Provide adapters for joining pipe or tubing with dissimilar end connections.

E. Solder: ASTM B32 alloy type Sb5, HA or HB. Provide non-corrosive flux.

F. Brazing alloy: AWS A5.8M/A5.8, brazing filler metals shall be BCuP series for copper to copper joints and BAg series for copper to steel joints.

G. Re-agent Grade Water Piping and Dialysis Water Piping:

1. Polypropylene, ASTM F2389, Schedule 80 pressure pipe without additions of modifiers, plasticizers, colorants, stabilizers or lubricants. Bio-based materials shall be utilized when possible. This virgin un-plasticized pipe and fittings shall transport 10 megohm water with no loss of purity. Provide socket or butt end fittings with ASTM D2657 heat fusion joints.
2. Polyethylene, ASTM F2769, Schedule 80, food and medical grade, capable of transporting 10 megohm water with no loss of purity. Processed by continuous compression molding without the addition of fillers, polymer modifiers or processing aids. Uniform color with no cracks, flaws, blisters or other imperfections in appearance. Provide ASTM D2657 or ASTM F2620 heat fusion butt welded joints. In accordance with manufacturer's recommendations, provide continuous channel support under all horizontal piping.
3. Reverse Osmosis (RO) Water Piping:

a. Low Pressure Feed, Reject and Recycle Piping: Less than or equal to 520 kPa (75 psig): ASTM D1785, Schedule 80 PVC, ASTM D2855 socket welded and flanged.
b. RO Product Tubing from each Membrane Housing: ASTM D1785, Schedule 80 PVC, ASTM D2855 socket welded and flanged.
c. Low Pressure Control and Pressure Gage Tubing: Polyethylene.
d. High Pressure Reject and Recycle Piping: Greater than 520 kPa (75 psig): ASTM A269/A269M, Type 304 schedule 10 stainless steel with butt welded joints.
e. High Pressure Control and Pressure Gage Tubing: 6895 kPa (1000 psig) burst nylon.

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.
B. Unfinished Rooms, Mechanical Rooms and Kitchens: Chrome-plated brass piping is not required. Paint piping systems as specified in Section 09 91 00, PAINTING.

2.4 TRAP PRIMER WATER PIPING

A. Pipe: Copper tube, ASTM B88, type K, hard drawn.
B. Fittings: Bronze castings conforming to ASME B16.18 Solder joints.
C. Solder: ASTM B32 alloy type Sb5. Provide non-corrosive flux.

2.5 STRAINERS

A. Provide on high pressure side of pressure reducing valves, on suction side of pumps, on inlet side of indicating and control instruments and equipment subject to sediment damage and where shown on drawings. Strainer element shall be removable without disconnection of piping.

B. Water: Basket or "Y" type with easily removable cover and brass strainer basket.

C. Body: Less than 75 mm (3 inches), brass or bronze; 75 mm (3 inches) and greater, cast iron or semi-steel.

2.6 DIELECTRIC FITTINGS

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

2.7 STERILIZATION CHEMICALS

A. Hypochlorite: ASTM E1229.

B. Liquid Chlorine: ASTM E1120.

2.8 WATER HAMMER ARRESTER

A. Closed copper tube chamber with permanently sealed 413 kPa (60 psig) air charge above a Double O-ring piston. Two high heat Buna-N 0-rings pressure packed and lubricated with FDA approved silicone compound. All units shall be designed in accordance with ASSE 1010. Access shall be provided where devices are concealed within partitions or above ceilings. Size and install in accordance with PDI-WH 201 requirements. Provide water hammer arrestors at:

1. All solenoid valves.
2. All groups of two or more flush valves.
3. All quick opening or closing valves.
4. All medical washing equipment.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with the International Plumbing Code and the following:

1. Install branch piping for water from the piping system and connect to all fixtures, valves, cocks, outlets, casework, cabinets and equipment, including those furnished by the Government or specified in other sections.
2. Pipe shall be round and straight. Cutting shall be done with proper tools. Pipe, except for plastic and glass, shall be reamed to remove burrs and a clean smooth finish restored to full pipe inside diameter.
3. All pipe runs shall be laid out to avoid interference with other work/trades.

4. Install union and shut-off valve on pressure piping at connections to equipment.
5. Pipe Hangers, Supports and Accessories:
   a. All piping shall be supported per the IPC, H-18-8 Seismic Design Handbook, MSS SP-58, and SMACNA as required.
   b. Shop Painting and Plating: Hangers, supports, rods, inserts and accessories used for pipe supports shall be shop coated with zinc chromate primer paint. Electroplated copper hanger rods, hangers and accessories may be used with copper tubing.
   c. Floor, Wall and Ceiling Plates, Supports, Hangers:
      1) Solid or split un-plated cast iron.
      2) All plates shall be provided with set screws.
      3) Pipe Hangers: Height adjustable clevis type.
      4) Adjustable Floor Rests and Base Flanges: Steel.
      5) Concrete Inserts: "Universal" or continuous slotted type.
      6) Hanger Rods: Mild, low carbon steel, fully threaded or Threaded at each end with two removable nuts at each end for positioning rod and hanger and locking each in place.
      7) Pipe Hangers and Riser Clamps: Malleable iron or carbon steel. Pipe Hangers and riser clamps shall have a copper finish when supporting bare copper pipe or tubing.
      8) Rollers: Cast iron.
      9) Self-drilling type expansion shields shall be "Phillips" type, with case hardened steel expander plugs.
      10) Hangers and supports utilized with insulated pipe and tubing shall have 180-degree (minimum) metal protection shield centered on and welded to the hanger and support. The shield thickness and length shall be engineered and sized for distribution of loads to preclude crushing of insulation without breaking the vapor barrier. The shield shall be sized for the insulation and have flared edges to protect vapor-retardant jacket facing. To prevent the shield from sliding out of the clevis hanger during pipe movement, center-ribbed shields shall be used.
      11) Miscellaneous Materials: As specified, required, directed or as noted on the drawings for proper installation of hangers,

supports and accessories. If the vertical distance exceeds 6.1 m (20 feet) for cast iron pipe additional support shall be provided in the center of that span. Provide all necessary auxiliary steel to provide that support.

12) With the installation of each flexible expansion joint, provide piping restraints for the upstream and downstream section of the piping at the flexible expansion joint. Provide calculations supporting the restraint length design and type of selected restraints. Restraint calculations shall be based on the criteria from the manufacturer regarding their restraint design.

6. Install chrome plated cast brass escutcheon with set screw at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.
7. Penetrations:
   a. Firestopping: Where pipes pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke, and gases as specified in Section 07 84 00, FIRESTOPPING. Completely fill and seal clearances between raceways and openings with the firestopping materials.
   b. Waterproofing: At floor penetrations, completely seal clearances around the pipe and make watertight with sealant as specified in Section 07 92 00, JOINT SEALANTS. Bio-based materials shall be utilized when possible.
   c. Acoustical sealant: Where pipes pass through sound rated walls, seal around the pipe penetration with an acoustical sealant that is compliant with ASTM C919.

B. Domestic Water piping shall conform to the following:
1. Grade all lines to facilitate drainage. Provide drain valves at bottom of risers and all low points in system. Design domestic hot and cold water circulating lines with no traps.
2. Connect branch lines at bottom of main serving fixtures below and pitch down so that main may be drained through fixture. Connect branch lines to top of main serving only fixtures located on floor above.

3.2 TESTS

A. General: Test system either in its entirety or in sections. Submit testing plan to COR 10 working days prior to test date.

B. Potable Water System: Test after installation of piping and domestic water heaters, but before piping is concealed, before covering is applied, and before plumbing fixtures are connected. Fill systems with water and maintain hydrostatic pressure of 1035 kPa (150 psig) gage for two hours. No decrease in pressure is allowed. Provide a pressure gage with a shutoff and bleeder valve at the highest point of the piping being tested. Pressure gauge shall have 1 psig increments.

C. Re-agent Grade Water Systems: Fill system with water and maintain hydrostatic pressure of 1380 kPa (200 psig) gage during inspection and prove tight.

D. All Other Piping Tests: Test new installed piping under 1-1/2 times actual operating conditions and prove tight.

E. The test pressure shall hold for the minimum time duration required by the applicable plumbing code or authority having jurisdiction.

3.3 STERILIZATION

A. After tests have been successfully completed, thoroughly flush and sterilize the interior domestic water distribution system in accordance with AWWA C651.

B. Use liquid chlorine or hypochlorite for sterilization.

3.4 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

B. Components provided under this section of the specification will be tested as part of a larger system.

3.5 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer’s technical representative for four hours to instruct VA Personnel in operation and maintenance of the system.

B. Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

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SECTION 22 11 23

DOMESTIC WATER PUMPS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Domestic Hot and Cold water recirculation pumps.

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 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

D. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

E. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Seismic Restraint.

F. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

G. Section 22 05 12, GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT.

H. Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS: Requirements for commissioning, systems readiness checklist, and training.

I. Section 26 29 11, MOTOR CONTROLLERS.

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):

ASME Boiler and Pressure Code - BPVC Section VIII-1-2021
.....Rules for Construction of Pressure Vessels, Division 1

BPVC Section VIII-2-2021 Rules for Construction of Pressure Vessels, Division 2-Alternative Rules

C. International Code Council (ICC)

IPC-2021.....International Plumbing Code

D. National Electrical Manufacturers Association (NEMA):

ICS 6-1993 (R2001, R2006) Industrial Control and Systems: Enclosures

250-2020.....Enclosures for Electrical Equipment (1000 Volts Maximum)

E. NSF International (NSF)

61-2020.....Drinking Water System Components – Health Effects

F. Underwriters' Laboratories, Inc. (UL):

508-1999 (R2013).....Standards for Industrial Control Equipment

778-2010 (R2014).....Standard for Motor-Operated Water Pumps

1.4 SUBMITTALS

A. Submittal 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 23, DOMESTIC WATER PUMPS", 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. Pump:
   a. Manufacturer and model.
   b. Operating speed.
   c. Capacity.
   d. Characteristic performance curves.
2. Motor:
   a. Manufacturer.
   b. Speed.
   c. Current Characteristics.
   d. Efficiency.
3. Drive: Information in accordance with Section 26 29 11, MOTOR CONTROLLERS.

D. Certified copies of all the factory and construction site test data sheets and reports.

E. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replacement parts, and troubleshooting guide:

1. Include complete list indicating all components of the systems.

2. Include complete diagrams of the internal wiring for each item of equipment.
3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

F. Completed System Readiness Checklist provided by the CxA and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

G. Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

1.5 QUALITY ASSURANCE

A. General:

1. UL Compliance: Comply with UL 778 for motor-operated water pumps.
2. Design Criteria:
   a. Pump sizes, capacities, pressures, operating characteristics and efficiency shall be as scheduled.
   b. Head-capacity curves shall slope up to maximum head at shut-off. Select pumps near the midrange of the curve, and near the point of maximum efficiency, without approaching the pump curve end point and possible cavitation and unstable operation. Select pumps for open systems so that required net positive suction head (NPSHR) does not exceed the net positive head available (NPSHA).
   c. Pump Driver: Furnish with pump. Size shall be non-overloading at any point on the head-capacity curve, including in a parallel or series pumping installation with one pump in operation.
   d. Provide all pumps with motors, impellers, drive assemblies, bearings, coupling guard and other accessories specified. Statically and dynamically balance all rotating parts.
   e. Furnish each pump and motor with a nameplate giving the manufacturers name, serial number of pump, capacity in GPM and head in feet at design condition, horsepower, voltage, frequency, speed and full load current and motor efficiency.
   f. Test all pumps before shipment. The manufacturer shall certify all pump ratings.

g. After completion of balancing, provide replacement of impellers or trim impellers to provide specified flow at actual pumping head, as installed.

B. Domestic Water Recirculating Pumps: Components shall be assembled by a single manufacturer and the pump motor assembly shall be the standard cataloged product of the manufacturer.

C. 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 provided on compact disk or DVD. Should the installing contractor engage the testing company to provide as-built or any portion thereof, it shall not be

deemed a conflict of interest or breach of the 'third party testing company' requirement.

D. Certification documentation shall be provided to COR 10 working days prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and 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 shall be prohibited in any potable water system intended for human consumption, and shall be certified in accordance with NSF 61 or NSF 372.

2.2 DOMESTIC WATER RECIRCULATING PUMP

A. General:

1. Centrifugal, single stage, pump. Driver shall be electric motor, close coupled or connected by flexible or magnetic coupling. Pump for hot water system shall be designed for quiet, trouble-free operation at a minimum of 82 degrees C (180 degrees F) water service and 1,035 kPa (150 psig).
2. Mounting shall be in-line, vertical or horizontal.
3. Stamped or engraved stainless steel nameplate.
4. Motors: Maximum 40 degrees C (104 degrees F) ambient temperature rise, drip-proof, for operation with current, voltage, phase and cycle shown in schedule on Electrical drawings, conforming to NEMA Type 4. Motors shall be equipped with thermal overload protection. When motor has cooled down it shall re-start automatically if the operating control has been left on and the system requires pump to start.
5. Pump shall operate continuously with on-off switch, or with an HOA switch for automatically controlled pumps, for manual shut down. In the inlet and outlet piping of the pump, shutoff valves shall be installed to permit service to the pump, strainer, and check valve without draining the system.

6. A check valve shall be installed in the pump discharge piping immediately downstream of the pump. A strainer with drain valve and removable strainer screen or basket shall be installed immediately upstream of the pump.

B. Horizontal, Wet-Rotor Circulators:
1. Maintenance free, close-coupled pump and motor with maximum 3,300 rpm rotational speed.
2. Bronze, Cast iron or Stainless steel body construction with stainless steel shaft, plastic impeller, fluid lubricated bearings, no mechanical seal, and flanged connections. Pump shall be capable of pumping the capacity scheduled on drawings.
3. Bearings: Carbon type.

C. The pump, motor, and variable speed drive shall be an integral product designed and built by the same manufacturer.

D. The pump shall have an integrated operator interface consisting of:
1. Minimum 2.4” (measured diagonally) color TFT display
2. 7 push buttons for navigation of menu
3. LEDs to signal pump status for quick indication

E. The pump shall have a sensor integrated directly into the pump housing with 4 lines consisting of Ground, Supply, and two signals for Differential Pressure and Media Temperature.

F. The pump module shall have one analog input configurable for either 4-20mA or 0-10VDC input signal configurable for external Temperature or Pressure sensor, or Setpoint influence. Sensor input shall have three wires for Ground, Supply, and Signal. The Supply for external analog input shall be 24V DC +/-10% at 22mA reference to Ground. The supply must be able to withstand a permanent short circuit. Connection can be made to a screw terminal capable of wire sizes up to AWG16.

G. The pump shall have 3 Digital Inputs galvanically isolated from the main supply by a reinforced insulation according to UL60730.
1. Start/Stop –Used to start or start the pump. The pump shall be enabled when connected to common ground by an external potential free short circuit. An open circuit to this input shall disable the pump. Connection can be made to a screw terminal capable of wire sizes up to AWG16.

2. Minimum – used to force the pump to run at minimum load (curve). When connected to common ground by an external potential free short circuit the pump must run at minimum load. Connection can be made to a screw terminal capable of wire sizes up to AWG16.
3. Maximum - used to force the pump to run at maximum load (curve). When connected to common ground by an external potential free short circuit the pump must run at maximum load. Connection can be made to a screw terminal capable of wire sizes up to AWG16.

H. The pump module shall have two Output Relays. Each relay shall be configurable for Alarm, Reading, or Operating indication. Each relay must have three screw terminals see above. Output relays contacts shall be rated for maximum 250VAC at 2A and minimum 5VDC at 20mA. Each must have galvanic isolation from the internal supply by reinforced insulation according to UL60730.

I. Shall be capable of integration into Building Management Systems: LonWorks, Bacnet, Modbus or Profibus.

J. The pump module shall have wireless connectivity for two pumps to communicate with one another or for the pump to communicate to a mobile device with additional hardware.
1. Communication range shall at minimum within 30ft of the pump without walls or barriers.
2. Two identical pumps shall be capable of wireless communication with one another to operate as a two pump system in, duty/standby, alternating, simultaneous modes.

PART 3 - EXECUTION

3.1 STARTUP AND TESTING

A. Make tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.

B. System Test: After installation is completed provide an operational test of the completed system including flow rates, pressure compliance, alarms and all control functions.

C. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.

D. The CxA will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and CxA. Contractor shall provide a minimum of 10 working days prior to startup and testing.

3.2 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.

3.3 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer’s technical representative for four hours to instruct VA Personnel in operation and maintenance of the system.

B. Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

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SECTION 22 13 00
FACILITY SANITARY AND VENT PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section pertains to sanitary sewer and vent systems, including piping, equipment and all necessary accessories as designated in this section.

B. A complete listing of common acronyms and abbreviations are included in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.

B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

D. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

E. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Seismic Restraint.

F. Section 07 84 00, FIRESTOPPING: Penetrations in rated enclosures.

G. Section 07 92 00, JOINT SEALANTS: Sealant products.

H. Section 09 91 00, PAINTING: Preparation and finish painting and identification of piping systems.

I. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING: Pipe Hangers and Supports, Materials Identification.

J. Section 22 07 11, PLUMBING INSULATION.

K. Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS

L. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

M. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

1.3 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Where conflicts occur these specifications and the VHA standard will govern.

B. American Society of Mechanical Engineers (ASME):

A13.1-2007.....Identification of Piping Systems

A112.36.2M-1991.....Cleanouts

A112.6.3-2019.....Floor and Trench Drains

B1.20.1-2013.....Pipe Threads, General Purpose (Inch)

B16.1-2015.....Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250

B16.4-2016.....Grey Iron Threaded Fittings Classes 125 and 250

B16.15-2018.....Cast Copper Alloy Threaded Fittings, Classes 125 and 250

B16.18-2018.....Cast Copper Alloy Solder Joint Pressure Fittings

B16.21-2016.....Nonmetallic Flat Gaskets for Pipe Flanges

B16.22-2018.....Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings

B16.23-2016.....Cast Copper Alloy Solder Joint Drainage Fittings: DWV

B16.24-2016.....Cast Copper Alloy Pipe Flanges and Flanged Fittings, and Valves: Classes 150, 300, 600, 900, 1500, and 2500

B16.29-2017.....Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fittings: DWV

B16.39-2014.....Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300

B18.2.1-2012.....Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series)

C. American Society of Sanitary Engineers (ASSE):

1001-2017.....Performance Requirements for Atmospheric Type Vacuum Breakers

1018-2001.....Performance Requirements for Trap Seal Primer Valves - Potable Water Supplied

1044-2015.....Performance Requirements for Trap Seal Primer Devices - Drainage Types and Electronic Design Types

1079-2012.....Performance Requirements for Dielectric Pipe Unions

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

A53/A53M-2018.....Standard Specification for Pipe, Steel, Black And Hot-Dipped, Zinc-coated, Welded and Seamless

A74-2017.....Standard Specification for Cast Iron Soil Pipe and Fittings

A888-2018a.....Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

B32-2008(R2014).....Standard Specification for Solder Metal

B43-2015.....Standard Specification for Seamless Red Brass Pipe, Standard Sizes

B88-2016.....Standard Specification for Seamless Copper Water Tube

B306-2013.....Standard Specification for Copper Drainage Tube (DWV)

B687-1999(R2016).....Standard Specification for Brass, Copper, and Chromium-Plated Pipe Nipples

B813-2016.....Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube

B828-2016.....Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings

C564-2014.....Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings

D2321-2018.....Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications

F402-2018.....Standard Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings

F477-2014.....Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

F1545-2015e1.....Standard Specification for Plastic-Lined Ferrous Metal Pipe, Fittings, and Flanges

E. Cast Iron Soil Pipe Institute (CISPI):

2006.....Cast Iron Soil Pipe and Fittings Handbook

301-2012.....Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

310-2012.....Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

F. Copper Development Association, Inc. (CDA):

A4015-14/19.....Copper Tube Handbook

G. International Code Council (ICC):

IPC-2018.....International Plumbing Code

H. Manufacturers Standardization Society (MSS):

SP-123-2018.....Non-Ferrous Threaded and Solder-Joint Unions for Use with Copper Water Tube

I. National Fire Protection Association (NFPA):

70-2020.....National Electrical Code (NEC)

J. Underwriters' Laboratories, Inc. (UL):

508-99 (R2013).....Standard For Industrial Control Equipment

1.4 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

B. Information and material submitted under this section shall be marked “SUBMITTED UNDER SECTION 22 13 00, FACILITY SANITARY AND VENT PIPING”, with applicable paragraph identification.

C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.

1. Piping.
2. Floor Drains.
3. Grease Removal Unit.
4. Cleanouts.
5. Trap Seal Protection.
6. Penetration Sleeves.
7. Pipe Fittings.

8. Traps.
9. Exposed Piping and Fittings.

D. Detailed shop drawing of clamping device and extensions when required in connection with the waterproofing membrane or the floor drain.

E. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replaceable parts, and troubleshooting guide:
1. Include complete list indicating all components of the systems.
2. Include complete diagrams of the internal wiring for each item of equipment.
3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

F. Completed System Readiness Checklist provided by the CXA and completed by the Contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

G. Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

1.5 QUALITY ASSURANCE

A. Bio-Based Materials: For products designated by the USDA's bio-based Bio-Preferred Program, provide products that meet or exceed USDA recommendations for bio-based content, so long as products meet all performance requirements in this specifications section. For more information regarding the product categories covered by the Bio-Preferred Program, visit http:www.biopreferred.gov.

B. Refer to Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS for additional sustainable design requirements.

1.6 AS-BUILT DOCUMENTATION

A. Comply with requirements in Paragraph "AS-BUILT DOCUMENTATION" of Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

PART 2 - PRODUCTS

2.1 SANITARY WASTE, DRAIN, AND VENT PIPING

A. Cast iron waste, drain, and vent pipe and fittings.
1. Cast iron waste, drain, and vent pipe and fittings shall be used for the following applications:

a. Pipe buried in or in contact with earth.
b. Sanitary pipe extensions to a distance of approximately 1500 mm (5 feet) outside of the building.
c. Interior waste and vent piping above grade.

2. Cast iron Pipe shall be bell and spigot or hubless (plain end or no-hub or hubless).
3. The material for all pipe and fittings shall be cast iron soil pipe and fittings and shall conform to the requirements of CISPI 301, ASTM A888, or ASTM A74.
4. Cast iron pipe and fittings shall be made from a minimum of 95 percent post-consumer recycled material.
5. Joints for hubless pipe and fittings shall conform to the manufacturer’s installation instructions. Couplings for hubless joints shall conform to CISPI 310. Joints for hub and spigot pipe shall be installed with compression gaskets conforming to the requirements of ASTM C564.

B. Copper Tube, (DWV):
1. Copper DWV tube sanitary waste, drain and vent pipe may be used for piping above ground, except for urinal drains.
2. The copper DWV tube shall be drainage type, drawn temper conforming to ASTM B306.
3. The copper drainage fittings shall be cast copper or wrought copper conforming to ASME B16.23 or ASME B16.29.
4. The joints shall be lead free, using a water flushable flux, and conforming to ASTM B32.

C. Polyvinyl Chloride (PVC)
1. PVC piping and fittings shall NOT be used for the following applications:
a. Waste collected from steam condensate drains.
b. Spaces such as mechanical equipment rooms, Sterile Processing Services, sterilizer areas, and areas designated for sleep.
c. Vertical waste and soil stacks serving more than two floors.
d. Exposed in mechanical equipment rooms.
e. Exposed inside of ceiling return plenums.

2.2 PUMP DISCHARGE PIPING

A. Galvanized steel pump discharge pipe and fittings:

1. Galvanized steel pipe shall be Schedule 40 weight class conforming to ASTM A53/A53M, with square cut grooved or threaded ends to match joining method.
2. Fittings shall be Class 125, gray-iron threaded fittings conforming to ASME B16.4.
3. Unions shall be Class 150 hexagonal-stock body with ball and socket, metal to metal, bronze seating surface, malleable iron conforming to ASME B16.39 with female threaded ends.
4. Flanges shall be Class 125 cast iron conforming to ASME B16.1.
   a. Flange gaskets shall be full face, flat nonmetallic, asbestos free conforming to ASME B16.21.
   b. Flange nuts and bolts shall be carbon steel conforming to ASME B18.2.1.

B. Copper pump discharge pipe and fittings:

1. Copper tube shall be hard drawn Type L conforming to ASTM B88.
2. Fittings shall be cast copper alloy conforming to ASME B16.18 or wrought copper conforming to ASME B16.22 with solder joint ends.
3. Unions shall be copper alloy, hexagonal stock body with ball and socket, metal to metal seating surface conforming to MSS SP-123 with female solder-joint or threaded ends.
4. Flanges shall be Class 150, cast copper conforming to ASME B16.24 with solder-joint end.
   a. Flange gaskets shall be full face, flat nonmetallic, asbestos free conforming to ASME B16.21.
   b. Flange nuts and bolts shall be carbon steel conforming to ASME B18.2.1.
5. Solder shall be lead free, water flushable flux conforming to ASTM B32 and ASTM B813.

2.3 EXPOSED WASTE PIPING

A. Chrome plated brass piping of full iron pipe size shall be used in finished rooms for exposed waste piping connecting fixtures, casework, cabinets, equipment and reagent racks when not concealed by apron including those furnished by the Government or specified in other sections.

1. The Pipe shall meet ASTM B43, regular weight.
2. The Fittings shall conform to ASME B16.15 ASTM D2665.
3. Nipples shall conform to ASTM B687, Chromium-plated.
4. Unions shall be brass or bronze with chrome finish. Unions 65 mm (2-1/2 inches) and larger shall be flange type with approved gaskets.

B. In unfinished Rooms such as mechanical rooms, Chrome-plated brass piping is not required. The pipe materials specified under the paragraph "Sanitary Waste, Drain, and Vent Piping" can be used. The sanitary pipe in unfinished rooms shall be painted as specified in Section 09 91 00, PAINTING.

2.4 SPECIALTY PIPE FITTINGS

A. Transition pipe couplings shall join piping with small differences in outside diameters or different materials. End connections shall be of the same size and compatible with the pipes being joined. The transition coupling shall be elastomeric, sleeve type reducing or transition pattern and include shear and corrosion resistant metal, tension band and tightening mechanism on each end. The transition coupling sleeve coupling shall be of the following material:
   1. For cast iron soil pipes, the sleeve material shall be rubber conforming to ASTM C564.

B. The dielectric fittings shall conform to ASSE 1079 with a pressure rating of 861 kPa (125 psig) at a minimum temperature of 82 degrees C (180 degrees F). The end connection shall be solder joint copper alloy and threaded ferrous.

C. Dielectric flange insulating kits shall be of non-conducting materials for field assembly of companion flanges with a pressure rating of 1035 kPa (150 psig). The gasket shall be neoprene or phenolic. The bolt sleeves shall be phenolic or polyethylene. The washers shall be phenolic with steel backing washers.

D. The di-electric nipples shall be electroplated steel nipple complying with ASTM F1545 with a pressure rating of 2070 kPa (300 psig) at 107 degrees C (225 degrees F). The end connection shall be male threaded. The lining shall be inert and noncorrosive propylene.

2.5 CLEANOUTS

A. Cleanouts shall be the same size as the pipe, up to 100 mm (4 inches); and not less than 100 mm (4 inches) for larger pipe. Cleanouts shall be easily accessible and shall be gastight and watertight. Minimum clearance of 600 mm (24 inches) shall be provided for clearing a clogged sanitary line.

B. Floor cleanouts shall be gray iron housing with clamping device and round, secured, scoriated, gray iron cover conforming to ASME A112.36.2M. A gray iron ferrule with hubless, socket, inside calk or spigot connection and counter sunk, taper-thread, brass or bronze closure plug shall be included. The frame and cover material and finish shall be nickel-bronze copper alloy with a square shape. The cleanout shall be vertically adjustable for a minimum of 50 mm (2 inches). When a waterproof membrane is used in the floor system, clamping collars shall be provided on the cleanouts. Cleanouts shall consist of wye fittings and eighth bends with brass or bronze screw plugs. Cleanouts in the resilient tile floors, quarry tile and ceramic tile floors shall be provided with square top covers recessed for tile insertion. In the carpeted areas, carpet cleanout markers shall be provided. Two way cleanouts shall be provided where indicated in the contract document and at every building exit. The loading classification for cleanouts in sidewalk areas or subject to vehicular traffic shall be heavy duty type.

C. Cleanouts shall be provided at or near the base of the vertical stacks with the cleanout plug located approximately 600 mm (24 inches) above the floor. If there are no fixtures installed on the lowest floor, the cleanout shall be installed at the base of the stack. The cleanouts shall be extended to the wall access cover. Cleanout shall consist of sanitary tees. Nickel-bronze square frame and stainless steel cover with minimum opening of 150 by 150 mm (6 by 6 inches) shall be furnished at each wall cleanout. Where the piping is concealed, a fixture trap or a fixture with integral trap, readily removable without disturbing concealed pipe, shall be accepted as a cleanout equivalent providing the opening to be used as a cleanout opening is the size required.

D. In horizontal runs above grade, cleanouts shall consist of cast brass tapered screw plug in fitting or caulked/hubless cast iron ferrule. Plain end (hubless) piping in interstitial space or above ceiling may use plain end (hubless) blind plug and clamp.

2.6 FLOOR DRAINS

A. General Data: floor drain shall comply with ASME A112.6.3. A caulking flange, inside gasket, or hubless connection shall be provided for connection to cast iron pipe, screwed or no hub outlets for connection to steel pipe. The drain connection shall be bottom outlet. A membrane clamp and extensions shall be provided, if required, where installed in connection with waterproof membrane. Puncturing membrane other than for drain opening shall not be permitted. Double drainage pattern floor drains shall have integral seepage pan for embedding into floor construction, and weep holes to provide adequate drainage from pan to drain pipe. For drains not installed in connection with a waterproof membrane, a .45 kg (16-ounce) soft copper 1.1 to 1.8 Kg (2.5 to 4 lbs.) flashing membrane, 600 mm (24 inches) square or another approved waterproof membrane shall be provided.

B. Type B (FD-B) medium duty (non-traffic) floor drain shall comply with ASME A112.6.3. The type B floor drain shall be constructed of galvanized cast iron with medium duty nickel bronze grate, double drainage pattern, clamping device, without sediment bucket but with secondary strainer in bottom for large debris. The grate shall be 175 mm (7 inches) minimum.

C. Type E (FD-E) floor drain shall comply with ASME A112.6.3. The type E floor drain shall have a heavy, cast iron body, double drainage pattern, heavy non-tilting nickel bronze ductile iron grate not less than 300 mm (12 inches) square, removable sediment bucket. Clearance between body and bucket shall be ample for free flow of waste water. For traffic use, an extra heavy duty load classification ductile iron grate shall be provided.

D. Type G (FD-G) medium duty (non-traffic) floor drain shall comply with ASME A112.6.3. The type G floor drain shall have a cast iron body, shallow type with double drainage flange and removable, perforated aluminum sediment bucket. The type G drain shall have all interior and exposed exterior surfaces coated with acid resistant porcelain enamel

finish. The floor drain shall have a clamping device. The frame and grate shall be nickel bronze. The grate shall be approximately 200 mm (8 inches) in diameter. The space between body of drain and basket shall be sufficient for free flow of waste water.

E. Type H (FD-H) medium duty (non-traffic) floor drain shall comply with ASME A112.6.3. The type H drain shall have a cast iron body, double drainage pattern, without sediment bucket but with loose set nickel bronze grate, secondary strainer, and integral clamping collar. The grate shall be 300 mm (12 inches) in diameter or 300 mm (12 inches) square. The drain body shall be 150 mm (6 inches) deep.

F. Type I (FD-I) medium duty (non-traffic) floor drain shall comply with ASME A112.6.3. The type I floor drain shall have a cast iron body, wide flange for seamless floor, double drainage pattern, with all interior surfaces and exposed exterior surfaces provided with acid resistant enamel finish for sanitary areas. The type I floor drain shall have a clamping device, secured nickel bronze rim, aluminum enameled finish sediment basket with, perforations with not less than 19,300 square mm (30 square inches) of free area. The sediment basket shall be approximately 100 mm (4 inches) deep, and be provided with grips for easy handling. The floor drain shall be provided with a loose-set, nickel bronze grate approximately 300 mm (12 inches) square and of sufficient strength to support pedestrian traffic. Ample space between body of drain and sediment basket shall be provided for free flow of waste liquids.

G. Type J (FD-J) floor drain shall comply with ASME A112.6.3. The type J floor drain shall be a flushing rim drain with heavy duty cast iron body, double drainage pattern with flushing rim and clamping device. The nickel bronze grate shall be approximately 280 mm (11 inches) in diameter and flush with floor. A deep-seal P-trap shall be attached to drain. The body and trap shall have pipe taps for water supply connections.

1. Drain Flange: Flange for synthetic flooring.
2. Flush Valve: Large diaphragm flushometer, exposed, side oscillating handle. For the flush valve mounting and installation detail, see the detail indicated in the contract documents.

H. Type K (FD-K) floor drain shall comply with ASME A112.6.3. The type K floor drain shall be a flushing Rim Drain with heavy duty cast iron body, double drainage pattern with flushing rim and clamping device. Solid bronze gasketed grate shall be approximately 280 mm (11 inches) in diameter, flush with floor. A deep-seal P-trap shall be attached to drain. Body and trap shall have pipe taps for water supply connections.
   1. Drain Flange: Flange for synthetic flooring.
   2. Flush Valve: Large diaphragm flushometer, exposed, side oscillating handle.

I. Type M (FD-M) medium duty (non-traffic) floor drain shall comply with ASME A112.6.3. The type M floor drain shall have a cast iron body, nickel bronze adjustable funnel strainer and clamping device. Funnel strainer shall consist of a perforated floor-level square or round grate and funnel extension for indirect waste. Cut-out grate below funnel. Minimum dimensions as follows:
   1. Area of strainer and collar – 23,000 square mm (36 square inches).
   2. Height of funnel – 95 mm (3-3/4 inches).
   3. Diameter of lower portion of funnel – 50 mm (2 inches).
   4. Diameter of top portion of funnel – 100 mm (4 inches).
   5. Provide paper collars for construction purposes.

J. Type N (FD-N) medium duty (non-traffic) floor drain shall comply with ASME A112.6.3. The type N floor drain shall have a cast iron body, wide flange for seamless floors, double drainage pattern, with all interior and exposed exterior surfaces provided with acid resistant enamel finish for sanitary areas. The type N floor drain shall have a clamping device, secured nickel bronze rim, aluminum enameled finish sediment basket, perforated with not less than 9,000 square mm (14 square inches) of free area and approximately 50 mm (2 inches) deep. The sediment bucket shall be provided with grips for easy handling. The loose-set, nickel bronze grate approximately 200 mm (8 inches) shall be round and of sufficient strength to support pedestrian traffic. Ample space between body of drain and sediment basket shall be provided for free flow of waste liquids.

K. Type O (FD-O) medium duty (non-traffic) floor drain shall comply with ASME A112.6.3. The type O floor drain shall have a cast iron body, double drainage pattern, clamping device, less grate and sediment

basket but with dome type secondary strainer. The drain shall be 300 mm (12 inches) in diameter or 300 mm (12 inches) square and approximately 150 mm (6 inches) deep. The interior and exposed exterior surfaces shall have an acid resisting, enamel finish for sanitary areas.

L. Type P (FD-P) medium duty (non-traffic) floor drain shall comply with ASME A112.6.3. The type P floor drain shall have a cast iron body, double drainage pattern, with all interior and exposed exterior surfaces provided with acid resistant enamel finish for sanitary areas. The type P floor drain shall have a clamping device, secured nickel bronze rim, an aluminum enameled finish sediment basket perforated with not less than 27,000 square mm (42 square inches) of free area and approximately 100 mm (4 inches) deep. The sediment bucket shall be provided with grips for easy handling. The loose-set, nickel bronze grate shall be approximately 7,700 square mm (12 square inches) and of sufficient strength to support pedestrian traffic. Ample space between body of drain and sediment basket shall be provided for free flow of waste liquids.

M. Type R (FD-R) floor drain shall comply with ASME A112.6.3. The type R floor drain shall have a cast iron body, double drainage pattern and clamping device, less grate and sediment basket but with dome type secondary strainer. The drain shall be 200 mm (8 inches) in diameter or 200 mm (8 inches) square and approximately 150 mm (6 inches) deep. The interior and exposed exterior surfaces and rim shall have an acid resisting finish for indirect waste in sanitary areas.

N. Type S (FD-S) floor sink shall comply with ASME A112.6.3. The type S floor sink shall be constructed from type 304 stainless steel and shall be 300 mm (12 inches) square, and 200 mm (8 inches deep). The interior surface shall be polished. The double drainage flange shall be provided with weep holes, internal dome strainer, and heavy duty non-tilting loose set grate. A clamping device shall be provided.

O. Type T (FD-T) floor drain shall comply with ASME A112.6.3. The type T drain shall be Funnel Type, chemical resistant floor drain with integral p-trap. Double drainage pattern floor drain shall have an integral seepage pan for embedding in floor and weep holes to provide adequate drainage from pan to drain pipe. Floor drain shall be polypropylene, flame retardant, Schedule 40 or 80. An outlet of floor

drain shall be suitable for properly jointing perforated or slotted floor-level grate and funnel extension. Cut-out grate below funnel. Minimum dimensions as follows:

1. Height of funnel – 95 mm (3-3/4 inches).
2. Diameter of lower portion of funnel – 50 mm (2 inches).
3. Diameter of top portion of funnel – 100 mm (4 inches).

P. Type V (FD-V) medium duty (non-traffic) floor drain shall comply with ASME A112.6.3 The type V floor drain shall have an oval funnel and cast iron body. Funnel strainer shall consist of a slotted cast iron floor-level grate funnel extension. Cut-out grate below funnel. Minimum dimensions as follows:

1. Area of strainer and collar – 23,000 square mm (36 square inches).
2. Height of funnel – 95 mm (3-3/4 inches).
3. Funnel size - 90 by 228 mm (3-1/2 by 9 inches).

Q. Type W (FD-W) Open Sight Drains (OSDs) for clear water wastes only:

1. OSD’s shall be the cast iron open hub type.
2. A cast iron drain standpipe shall be utilized for equipment with a high rate of discharge.

R. Type X (FD-X) floor drain shall comply with ASME A112.6.3. The type X floor drain shall be a chemical resistant floor drain and integral p-trap. Double drainage pattern floor drain shall have integral seepage pan for embedding in floor and weep holes to provide adequate drainage from pan to drain pipe. Floor drain shall be polypropylene, flame retardant, Schedule 40 or 80. An outlet of floor drain shall be suitable for properly joining a perforated or slotted floor level grate.

S. Type Y (FD-Y) floor drain shall comply with ASME A112.6.3. The type Y floor drain shall be suitable for parking decks and constructed of extra heavy duty, galvanized cast iron body with double drainage pattern. The extra heavy duty polished bronze grate shall be not less than 228 mm (9 inches) in diameter with seepage pan and combination membrane flashing clamp, heavy duty support flange, under deck clamp and vandal proof grate.

T. Type Z (FD-Z) trench drain shall comply with ASME A112.6.3. The type Z trench drain shall be suitable for shower thresholds and constructed of Type 304 stainless steel. The stainless steel slotted grate shall be

not less than 100 mm (4 inches) wide with anchor supports, tile edge, bottom outlet and combination membrane flashing collar.

2.7 TRAPS

A. Traps shall be provided on all sanitary branch waste connections from fixtures or equipment not provided with traps. Exposed brass shall be polished brass chromium plated with nipple and set screw escutcheons. Concealed traps may be rough cast brass or same material as the piping they are connected to. Slip joints are prohibited on sewer side of trap. Traps shall correspond to fittings on cast iron soil pipe or steel pipe respectively, and size shall be as required by connected service or fixture.

2.8 PRIMER VALVES AND TRAP SEAL PRIMER SYSTEMS

A. Trap Primer (TP-1): The trap seal primer system shall be electronic type conforming to ASSE 1044.
   1. The controller shall have a 24 hour programmable timer, solid state, 6 outlet zones, minimum adjustable run time of 1 minute for each zone, 12 hour program battery backup, manual switch for 120VAC power, 120VAC to 24VAC internal transformer, fuse protected circuitry, UL listed, 120VAC input-24VAC output, constructed of enameled steel or plastic.
   2. The cabinet shall be recessed mounting with a stainless steel cover.
   3. The solenoid valve shall have a brass body, suitable for potable water service, normally closed, 861 kPa (125 psig) rated, 24VAC.
   4. The control wiring shall be copper in accordance with the National Electric Code (NFPA 70), Article 725 and not less than 18 gauge. All wiring shall be in conduit and in accordance with Division 26 of the specifications.
   5. The vacuum breaker shall conform to ASSE 1001.

B. Trap Primer (TP-2): The trap seal primer valve shall be hydraulic, supply type with a pressure rating of 861 kPa (125 psig) and conforming to standard ASSE 1018.
   1. The inlet and outlet connections shall be 15 mm or DN15 (NPS 1/2 inch)
   2. The trap seal primer valve shall be fully automatic with an all brass or bronze body.

3. The trap seal primer valve shall be activated by a drop in building water pressure, no adjustment required.
4. The trap seal primer valve shall include a manifold when serving two, three, or four traps.
5. The manifold shall be omitted when serving only one trap.

2.9 PENETRATION SLEEVES

A. A sleeve flashing device shall be provided at points where pipes pass through membrane waterproofed floors or walls. The sleeve flashing device shall be manufactured, cast iron fitting with clamping device that forms a sleeve for the pipe floor penetration of the floor membrane. A galvanized steel pipe extension shall be included in the top of the fitting that shall extend 50 mm (2 inches) above finished floor and galvanized steel pipe extension in the bottom of the fitting that shall extend through the floor slab. A waterproof caulked joint shall be provided at the top hub.

PART 3 - EXECUTION

3.1 PIPE INSTALLATION

A. The pipe installation shall comply with the requirements of the International Plumbing Code (IPC) and these specifications.
B. Branch piping shall be installed for waste from the respective piping systems and connect to all fixtures, valves, cocks, outlets, casework, cabinets and equipment, including those furnished by the Government or specified in other sections.
C. Pipe shall be round and straight. Cutting shall be done with proper tools. Pipe shall be reamed to full size after cutting.
D. All pipe runs shall be laid out to avoid interference with other work.
E. The piping shall be installed above accessible ceilings where possible.
F. The piping shall be installed to permit valve servicing or operation.
G. The piping shall be installed free of sags and bends.
H. Seismic restraint shall be installed where required by code.
I. Changes in direction for soil and waste drainage and vent piping shall be made using appropriate branches, bends and long sweep bends. Sanitary tees and short sweep quarter bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Long turn double wye branch and eighth bend fittings shall be used if two fixtures are installed back to back or side by side with common

drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow greater than 90 degrees. Proper size of standard increaser and reducers shall be used if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

J. Buried soil and waste drainage and vent piping shall be laid beginning at the low point of each system. Piping shall be installed true to grades and alignment indicated with unbroken continuity of invert. Hub ends shall be placed upstream. Required gaskets shall be installed according to manufacturer's written instruction for use of lubricants, cements, and other installation requirements.

K. Cast iron piping shall be installed according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings"

L. Aboveground copper tubing shall be installed according to Copper Development Association's (CDA) "Copper Tube Handbook".

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

3.2 JOINT CONSTRUCTION

A. Hub and spigot, cast iron piping with gasket joints shall be joined in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Hub and spigot, cast iron piping with calked joints shall be joined in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.

C. Hubless or No-hub, cast iron piping shall be joined in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless piping coupling joints.

D. For threaded joints, thread pipe with tapered pipe threads according to ASME B1.20.1. The threads shall be cut full and clean using sharp disc cutters. Threaded pipe ends shall be reamed to remove burrs and restored to full pipe inside diameter. Pipe fittings and valves shall be joined as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is required by the pipe service.

2. Pipe sections with damaged threads shall be replaced with new sections of pipe.

E. Copper tube and fittings with soldered joints shall be joined according to ASTM B828. A water flushable, lead free flux conforming to ASTM B813 and a lead-free alloy solder conforming to ASTM B32 shall be used.

3.3 SPECIALTY PIPE FITTINGS

A. Transition coupling shall be installed at pipe joints with small differences in pipe outside diameters.

B. Dielectric fittings shall be installed at connections of dissimilar metal piping and tubing.

3.4 PIPE HANGERS, SUPPORTS AND ACCESSORIES

A. All piping shall be supported according to the International Plumbing Code (IPC), Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, and these specifications. Where conflicts arise between these the code and Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING the most restrictive or the requirement that specifies supports with highest loading or shortest spacing shall apply.

B. Hangers, supports, rods, inserts and accessories used for pipe supports shall be painted according to Section 09 91 00, PAINTING. Electroplated copper hanger rods, hangers and accessories may be used with copper tubing.

C. Horizontal piping and tubing shall be supported within 300 mm (12 inches) of each fitting or coupling.

D. Horizontal cast iron piping shall be supported with the following maximum horizontal spacing and minimum hanger rod diameters:

1. 40 mm or DN40 to 50 mm or DN50 (NPS 1-1/2 inch to NPS 2 inch): 1500 mm (60 inches) with 10 mm (3/8 inch) rod.
2. 75 mm or DN75 (NPS 3 inch): 1500 mm (60 inches) with 15 mm (1/2 inch) rod.
3. 100 mm or DN100 to 125 mm or DN125 (NPS 4 inch to NPS 5 inch): 1500 mm (60 inches) with 18 mm (5/8 inch) rod.
4. 150 mm or DN150 to 200 mm or DN200 (NPS 6 inch to NPS 8 inch): 1500 mm (60 inches) with 20 mm (3/4 inch) rod.
5. 250 mm or DN250 to 300 mm or DN300 (NPS 10 inch to NPS 12 inch): 1500 mm (60 inch) with 23 mm (7/8 inch) rod.

E. The maximum spacing for plastic pipe shall be 1.22 m (4 feet).

F. Vertical piping and tubing shall be supported at the base, at each floor, and at intervals no greater than 4.6 m (15 feet).

G. In addition to the requirements in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, Floor, Wall and Ceiling Plates, Supports, Hangers shall have the following characteristics:

1. Solid or split unplated cast iron.
2. All plates shall be provided with set screws.
3. Height adjustable clevis type pipe hangers.
4. Adjustable floor rests and base flanges shall be steel.
5. Hanger rods shall be low carbon steel, fully threaded or threaded at each end with two removable nuts at each end for positioning rod and hanger and locking each in place.
6. Riser clamps shall be malleable iron or steel.
7. Rollers shall be cast iron.
8. See Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, for requirements on insulated pipe protective shields at hanger supports.

H. Miscellaneous materials shall be provided as specified, required, directed or as noted in the contract documents for proper installation of hangers, supports and accessories. If the vertical distance exceeds 6.1 m (20 feet) for cast iron pipe additional support shall be provided in the center of that span. All necessary auxiliary steel shall be provided to provide that support.

I. Cast escutcheon with set screw shall be provided at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.

J. Penetrations:

1. Fire Stopping: Where pipes pass through fire partitions, fire walls, smoke partitions, or floors, a fire stop shall be installed that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING. Clearances between raceways and openings shall be completely filled and sealed with the fire stopping materials.
2. Water proofing: At floor penetrations, clearances shall be completely sealed around the pipe and make watertight with sealant as specified in Section 07 92 00, JOINT SEALANTS.

K. Exhaust vents shall be extended separately through roof. Sanitary vents shall not connect to exhaust vents.

3.5 TESTS

A. Sanitary waste and drain systems shall be tested either in its entirety or in sections.

B. Waste System tests shall be conducted before trenches are backfilled or fixtures are connected. A water test or air test shall be conducted, as directed.

1. If entire system is tested for a water test, tightly close all openings in pipes except highest opening, and fill system with water to point of overflow. If the waste system is tested in sections, tightly plug each opening except highest opening of section under test, fill each section with water and test with at least a 3 m (10 foot) head of water. In testing successive sections, test at least upper 3 m (10 feet) of next preceding section so that each joint or pipe except upper most 3 m (10 feet) of system has been submitted to a test of at least a 3 m (10 foot) head of water. Water shall be kept in the system, or in portion under test, for at least 15 minutes before inspection starts. System shall then be tight at all joints.
2. For an air test, an air pressure of 34 kPa (5 psig) gauge shall be maintained for at least 15 minutes without leakage. A force pump and mercury column gauge shall be used for the air test.
3. After installing all fixtures and equipment, open water supply so that all p-traps can be observed. For 15 minutes of operation, all p-traps shall be inspected for leaks and any leaks found shall be corrected.
4. Final Tests: Either one of the following tests may be used.
   a. Smoke Test: After fixtures are permanently connected and traps are filled with water, fill entire drainage and vent systems with smoke under pressure of .25 kPa (1 inch of water) with a smoke machine. Chemical smoke is prohibited.
   b. Peppermint Test: Introduce 60 ml (2 ounces) of peppermint into each line or stack.

3.6 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

B. Components provided under this section of the specification shall be tested as part of a larger system.

3.7 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer’s technical representative for 4 hours to instruct each VA personnel responsible in operation and maintenance of the system.

B. Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

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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 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

D. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

E. Section 07 92 00, JOINT SEALANTS: Sealing between fixtures and other finish surfaces.

F. Section 08 31 13, ACCESS DOORS AND FRAMES: Flush panel access doors.

G. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

H. Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS: Requirements for commissioning, systems readiness checklist, and training.

I. Section 22 13 00, FACILITY SANITARY AND VENT PIPING.

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

A112.19.1-2013.....Enameled Cast Iron and Enameled Steel Plumbing Fixtures

A112.19.2-2013.....Ceramic Plumbing Fixtures

A112.19.3-2008.....Stainless Steel Plumbing Fixtures

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

A276-2013a.....Standard Specification for Stainless Steel Bars and Shapes

B584-2008.....Standard 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 500-2006.....Metal Finishes Manual

G. NSF International (NSF):

14-2013.....Plastics Piping System Components and Related Materials

61-2013.....Drinking Water System Components – Health Effects

372-2011.....Drinking Water System Components – Lead Content

H. American with Disabilities Act (A.D.A)

I. International Code Council (ICC):

IPC-2015.....International Plumbing Code

1.4 SUBMITTALS

A. Submittals, including number of required copies, will be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Information and material submitted under this section will 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.

E. Completed System Readiness Checklist provided by the CxA and completed by the Contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

F. Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

1.5 QUALITY ASSURANCE

A. 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 will be in electronic version on compact disc or DVD. 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 will be included in the operation and maintenance manual. The operations and maintenance manual will include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices such as damper and door closure interlocks will be included. A List of recommended spare parts (manufacturer, model number, and quantity) will be furnished. Information explaining any special knowledge or tools the owner will be required to employ will be inserted into the As-Built documentation.

C. The installing contractor will maintain as-built drawings of each completed phase for verification; and will 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 2018 provided on compact disk or DVD. Should the installing contractor engage the testing company to provide as-built or any portion thereof, it will not be deemed a conflict of interest or breach of the 'third party testing company' requirement.

D. Certification documentation will be provided to COR 10 working days prior to submitting the request for final inspection. The documentation will 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 will be certified in accordance with NSF 61 or NSF 372. Endpoint devices used to dispense water for drinking will meet the requirements of NSF 61.

B. Plastic pipe, fittings, and solvent cement will meet NSF 14 and will be NSF listed for the service intended.

2.2 STAINLESS STEEL

A. Corrosion-resistant Steel (CRS):

1. Plate, Sheet and Strip: CRS flat products will conform to chemical composition requirements of any 300 series steel specified in ASTM A276.
2. Finish: Exposed surfaces will 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 lock-shield loose key or screw driver pattern angle stops, straight stops or stops integral with faucet, with each compression type faucet whether specifically called for or not, including sinks in solid-surface, wood and metal casework, laboratory furniture and pharmacy furniture. Locate stops centrally above or below fixture in accessible location.

B. Furnish keys for lock shield stops to the COR.

C. Supply from stops not integral with faucet will 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 will be rigid threaded IPS copper alloy pipe, i.e. red brass pipe nipple, chrome plated where exposed.

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 will provide non-aeration, clear, coherent laminar flow that will not splash in basin. Device will 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.
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 SINKS

A. Dimensions for sinks are specified, length by width (distance from wall) and depth.

B. (P-502) Service Sink (Corner, mounted) stain resistant terrazzo, 711 mm by 711 mm by 305 mm (28 inches by 28 inches by 12 inches) with 152 mm (6 inches) drop front. Terrazzo, composed of marble chips and white Portland cement, will develop compressive strength of 20684 kPa (3000 psig) seven days after casting. Provide extruded aluminum cap on front side.

1. Faucet: Solid brass construction, 9.5 L/m (2.5 gpm) combination faucet with replaceable Monel seat, removable replacement unit containing all parts subject to wear, integral check/stops, mounted on wall above sink. Spout will have a pail hook, 19 mm (3/4 inch) hose coupling threads, vacuum breaker, and top or bottom brace to wall. Four-arm handles on faucets will be cast, formed, or drop forged copper alloy. Escutcheons will be either forged copper alloy or CRS. Exposed metal parts, including exposed part under valve handle when in open position, will have a smooth bright finish. Provide 914 mm (36 inches) hose with wall hook. Centerline of rough in is 1219 mm (48 inches) above finished floor.

2. Drain: Seventy-six millimeter (3 inches) cast brass drain with nickel bronze strainer.
3. Trap: P-trap, drain through floor.

C. (P-503) Service Sink (Regular, Foot Pedal Control, ASME A112.19.1, Class 1) single bowl, acid resistant enameled cast iron, approximately 610 mm by 508 mm (24 inches by 20 inches) with 229 to 305 mm (9 to 12 inches) raised back without faucet holes. Equip sink with CRS rim guard. Mount sink on trap standard.

1. Faucet: Solid brass connection, 9.5 L/m (2.5 gpm) horizontal swing spout with escutcheon mounted on wall above sink. Mechanical pedal mixing valve with self-closing pedal valve with check/stops, renewable Monel seats, removable replacement unit containing all parts subject to wear, and supply from valve to spout, indexed lift up pedals having clearance of not more than 13 mm (1/2 inch) above the floor and not less than 356 mm (14 inches) from wall when in operation. Supply pipe from wall to valve stop will be rigid threaded IPS copper alloy pipe. Supply pipe from valve to faucet will be copper alloy pipe. Supply pipe from valve to faucet will be manufacturer's option. Exposed brass parts will be chromium plated with a smooth bright finish.
2. Drain: Seventy-six millimeter (3 inches) cast brass with nickel bronze strainer.
3. Trap: Trap standard, painted outside and enameled inside with acid-resistant enamel, drain through adjoining wall.

D. (P-527) Cook’s Sink (CRS, Single Compartment with Legs) 14 gage CRS, single bowl with raised back, approximately 635 mm by 559 mm by 356 mm (25 inches by 22 inches by 14 inches) deep, base with legs.

1. Faucet: Solid brass construction, combination faucet with replaceable Monel seat, removable replacement unit containing all parts subject to wear, vacuum breaker, integral stops, mounted on splash back. Lever handles on faucet will be cast, formed or drop forged copper alloy. Escutcheons will be either forged copper alloy or CRS. Exposed metal parts, including exposed part under valve handle when in open position, will have a smooth bright finish.
2. Drain: Drain plug with strainer, stainless steel.
3. Trap: Cast copper alloy, 38 mm (1 1/2 inches) P-trap. Adjustable with connected elbow and nipple to wall and escutcheon.

4. Provide cover for exposed piping, drain, stops and trap per A.D.A.

2.7 EMERGENCY FIXTURES

A. (P-707) Emergency Shower and Eye and Face Wash (Free Standing):
   1. Shower Head: Polished chrome plated, 203 mm (8 inches) in diameter, install head 2134 mm (84 inches) above floor. Equip with stay-open ball valve, chrome plated. Operate valve with 610 mm (24 inches) stainless steel pull-rod with triangle handle. Pull-down opens valve; push-up closes valve. Flow rate will be 75.7 L/m (20 gpm).
   2. Emergency Eye and Face Wash: CRS receptor. Equipment with a 13 mm (1/2 inch) stay open ball valve operated by push flag handle. Mount eye and face wash spray heads 1067 mm (42 inches) above finished floor. Flow rate will be 11.4 L/m (3 gpm).
   3. Provide with thermostatic mixing valve to provide tepid water from 30 to 35 degrees C (85 to 95 degrees F).
   4. Shower head and emergency eye and face wash will be mounted to stanchion with floor flange through floor waste connection and P-trap. Paint stanchion same color as room interior. Provide with signage to easily locate fixture.

B. (P-708) Emergency Eye and Face Wash (Wall Mounted): CRS, wall mounted, foot pedal control. Mount eye and face wash spray heads 1067 mm (42 inches) above finished floor. Pedal will be wall mounted, entirely clear of floor, and be hinged to permit turning up. Receptor will be complete with drain plug with perforated strainer, P-trap and waste connection to wall with escutcheon. Provide with thermostatic mixing valve to provide tepid water from 30 to 35 degrees C (85 to 95 degrees F). Flow rate will be 11.4 L/m (3 gpm).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fixture Setting: Opening between fixture and floor and wall finish will be sealed as specified under Section 07 92 00, JOINT SEALANTS. Bio-based materials will 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 will be hexagonal, polished chrome plated brass with rounded tops.

C. Toggle Bolts: For hollow masonry units, finished or unfinished.

D. Expansion Bolts: For brick or concrete or other solid masonry. Will 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.

E. Power Set Fasteners: May be used for concrete walls, will be 6 mm (1/4 inch) threaded studs, and will extend at least 32 mm (1 1/4 inches) into wall.

F. Tightly cover and protect fixtures and equipment against dirt, water and chemical or mechanical injury.

G. Aerators are prohibited on sinks.

H. If an installation is unsatisfactory to the COR, the Contractor will 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 will be thoroughly cleaned.

3.3 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

B. Components provided under this section of the specification will be tested as part of a larger system.

3.4 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer’s technical representative for four hours to instruct VA Personnel in operation and maintenance of the system.

B. Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

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05-01-23

SECTION 22 63 00
GAS SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Central Laboratory and Healthcare Gas Systems: Consisting of oxygen, nitrous oxide, nitrogen, and compressed air services; complete, ready for operation, including all necessary piping, fittings, valves, cabinets, station outlets, rough-ins, ceiling services, gages, alarms including low voltage wiring, nitrogen control panels, cylinder manifolds, air compressors, electric motors and starters, air dryers, filters, pressure regulators, dew point monitor, carbon monoxide monitor and all necessary parts, accessories, connections and equipment. Match existing station outlet and inlet terminal connections.

B. Oxygen System: Ready for connection to outside bulk supply tank, but not including tank.

C. Oxygen System: Provide bulk oxygen system consisting of primary liquid tank, reserve liquid tank, vaporizers, alarms including all low voltage wiring, and automatic controls including all interconnecting control and power wiring. Connect to bulk supply main at outside bulk tank farm.

D. Nitrous Oxide and Nitrogen Systems: Ready for connection to cylinders, but not including cylinders.

E. Supply Lines Outside of Building (including PVC protective pipe): As specified in this Section.

F. Laboratory and healthcare gas system alarm wiring from equipment to alarm panels.

G. 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 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

D. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

E. Section 07 84 00, FIRESTOPPING: Sealing around pipe penetrations to maintain the integrity of time rated construction.

F. Section 07 92 00, JOINT SEALANTS: Sealing around pipe penetrations through the floor to prevent moisture migration.

G. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Seismic Restraint.

H. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING: General requirements and items common to more than one section of Division 22.

I. SECTION 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS: Requirements for commissioning, systems readiness checklist, and training.

J. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC: Alarm interface with BAS.

K. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Control wiring.

L. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduit.

M. Section 26 27 26, WIRING DEVICES: Electrical wiring and accessories.

1.3 APPLICABLE PUBLICATIONS

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

B. American Society of Mechanical Engineers (ASME):

A13.1-2007 (R2013).....Scheme for the Identification of Piping Systems

B16.15-2013.....Cast Copper Alloy Threaded Fittings: Classes 125 and 250

B16.22-2013.....Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings

B16.50-2013.....Wrought Copper and Copper Alloy Braze-Joint Pressure Fittings

B40.100-2013.....Pressure Gauges and Gauge Attachments

ASME Boiler and Pressure Vessel Code -

BPVC Section VIII-2015..Rules for Construction of Pressure Vessels, Division I

BPVC Section IX-2015....Welding, Brazing, and Fusing Qualifications

C. American Society of Sanitary Engineers (ASSE):

6000 Series-2012.....Professional Qualifications Standard for Medical Gas Systems Personnel

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

B43-2014.....Standard Specification for Seamless Red Brass Pipe, Standard Sizes

B687-1999 (2011).....Standard Specification for Brass, Copper, and Chromium-Plated Pipe Nipples

B819-2000 (R2011).....Standard Specification for Seamless Copper Tube for Medical Gas Systems

D1785-2012.....Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

E. American Welding Society (AWS):

A5.8M/A5.8-2011.....Specification for Filler Metals for Brazing and Braze Welding

B2.2/B2.2M-2010.....Specification for Brazing Procedure and Performance Qualification

F. Compressed Gas Association (CGA):

C-9-2013.....Standard Color Marking of Compressed Gas Containers for Medical Use

G-4.1-2009.....Cleaning Equipment for Oxygen Service

G-10.1-2008.....Commodity Specification for Nitrogen

P-9-2008.....The Inert Gases: Argon, Nitrogen, and Helium

V-1-2013.....Standard for Compressed Gas Cylinder Valve Outlet and Inlet Connections

G. Manufacturing Standardization Society (MSS):

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

H. National Electrical Manufacturers Association (NEMA):

ICS 6-1993 (R2001, R2006) Industrial Control and Systems Enclosures

I. National Fire Protection Association (NFPA):

99-2015.....Health Care Facilities 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. Medical Gas Partnering and Quality Control Plan
   1. Identifies all stakeholders early in the project to partner together and develop a communication strategy that is productive and effective.
   2. Requires the 3 Phases of Quality Control
      a. Preparatory Phase – review contract requirements and necessary communication before execution of each portion of work.
      b. Initial Phase – Ensure the employees completing the work are qualified and executing as expected
      c. Follow Up Phase – Check in on the work repeatedly to ensure continued compliance
   3. Provides installer certifications for approval,
   4. Provides Verifiers Credentials for approval
   5. Provides Certifiers Credentials for approval
   6. Includes all Quality control processes, procedures and daily documentation to be used during installation.
   7. Outlines a process that clearly documents and demonstrates a nitrogen atmosphere is obtained and maintained within the piping throughout the installation process until final certification and activation.
   8. Outlines post installation/precertification blowdown procedures to ensure a sufficient volume and velocity of gas is expelled to carry any particulate through the entire system during the blowdown/white rag test. This test shall be witnessed by the COR and appropriate stakeholders.

C. Information and material submitted under this section shall be marked “SUBMITTED UNDER SECTION 22 63 00, GAS SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES”, with applicable paragraph identification.

D. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.
   1. Piping.
   2. Valves.
   3. Inlet and outlet cocks
   4. Valve cabinets.

5. Gages.
6. Station outlets and rough-in assemblies.
7. Ceiling services.
8. Alarm controls and panels.
9. Pressure Switches.
10. Manifolds.
12. Air compressor systems (Provide certified compressor test data at startup.):
    a. Compressors: Manufacturer and model.
    b. Characteristic performance curves.
    c. Compressor operating speed (RPM).
    d. Capacity: Free air delivered at indicated pressure (L/s) (SCFM).
    e. Type of bearing in compressor.
    f. Type of lubrication.
    g. Type and adjustment of drive.
    h. Electric motors: Manufacturer, frame and type.
    i. Speed of motors (RPM).
    j. Current characteristics and horsepower of motors.
    k. Receiver capacity and rating.
    l. Air silencer: Manufacturer, type and model.
    m. Air filters: Manufacturer, type, model and capacity.
    n. Pressure regulators: Manufacturer and capacity.
    o. Dew point monitor: Manufacturer, type and model.
    p. Air dryers: Manufacturer, type, model and capacity (L/s) (SCFM).
    q. Carbon monoxide monitor manufacturer, type and model.
    r. Aftercoolers.

E. Station Outlets: Submit letter from manufacturer stating that outlets are designed and manufactured to comply with NFPA 99. Outlet shall bear label of approval as an assembly, of Underwriters Laboratories, Inc., or Associated Factory Mutual Research Corporation.

F. Certification: The completed systems have been installed, tested, purged, analyzed and verified in accordance with the requirements of this specification. Certification shall be submitted to COR.

G. 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.

H. Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

I. Submit one physical sample of a typical brazed joint for each approved installer to be compared against their installed work as a Quality assurance measure.

J. Documentation of conditions while work is performed
   1. Daily reports, photos, uncapped piping, nitrogen pressures, Oxygen concentrations and all preapproved Pipefitter's names and all locations brazed by that individual each workday etc.
   2. All copies of verification reports documenting compliance with NFPA99 during construction.
   3. Delivery tickets for nitrogen gas deliveries.
   4. Installation equipment calibration certificates.

1.5 QUALITY ASSURANCE

A. Materials and Installation: In accordance with NFPA 99 and as specified.

B. Equipment Installer: Show technical qualifications and previous experience in installing laboratory and healthcare equipment on three similar projects. Submit names, phone numbers, and addresses of referenced projects. Installers shall meet the qualifications of ASSE Standard Series 6000.

C. Equipment Supplier: Provide evidence of equivalent product installed at three installations similar to this project that has been in satisfactory and efficient operation for three years. Submit names, phone numbers, and addresses where the product is installed.

D. Laboratory and healthcare System Testing Organization: The testing shall be conducted by a party technically competent and experienced in the field of laboratory and healthcare pipeline testing. Testing and systems verification shall be performed by personnel meeting the qualifications of ASSE Standard Series 6000. Such testing shall be performed by a party other than the installing contractor.

E. Provide the names of three projects where testing of medical or laboratory gases systems has been performed by the testing agency.

Include the name of the project, names of such persons at that project who supervised the work for the project owner, or who accepted the report for the project owner, and a written statement that the projects listed required work of similar scope to that set forth in this specification.

F. Submit the testing agency's detailed procedure which shall be followed in the testing of this project. Include details of the testing sequence, procedures for cross connection tests, outlet function tests, alarm tests, purity tests, etc., as required by this specification. For purity test procedures, include data on test methods, types of equipment to be used, calibration sources and method references.

G. Certification: Provide COR documentation 10 working days prior to submitting request for final inspection to 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 allowed by this specification.

H. “Hot taps” are prohibited for operating medical oxygen systems. Methods for connection and extension of active and pressurized medical gas systems without subsequent medical gas testing and verification are prohibited.

I. 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 ____ provided on compact disk or DVD. Should the installing contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement.

D. Certification documentation shall be provided to COR 10 working days prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and certification that all results of tests were within limits specified.

PART 2 - PRODUCTS

2.1 PIPING AND FITTINGS

A. Copper Tubing: Type "K", ASTM B819, seamless copper tube, hard drawn temper, with wrought copper fittings conforming to ASME B16.22 or brazing fittings complying with ASME B16.50. Size designated reflecting nominal inside diameter. All tubing and fittings shall be labeled "ACR/OXY", "OXY", "OXY/MED", "ACR/MED", or "MED".

B. Brazing Alloy: AWS A5.8M/A5.8, Classification BCuP, greater than 538 degrees C (1000 degrees F) melting temperature. Flux is strictly prohibited for copper-to-copper connections.

C. Threaded Joints: Polytetrafluoroethylene (Teflon) tape.

D. Underground Protective Pipe: Polyvinyl Chloride (PVC), ASTM D1785, Schedule 80.

E. Memory metal couplings: Temperature and pressure rating shall not be less than that of a brazed joint in accordance with NFPA 99, paragraph 5.1.10.6.1.

F. Apply piping identification labels at the time of installation in accordance with NFPA 99. Apply supplementary color identification in accordance with CGA Pamphlet C-9.

G. Special Fittings: The following special fittings shall be permitted to be used in lieu of brazed joints:

1. Memory-metal couplings having temperature and pressure ratings joints not less than that of a brazed joint.
2. Listed or approved metallic gas tube fittings that, when made up, provide a permanent joint having the mechanical, thermal, and sealing integrity of a brazed joint.
3. Dielectric fittings where required by the manufacturer of special medical equipment to electrically isolate the equipment from the piping distribution system.
4. Axially swaged, elastic strain preload fittings providing metal to metal seal having pressure and temperature ratings not less than that of a brazed joint and when complete are permanent and non-separable.

2.2 EXPOSED LABORATORY AND HEALTHCARE GASES PIPING

A. Finished Room: Use iron pipe size (IPS) chrome plated brass or stainless steel piping for exposed laboratory and healthcare gas 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: Fittings shall comply with ASME B16.15 cast bronze threaded fittings with chrome finish (125 and 250 psig Classes).
3. Nipples: Nipples shall comply with ASTM B687, chromium-plated.
4. Unions: Unions shall comply with MSS SP-72, MSS SP-110, brass or bronze with chrome finish. Unions 65 mm (2-1/2 inches) and greater shall be flange type with approved gaskets.
5. Valves: Valves shall comply with MSS SP-72, MSS SP-110, brass or bronze with chrome finish.

2.3 VALVES

A. Ball: In-line, other than zone valves in cabinets:

1. 75 mm (3 inches) and smaller: Bronze/ brass body, MSS SP-72, MSS SP-110, Type II, Class 150, Style 1, with tubing extensions for brazed connections, full port, three-piece or double union end connections, Teflon seat seals, full flow, 4138 kPa (600 psig) WOG minimum working pressure, with locking type handle, cleaned for oxygen use and labeled for intended service.
2. 75 to 100 mm (3 to 4 inches): Bronze/ brass body, MSS SP-72 MSS SP-110, Type II, Class 150, Style 1 with tubing extensions brazed to flanges, full port, three piece, double seal, Teflon seals, full flow, 4138 kPa (600 psig) WOG minimum working pressure, with locking type handle, cleaned for oxygen use and labeled for intended service.

B. Check:

1. 75 mm (3 inches) and smaller: Bronze/brass body, straight through design for minimum pressure drop, spring loaded, self-aligning with Teflon cone seat, vibration free, silent operation, supplied NPT female threads at each end with flow direction arrow permanently cast into, cleaned for oxygen use and labeled for intended service, 2758 kPa (400 psig) WOG minimum working pressure.
2. 100 mm (4 inches) and larger: Iron body, bronze trim, swing type, vertical or horizontal installation, flange connection, with flow direction arrow permanently cast into, cleaned for oxygen use and labeled for intended service, 1035 kPa (150 psig) WSP.

C. Zone Valve in Cabinet: Ball valve, bronze/ brass body, double seal, three piece or double union end connections, replaceable Teflon seat seals, Teflon stem seal, 4138 kPa (600 psig) WOG, cold, non-shock gas working pressure service to 100 kPa (29 inches Hg), cleaned for oxygen use and labeled for intended service, blowout proof stem, one quarter turn of handle to completely open or close. Provide tubing extensions factory brazed, and pressure tested. Provide 3.2 mm (1/8 inch) NPT gauge port for a 50 mm (2 inch) diameter monitoring gauge downstream of the shut off valve. Zone valves shall be securely attached to the cabinet and provided with type “K” copper tube extensions for making connection to system piping outside the cabinet. Zone valves shall be

products of one manufacturer, and uniform throughout in pattern, overall size and appearance. Trim with color coded plastic inserts or color coded stick-on labels. Install valves in cabinets such that cover window cannot be in place when any valve is in the closed position. Color coding for identification plates and labels is as follows:

SERVICE LABEL	IDENTIFICATION COLORS	MFG. STD. CLR.
OXYGEN	White letters on green background	GREEN
NITROUS OXIDE	White letters on blue background	BLUE
NITROGEN	White letters on black background	BLACK
MEDICAL AIR	Black letters on yellow background	YELLOW
CARBON DIOXIDE	Black or white letters on gray background	GRAY

2.4 VALVE CABINETS

A. Flush mounted commercially available item for use with laboratory and healthcare services, not lighter than 1.3 mm (18 gage) steel or 1.9 mm (14 gage) extruded aluminum, rigidly assembled, of adequate size to accommodate valve(s) and fittings. Punch or drill sides to receive tubing. Provide anchors to secure cabinet to wall construction. Seal openings in cabinet to be dust tight. Locate bottom of cabinet 1375 mm (4 feet 6 inches) above finished floor.

B. Mount engraved rigid plastic identification plate on wall above or adjacent to cabinet. Color code identification plate to match gas identification colors as indicated above. Identification plate shall be clearly visible at all times. Provide inscriptions on plate to read in substance: "VALVE CONTROL SUPPLY TO ROOMS."

C. Cover plate: Fabricate from 1.3 mm (18 gage) sheet metal with satin chromed finish, extruded anodized aluminum, or 0.85 mm (22 gage) stainless steel. Provide cover window of replaceable plastic, with a corrosion resistant device or lever secured to window for emergency window removal. Permanently paint or stencil on window: CAUTION-CLOSE ONLY IN EMERGENCY, SHUT-OFF VALVES FOR PIPED GASES", or equivalent wording. Configure such that it is not possible to install window with any valve in the closed position. Each valve shall have gauge upstream of valve inside valve box.

D. Cabinets and isolation valves shall be located and piped as shown on drawings, and at a minimum, so as to allow the isolation of each smoke compartment separately. No cabinet shall serve more than one smoke compartment.

2.5 GAGES

A. Pressure Gages: Includes gages temporarily supplied for testing purposes.

1. For line pressure use adjacent to source equipment: ASME B40.1, pressure gage, single, size 115 mm (4-1/2 inches), for compressed air, nitrogen and oxygen, accurate to within 2 percent, with metal case. Range shall be two times operating pressure. Dial graduations and figures shall be black on a white background, or white on a black background. Gage shall be cleaned for oxygen use, labeled for appropriate service, and marked "USE NO OIL". Install with gage cock.
2. For all services downstream of main shutoff valve: Manufactured for oxygen use, labeled for the appropriate service and marked "USE NO OIL", 40 mm (1-1/2 inch) diameter gage with dial range 1 to 690 kPa (1 to 100 psig) for air service.

2.6 STATION OUTLETS

A. For all services except ceiling hose drops and nitrogen system: For designated service, consisting of a quick coupler and inlet supply tube. Provide coupler that is non-interchangeable with other services, and leak proof under three times the normal working pressure. Equip each station outlet with an automatic valve and a secondary check valve to conform with NFPA 99. Equip each station inlet with an automatic valve to conform with NFPA 99. Place valves in the assembly to provide easy access after installation for servicing and replacement, and to facilitate line blow-out, purging, and testing. Fasten each outlet and inlet securely to rough-in to prevent floating and provide each with a capped stub length of 6 mm (1/4-inch) (10 mm outside diameter) (3/8-inch outside diameter) tubing for connection to supply. Identification of each gas service shall be permanently cast into the back plate and shall be visible through a transparent plastic guard. Label stub tubing for appropriate service. Rough-in kits and test plugs for PBPU are furnished under this specification but installed by manufacturer of

PBPU before initial test specified herein. Install completion kits (valve body and face plate) for the remainder of required tests.

B. For Ceiling Hose Drops and Nitrogen Service: Brass, stainless steel or chromed metal non-interchangeable DISS connections for appropriate service to conform with CGA V-5. Equip each station outlet with an automatic valve and a secondary check valve to conform with NFPA 99. Equip each station inlet with an automatic valve to conform with NFPA 99. Place valves in the assembly to provide easy access after installation, for servicing and replacement, and to facilitate line blow-out, purging, and testing. Fasten each outlet and inlet securely to rough-in to prevent floating, and provide each with a capped stub length of 6 mm (1/4-inch) (10 mm (3/8-inch) outside diameter) tubing for connection to supply. Label stub tubing for appropriate service. Adjust to compensate for variations in plaster or cover thickness.

2.7 STATION OUTLETS

A. For all services: Brass, stainless steel or chromed metal non-interchangeable DISS connections for appropriate service to conform with CGA V-5. Equip each station outlet with an automatic valve and a secondary check valve to conform with NFPA 99. Equip each station inlet with an automatic valve to conform with NFPA 99. Place valves in the assembly to provide easy access after installation, for servicing and replacement, and to facilitate line blow-out, purging, and testing. Fasten each outlet securely to outlet rough-in to prevent floating, and provide each outlet with a capped stub length of 6 mm (1/4-inch) (10 mm (3/8-inch) outside diameter) tubing for connection to supply. Label stub tubing for appropriate service. Adjustable to compensate for variations in plaster or cover thickness. Rough-in kits and test plugs for PBPU are furnished under this specification but installed by manufacturer of PBPU before initial tests specified herein. Install outlet completion kits (valve body and face plate) for the remainder of required tests.

2.8 STATION OUTLET ROUGH-IN

A. Anchor flush mounted rough-in securely to unit or wall construction.

B. Modular Cover Plate: Die cast back plate, two-piece 0.85 mm (22 gage) stainless steel or 1.6 mm (16 gage) chromium plated metal, with

mounting flanges on all four sides, secured to rough-in with stainless steel or chromium plated countersunk screws.

C. Cover Plate for PBPU: One-piece with construction and material as indicated for modular cover plate.

D. Provide permanent, metal or plastic, identification plates securely fastened at each outlet and inlet opening, with inscription for appropriate service using color coded letters and background. Metal plates shall have letters embossed on baked-on enamel background. Color coding for identification plates is as follows:

SERVICE LABEL	IDENTIFICATION PLATE COLORS
OXYGEN	White letters on green background and vice versa
NITROUS OXIDE	White letters on blue background
NITROGEN	White letters on black background
MEDICAL AIR	Black letters on yellow
CARBON DIOXIDE	White letters on gray background

2.9 ALARMS

A. Provide all low voltage control wiring, including wiring from alarm relay interface control cabinet to BAS, required for complete, proper functioning system, in conformance with Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES. Run wiring in conduit, in conformance with Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.

B. Local Alarm Functions: Provide individual local air compressor malfunction alarms at each compressor system main control panel.

1. Compressor Malfunction Alarm: Each compressor system receiving any of the following individual signals and sends a single combined "compressor malfunction alarm" signal to master alarm panel.

a. Thermal Malfunction Alarm: Functions when discharge air temperature exceeds 177 degrees C (350 degrees F), shutting down affected compressor.

b. Lead Compressor Fails to Start: Functions when lead compressor fails to start when actuated, causing lag pump to start.

c. Lag Compressor In Use: Functions when the primary or lead compressor is incapable of satisfying the demand. When three or

more compressors are part of the system, the lag compressor in use alarm shall energize when the last compressor has been signaled to start.

d. High Water Level in Receiver (liquid ring or water-cooled units).

e. High Water Level in Separator (if so required) (liquid ring unit).

2. Desiccant Air Dryer Malfunction Alarm: Dryer receives the following individual signals and sends a single consolidated dryer malfunction alarm signal to master alarm panel.

a. Dew Point Alarm: Functions when line pressure dew point rises above 4 degrees C (40 degrees F) at 380 kPa (55 psig).

3. Vacuum Pump Malfunction Alarm: Pump system receives the following individual signals and sends a single consolidated pump malfunction alarm signal to master alarm panel.

a. High Temperature Shut down Alarm: Functions when exhaust air temperature exceeds 104 degrees C (220 degrees F), shutting down affected pump.

b. Lead Pump Fails to Start Alarm: Functions when lead pump fails to start when actuated causing lag pump to start.

c. Lag Pump In Use Alarm: Functions when the primary or lead vacuum pump in incapable of satisfying the demand. When three or more vacuum pumps are part of the system, the lag pump in use alarm shall energize when the last vacuum pump has been signaled to start.

4. Waste Anesthetic Gas Disposal (WAGD) Lag In Use Alarm: Provide when a central WAGD system is used. The signal shall be manually reset.

5. Instrument Air Dew Point High: Functions when the line pressure dew point is greater than -30 degrees C (-22 degrees F).

C. Master Alarm Functions: Provide the following individual alarms at the master alarm panel.

1. Compressed Air Alarms:

a. Medical air dew point high alarm: Functions when the line pressure dew point rises above 2 degrees C (35 degrees F) at 380 kPa (55 psig).

b. Carbon Monoxide Alarm: Functions when the carbon monoxide levels rise above 10 parts per million; receives signal from the carbon monoxide monitor.

c. Main Bank Filter Set Alarm: Functions when the pressure drop across filter set increases more than 14 kPa (2 psig) over that when filters are clean and new; operates by differential pressure switch or transmitters.

d. Desiccant Prefilter Alarm: Functions when pressure across the filter increases more than 21 kPa (3 psig) over that when filters are clean and new; operates by pressure differential switch.

e. Desiccant Post Filter Alarm: Functions when pressure drop across filter increases more than 21 kPa (3 psig) over that when filters are clean and new; operates by pressure differential switch.

f. Desiccant Dryer Malfunction Alarm: Functions on any combination of failure of tower cycling and/or pressure dew point rise above 60 degrees C at 690 kPa (140 degrees F at 100 psig).

g. Aftercooler High temperature Alarm: Functions when aftercooler discharge air temperature exceeds 38 degrees C (100 degrees F).

h. Pressure Abnormal Alarm: Functions when system pressure downstream of main shutoff valve drops below 550 kPa (80 psig) (± gage or increases above 830 kPa (120 psig) (±14 kPa (±2 psig) set points; operated by pressure switch.

i. Compressor Malfunction Alarm: Functions when compressor system control panel signals compressor thermal malfunction alarm, lead compressor fails to start alarm or high water level in receiver or separator (if so required) receives signal from system control panel.

j. Low Lubricant Shutdown: For rotary screw compressors. Functions when lubricant level drops to a low point. Receives signal from compressor control panel.

k. Instrument air dew point high alarm: Functions when the line pressure dew point rises above -30 degrees C (-22 degrees F) at 380 kPa (55 psig).

D. Alarm Functions:

1. Oxygen, nitrous oxide, carbon dioxide and compressed air alarms: Pressure alarms: Functions when pressure in branch drops below 275

kPa (40 psig), ±14 kPa (±2 psig) or increases above 414 kPa (60 psig), ±14 kPa (±2 psig) set points; operated by pressure switches or transmitters.

E. Alarm Panels:

1. General: Modular design, easily serviced and maintained; alarms operate on alternating current (AC) low voltage control circuit; provide required number of transformers for efficient functioning of complete system. Alarm panels shall be integral units, reporting [insert special gas here], compressed air and vacuum services, as required.
2. Box: Flush mounted, sectional or one piece, corrosion resistant. Size box to accommodate required number of service functions for each location, and for one audible signal in each box. Anchor box securely. Provide spare capacity to accommodate 50 percent of the number of provided alarm points.
3. Cover plate: Designed to accommodate required number of signals, visual and audible, for each location, and containing adequate operating instructions within the operator's view. Bezel shall be extruded aluminum, chromium plated metal, or plastic. Secure to the box with chromium plated or stainless steel countersunk screws.
4. Service indicator lights: Red translucent plastic or LED with proper service identification inscribed thereon. Number of lights and service instruction shall be as required for each location. Provide each panel with a green test button of the same material, inscribed with "PUSH TO TEST" or similar message.
5. Audible signal: Provide one in each alarm panel and connect electrically with all service indicator light functions.
6. Controls:
   a. Visual signal: When the condition occurs which any individual service indicator light is to report, button for particular service shall give a lighted visual signal which cannot be canceled until such condition is corrected.
   b. Audible signal: Alarm shall give an audible signal upon circuit energization of any visual signal. Audible signal shall be continuous until silenced by pushing a button. This shall cancel

and reset audible only, and not affect the visual signal. After silencing, subsequent alarms shall reactivate the audible alarm.

c. Signal tester: Test button or separate normal light shall be continuously lighted to indicate electrical circuit serving each individual alarm is energized. Pushing test button shall temporarily activate all visual signals and sound audible signal, thereby providing desired indications of status of system.

F. Alarm Relay Interface Control Cabinet: Design cabinet to transfer the closed circuit alarm signals through relays to a set of terminals for monitoring signals at the BAS without interrupting the closed circuit system. Constructed of 1.9 mm (14 gage) steel, conforming with NEMA ICS 6, Type 1, enclosures. Provide both normally open and normally closed contacts for output signals, with number of circuits required for full alarm capability at the BAS. Refer to Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC for compatibility.

G. Alarm Network Communication: Network communications board shall be installed in local alarm and connected to the contractor supplied network facility’s Ethernet. Local alarm modules shall send information to the master alarm and the data can be downloaded thru the computer connected to the contractor supplied network facility’s Ethernet. Master alarm displays the message, sounds its alarm and saves the information in an event log. This event log shall be downloaded to a computer file for tracking data and troubleshooting.

2.10 PRESSURE SWITCHES

A. General purpose, contact or mercury type, allowing both high and low pressure set points, with contact type provided with a protective dust cover; adjustable range; switches activate when indicated by alarm requirements. Use one orifice nipple (or DISS demand check valve) for each sensor or pressure switch.

2.11 AIR COMPRESSOR SYSTEMS

A. System Design: The laboratory air system shall be of a modular base mounted design consisting of multiplex triplex duplex compressor, dryer/control, and an air receiver. Each unit shall be fully compliant with the latest edition of NFPA 99.

B. Compressors: Continuous duty rated “oil-less” type with permanently lubricated, sealed bearings. Single stage design, air cooled,

reciprocating type with corrosion resistant reed type valves with stainless steel reeds. Both the compression rings and rider rings shall be made from a long life, fluororesin material designed for continuous duty operation. The crankshaft shall be constructed of a durable nodular graphite cast iron and designed to be fully supported on both ends by heavy duty ball bearings permanently lubricated and sealed. The crankcase shall be constructed of gray cast iron. Maximum heat dissipation shall be achieved through cast aluminum alloy cylinders treated for optimum corrosion and wear resistance. Cylinder sleeves shall not be required. Additionally, heat transmission from the piston wall to the piston pin needle bearing shall be minimized by an insulated "heat cut" piston pin. The connecting rod shall be of a one piece design for maximum reliability. Bio-based materials shall be utilized when possible.

C. Compressor Drive and Motor: V-belt driven through a combination flywheel/sheave and steel motor sheave with tapered bushing and protected by an OSHA approved, totally enclosed belt guard. Belt tensioning shall be achieved by a pivoting motor mounting base that is fully adjustable through twin adjusting screws. The motor shall be a NEMA rated, open-drip-proof, 1800 RPM, with 1.15 service factor.

D. Intake Piping: Provide a pre-piped intake manifold with one inlet air filter with threaded opening for remote intake connection. Isolate filter housing from the intake manifold with a braided 304 stainless steel flex connector.

E. Discharge Piping: Provide an integral air cooled aftercooler designed for a maximum approach temperature of -11 degrees C (12 degrees F) complete with moisture separator and timed automatic solenoid drain valve with a manual drain value by-pass. Provide each cylinder head with a pre-wired high discharge air temperature shutdown switch. Include a flex connector, safety relief valve, and check valve. The compressor discharge line the piping shall be of ASTM B819 copper tubing, brass, and/or stainless steel. The discharge flex connector shall be braided 304 stainless steel, brass or bronze.

F. Isolation System: Isolate the compressor and monitor from the main compressor module base by means of a four point, heavy duty, spring isolation system for a minimum of 95 percent isolation efficiency.

G. Dryer/Control: The dryer/control shall include a NEMA 12, U.L. labeled control system, duplexed desiccant drying system, duplexed final line filters, duplexed final line regulators, and combination dew point/CO monitor. All of the above shall be pre-wired and pre-piped in accordance with NFPA 99 and include valving to allow complete air receiver by-pass, as well as air sampling port.

H. Dryer: Size each desiccant dryer for the peak calculated demand and capable of producing -12 degrees C (10 degrees F) pressure dew point. Dryer purge flow shall be minimized through an on-demand purge saving control system. Include a mounted prefilter rated for 0.01 micron with automatic drain and element change indicator on the inlet of each dryer.

I. Control System: Mounted and pre-wired control system shall be NEMA 12 and U.L. labeled. This control system shall provide automatic lead/lag sequencing with circuit breaker disconnects for each compressor with external operators, one non-fused main disconnect with external operators, full voltage motor magnetic starters with overload protection, redundant 120V control circuit transformers, visual and audible reserve unit alarm with isolated contacts for remote alarm, hand-off-auto (HOA) lighted selector switches, automatic alternation of both compressors with provisions for simultaneous operation if required, automatic activation of reserve unit if required, visual alarm indication for high discharge air temperature shutdown with isolated contacts for remote alarm, and duplexed run time hour meters.

J. Final Line Filters and Regulators: Fully duplexed final line filters rated for 0.01 micron with element change indicators shall be factory mounted and pre-piped, along with duplexed factory mounted and pre-piped final line regulators and duplex safety relief valves.

K. Dew Point Hygrometer/CO Monitor: Mounted, pre-piped and wired, combination dew point hygrometer/CO monitor shall be of the ceramic type with integral chemical type CO sensor. System accuracy shall be ± 1 degree C (2 degrees F) for dew point and 2 mg/L (2 PPM) (at 10 PPM) for carbon monoxide. Dew point alarm shall be factory set at 4 degrees C (40 degrees F) per NFPA 99, and the CO alarm shall be factory set at 10 mg/L (10 PPM). Both set points shall be field adjustable.

L. Air Receiver: Vertical air receiver, galvanized, ASME Coded, National Board Certified, rated for minimum 1035 kPa (150 psig) design pressure and includes a sight gauge glass as well as a timed automatic solenoid drain valve. Provide three valve bypass on supply.

M. Example of an acceptable product and manufacturer: Beacon Medical Products "Lifeline Medical Air Systems".

2.12 PRESSURE REGULATORS

A. For 690 kPa (100 psig) regulator, provide duplex in parallel, valve for maintenance shut-down without service interruption. For additional pressures, locate regulators remote from compressor near point of use, and provide with isolation valves and valve bypass.

1. For systems 5 L/s (10 SCFM) and below: Brass or bronze body and trim, reduced pressure range 170 to 850 kPa (25 to 123 psig) adjustable, spring type, diaphragm operated, relieving. Delivered pressure shall vary not more than 1.0 kPa (0.15 psig) for each 10 kPa (1.5 psig) variation in inlet pressure.

PART 3 - EXECUTION

3.1 INSTALLATION

A. In accordance with NFPA 99. Run buried oxygen piping in PVC protective pipe for entire length including enclosure of fittings and changes of direction.

B. Install cast escutcheon with set screw at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.

C. Open ends of tube shall be capped or plugged at all times or otherwise sealed until final assembly to prevent infiltration of any foreign matter.

D. Cut piping square and accurately with a tube cutter (sawing is prohibited) to measurements determined at place of installation. Ream tube to remove burrs, being careful not to expand tube, and so no chips of copper remain in the tube. Work into place without springing or forcing. Bottom tube in socket so there are no gaps between tube and fitting. Exercise care in handling equipment and tools used in cutting or reaming of tube to prevent oil or grease being introduced into tubing. Where contamination has occurred, material is no longer suitable for oxygen service.

E. Spacing of hangers: NFPA 99.

F. Rigidly support valves and other equipment to prevent strain on tube or joints.

G. While being brazed, joints shall be continuously purged with oil free nitrogen. The flow of purged gas shall be maintained until joint is cool to touch.

H. Do not bend tubing. Use fittings.

I. Support ceiling column assembly from heavy sub-mounting castings furnished with the unit as part of roughing-in. Anchor with 15 mm (1/2-inch) diameter bolts attached to angle iron frame supported from structural ceiling, unless otherwise indicated.

J. Provide two 25 mm (1 inch) minimum conduits from ceiling column assembly to adjacent corridor, one for mass spectrometer tubing and wiring and one for monitor wiring, for connection to signal cabling network.

K. Install pressure switches, transmitter and gauges to be easily accessed, and provide access panel where installed above plaster ceiling. Install pressure switch and sensors with orifice nipple between the pipe line and switches/sensors.

L. Apply pipe labeling during installation process and not after installation is completed. Size of legend letters shall be in accordance with ASME A13.1.

M. Pipe compressor intake to a source of clean ambient air as indicated in NFPA 99.

N. After initial leakage testing is completed, allow piping to remain pressurized with testing gas until testing agency performs final tests.

O. Penetrations:

1. Fire Stopping: Where pipes pass through fire partitions, fire walls, smoked partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING, with intumescent materials only. Completely fill and seal clearances between raceways and openings with the fire stopping material.

2. Waterproofing: At floor penetrations, completely seal clearances around the pipe and make watertight with sealant as specified in

Section 07 92 00, JOINT SEALANTS. Bio-based materials shall be utilized when possible.

P. Provide 40 mm (1-1/2 inch) diameter line pressure gage downstream of zone valve in cabinets.

Q. Provide zone valves in cabinets where indicated and outside each Operating Room and a minimum one zone valve assembly for each 18 outlet set.

3.2 STARTUP AND TESTING

A. Initial Tests: Blow down and high and low pressure leakage tests as required by NFPA 99 with documentation.

B. Laboratory and/or healthcare testing agency shall perform the following:

1. Perform and document all cross connection tests, labeling verification, supply system operation, and valve and alarm operation tests as required by, and in accordance with NFPA 99 and the procedures set forth in pre-qualification documentation.
2. Verify that the systems, as installed, meet or exceed the requirements of NFPA 99, this specification, and that the systems operate as required.
3. Piping purge test: For each positive pressure gas system, verify cleanliness of piping system. Filter a minimum of 1000 liters (35 cubic feet) of gas through a clean white 0.45 micron filter at a minimum velocity of 100 liters per minute (3.5 SCFM). Filter shall show no discoloration, and shall accrue no more than 0.1 mg (0.0000035 ounces) of matter. Test each zone at the outlet most remote from the source. Perform test with the use of an inert gas as described in CGA P-9.
4. Piping purity test: For each positive pressure system, verify purity of piping system. Test each zone at the most remote outlet for dew point, carbon monoxide, total hydrocarbons (as methane), and halogenated hydrocarbons, and compare with source gas. The two tests shall in no case exceed variation as specified in paragraph, “Maximum Allowable Variation”. Perform test with the use of an inert gas as described in CGA P-9.

5. Outlet and inlet flow test:
   a. Test all outlets for flow. Perform test with the use of an inert gas as described in CGA P-9.
   b. Oxygen, nitrous oxide and air outlets shall deliver 100 Lpm (3.5 SCFM) with a pressure drop of no more than 34 kPa (5 psig), and static pressure of 345 kPa (50 psig).
   c. Nitrogen outlets shall deliver 565 Lpm (20 SCFM) with a pressure drop of no more than 34 kPa (5 psig), and static pressure of 1448 kPa (210 psig).
   d. Needle valve air outlets shall deliver 1.5 SCFM with a pressure drop of no more than five psig, and static pressure of 345 kPa (50 psig).
6. Source Contamination Test: Analyze each pressure gas source for concentration of contaminants, by volume. Take samples for air system test at the intake and at a point immediately downstream of the final filter outlet. The compared tests shall in no case exceed variation as specified in paragraph “Maximum Allowable Variation”. Allowable concentrations are below the following:

Dew point, air	4 degrees C (40 degrees F) pressure dew point at 690 kPa (100 psig)
Carbon monoxide, air	10 mg/L (ppm)
Carbon dioxide, air	500 mg/L (ppm)
Gaseous hydrocarbons as methane, air	25 mg/L (ppm)
Halogenated hydrocarbons, air	2 mg/L (ppm)

7. Analysis Test:
   a. Analyze each pressure gas source and outlet for concentration of gas, by volume.
   b. Make analysis with instruments designed to measure the specific gas dispensed.
   c. Allowable concentrations are within the following:
      1) Laboratory air 19.5 percent to 23.5 percent oxygen.

Oxygen	>=97% plus oxygen
Nitrous oxide	>=99% plus nitrous oxide

Nitrogen	>=99% plus nitrogen
Medical air	19.5% to 23.5% oxygen
Carbon Dioxide	99% plus carbon dioxide

8. Maximum Allowable Variation: Between comparative test results required are as follows:

Dew point	2 degrees C (35 degrees F)
Carbon monoxide	2 mg/L (ppm)
Total hydrocarbons as methane	1 mg/L (ppm)
Halogenated hydrocarbons	2 mg/L (ppm)

C. The CxA will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and CxA. Contractor shall provide a minimum of 10 working days prior to startup and testing.

3.3 CONNECTION TO EXISTING LABORATORY GAS SYSTEM:

A. Contactor shall test the existing system for hydrocarbons, dew point, etc. per NFPA 99. If problems are present, the COR would notify the facility of the results. The facility would then make the necessary repairs and/or maintenance prior to connecting to new system.

B. Install shut-off valve at the connection of new line to existing line.

C. Time for shutdown of the existing laboratory and healthcare system shall be coordinated at least 10 work days prior to shutdown with the COR and VA Medical Center.

D. Shut off all oxygen zone valves and gas riser valves if the section to be connected cannot be totally isolated from the remainder of the system.

E. Prior to any work being done, check the new pipeline for particulate or other forms of contamination per NFPA 99.

F. Ensure that the correct type of pipe tubing and fittings are being used.

G. Make a spot check of the existing pipelines in the facility to determine the level of cleanness present.

H. Reduce the pressure to zero and make the tie-in as quickly as possible. A nitrogen purge is not required since this would require another opening in the pipe.

I. After the tie-in is made and allowed to cool, slowly bleed the source gas back into the pipeline. Test the work area for leaks with soapy water and repair any leaks.

J. After all leaks, if any, are repaired and the line is fully recharged, perform blow down and testing. Open the zone that is closest to the main to the system, access the closest outlet to the work, and blow the main through the outlet. After the outlet blows clear into a white cloth, make an additional check at a zone most distant from the work. Perform all required NFPA 99 tests after connection.

3.4 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

B. Components provided under this section of the specification will be tested as part of a larger system.

3.5 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer’s technical representative for four hours to instruct VA Personnel in operation and maintenance of units.

B. Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

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SECTION 22 66 00

CHEMICAL-WASTE SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section describes the requirements for chemical-waste systems including piping, neutralization equipment, and all necessary accessories as designated in this section.

B. A complete listing of common acronyms and abbreviations are included in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.

B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

D. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

E. Section 07 84 00, FIRESTOPPING: Penetrations in rated enclosures.

F. Section 07 92 00, JOINT SEALANTS.

G. Section 09 91 00, PAINTING: Preparation and finish painting and identification of piping systems.

H. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

I. Section 22 07 11, PLUMBING INSULATION.

J. Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

1.3 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Where conflicts occur these specifications and the VHA standards will govern.

B. American Society of Mechanical Engineers (ASME):

A13.1-2015.....Scheme for Identification of Piping Systems

B1.20.1-2013.....Pipe Threads, General Purpose, Inch

B16.11-2016.....Forged Fittings, Socket-Welding and Threaded

B16.12-2019.....Cast Iron Threaded Drainage Fittings

B16.15-2018.....Cast Copper Alloy Threaded Fittings: Classes 125 and 250

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

A74-2020.....Standard Specification for Cast Iron Soil Pipe and Fittings

A183-2014(R2020).....Standard Specification for Carbon Steel Track Bolts and Nuts

A518/A518M-1999(R2018)..Standard Specification for Corrosion-Resistant High-Silicon Iron Castings

A861-2004(R2017).....Standard Specification for High-Silicon Iron Pipe and Fittings

C564-2020a.....Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings

D2321-2018.....Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications

D2654-2012(R2018).....Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems

D2665-2014.....Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings

D2855-2015.....Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly(Vinyl Chloride) (PVC) or Chlorinated Poly(Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets

D3222-2018a.....Standard Specification for Unmodified Poly(Vinylidene Fluoride) (PVDF) Molding Extrusion and Coating Materials

D4101-2017e1.....Standard Classification System and Basis for Specification for Polypropylene Injection and Extrusion Materials

E84-2019b.....Standard Test Method for Surface Burning Characteristics of Building Materials

F402-2018.....Standard Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings

F437-2015.....Standard Specification for Threaded Chlorinated Poly(Vinyl Chloride)(CPVC) Plastic Pipe Fittings, Schedule 80

F493-2014.....Standard Specification for Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings

F1412-2016.....Standard Specification for Polyolefin Pipe and Fittings for Corrosive Waste Drainage Systems

F1673-2010(R2016).....Standard Specification for Polyvinylidene Fluoride (PVDF) Corrosive Waste Drainage Systems

F2618-2019.....Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Pipe and Fittings for Chemical Waste Drainage Systems

D. Cast Iron Soil Pipe Institute (CISPI):

2006.....Cast Iron Soil Pipe and Fittings Handbook, 12th Printing

301-2018.....Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

310-2018.....Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

E. International Code Council (ICC):

IPC-2018.....International Plumbing Code

F. National Electrical Manufacturers Association (NEMA):

250-2018.....Enclosures for Electrical Equipment (1000 Volts Maximum)

G. Underwriters' Laboratories, Inc. (UL):

723-2018.....Standard for Test for Surface Burning Characteristics of Building Materials

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 66 00, CHEMICAL-WASTE SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES", 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. Chemical resistant waste and vent piping
2. Piping specialties
3. Cleanouts
4. Floor drains
5. Waterproofing

D. Detailed shop drawing of clamping device and extensions when required in connection with the waterproofing membrane or the floor drain.

E. Shop Drawings: For neutralization system and leak-detection system. Include plans, elevations, sections, details, and in junction with Electrical and Architectural work.

1. Detail leak-detection system assemblies and indicate required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

F. Seismic-Design Submittal: For seismic restraints of aboveground piping, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

G. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replaceable parts, and troubleshooting guide:

1. Include complete list indicating all components of the systems.
2. Include complete diagrams of the internal wiring for each item of equipment.
3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

H. 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.

I. Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

1.5 QUALITY ASSURANCE

A. Bio-Based Materials: For products designated by the USDA's Bio-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 https:www.biopreferred.gov.

B. Refer to Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS for additional sustainable design requirements.

1.6 AS-BUILT DOCUMENTATION

A. Comply with requirements in Paragraph AS-BUILT DOCUMENTATION of Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Chemical-Waste Service: Do not interrupt chemical-waste service to facilities occupied unless permitted under the following conditions and then only after arranging to provide temporary chemical-waste service according to requirements indicated:

1. Provide written notice to COR no fewer than two days in advance of proposed interruption of chemical-waste service.
2. Do not proceed with interruption of chemical-waste service without COR's written permission.

PART 2 - PRODUCTS

2.1 CHEMICAL RESISTANT WASTE AND VENT PIPING

A. The material shall include connecting fittings in stacks or mains.

B. The chemical resistant waste and vent pipe material shall be PVDF pipe and drainage pattern fittings conforming to ASTM F1673. The PVDF pipe and fittings shall be scheduled with mechanical joints for sizes under 75 mm or DN80 (NPS 3 inches) and fusion and mechanical joints for sizes 75 mm or DN80 (NPS 3 inches) and over. Mechanical joints shall be used at all traps and trap arms.

1. Exception: Underground piping joints shall be fusion weld.

C. Chlorinated Poly (Vinyl Chloride) (CPVC) pipe shall be manufactured from CPVC Type IV, ASTM Cell Classification 23447 and in strict accordance to the requirements of ASTM F2618 for physical dimensions and tolerances and certified by NSF International for corrosive waste end use (NSF-cw). Joining method for pipe and fittings shall be solvent cement welding. Solvent cement shall be a solvent cement specially formulated for resistance to corrosive chemicals and manufactured in accordance with ASTM F493. This pipe shall have a flame spread rating of < 25 and a smoke development rating of < 50 when tested for surface burning characteristics in accordance with ASTM E84 and UL 723 or equivalent.

2.2 PIPING SPECIALTIES

A. Corrosion resistant P-trap or drum trap shall have 38 mm or DN40 to 50 mm or DN50 (NPS 1-1/2 or NPS 2 inches) as required for fixture and waste and conform to ASTM A861 for high silicon iron pipe with hubless joints, ASTM D4101 for polypropylene pipe with mechanical joints, and ASTM D3222 for PVDF pipe with mechanical joints.

2.3 LEAK-DETECTION SYSTEMS

A. Cable leak-detection system capable of detecting and annunciating fluid leaks; with controls, panel, wiring, cable sensors, probes if required, and piping.
   1. Annunciator Panel: Enclosure with visual and audible alarms and leak location indicator.
   2. Sensors: Electric cable, suitable for insertion into double-containment piping annular space, with capability of detecting fluid leaks and signaling locations of leaks.

2.4 CLEANOUTS

A. Cleanouts shall be the same size as the pipe, up to 100 mm or DN100 (NPS 4 inches); not less than 100 mm or DN100 (NPS 4 inches) for larger pipe. Cleanouts for chemical-waste drain pipe shall be of same material as the pipe. Cleanouts shall be easily accessible and shall be gastight and watertight. A minimum clearance of 610 mm (24 inches) shall be provided for clearing a clogged chemical-waste drain.

B. Floor cleanouts shall have cast-iron body and frame with square adjustable scoriated secured nickel bronze top. The cleanout shall be vertically adjustable for a minimum of 50 mm or DN50 (NPS 2 inches).

When a waterproof membrane is used in the floor system, a clamping collar shall be provided on the cleanouts. Cleanouts shall consist of wye fittings and eighth bends with brass or bronze screw plugs. Cleanouts in the resilient tile floors, quarry tile and ceramic tile floors shall be provided with square top covers recessed for tile insertion. In the carpeted areas, carpet cleanout markers shall be provided. Two way cleanouts shall be provided where indicated on drawings.

C. Cleanouts shall be provided at or near the base of the vertical stacks with the cleanout plug located approximately 600 mm (24 inches) above the floor. If there are no fixtures installed on the lowest floor, the cleanout shall be installed at the base of the stack. The cleanouts shall be extended to the wall access cover. The vertical cleanout shall consist of sanitary tees. Nickel bronze square frame and stainless-steel cover shall be furnished with a minimum opening of 152 by 152 mm (6 by 6 inches) at each wall cleanout. Where the piping is concealed, a fixture trap or a fixture with integral trap, readily removable without disturbing concealed roughing work, shall be accepted as a cleanout equivalent providing the opening to be used as a cleanout opening is the size required.

D. In horizontal runs above grade, cleanouts shall consist of cast brass tapered screw plug in fitting or caulked/no hub cast-iron ferrule. Plain end (no-hub) piping in interstitial space or above ceiling may use plain end (no-hub) blind plug and clamp.

2.5 FLOOR DRAINS

A. Type T: Funnel Type Chemical Resistant Floor Drain and "P" Trap: Double drainage pattern with integral seepage pan for embedding in floor and weep holes to provide adequate drainage from pan to drain pipe. Floor drain shall be polypropylene, flame retardant, Schedule 40 or 80. Provide outlet of floor drain suitable for properly jointing perforated or slotted floor level grate and funnel extension. Cut out grate below funnel. Minimum dimensions as follows:

1. Height of funnel - 95 mm (3-3/4 inches).
2. Diameter of lower portion of funnel - 50 mm (2 inches).
3. Diameter of top portion of funnel - 100 mm (4 inches).

B. Type X: Chemical resistant floor drain and p-trap. Double drainage pattern with integral seepage pan for embedding in floor and weep holes to provide adequate drainage from pan to drain pipe. Floor drain shall be polypropylene, flame retardant, Schedule 40 or 80. Provide outlet of floor drain suitable for properly joining with chemical resistant pipe material.

2.6 WATERPROOFING

A. A sleeve flashing device shall be provided at points where pipes pass through membrane waterproofed floors or walls. The sleeve flashing device shall be manufactured, cast-iron fitting with clamping device that forms a sleeve for the pipe floor penetration of the floor membrane. A galvanized steel pipe extension shall be included in the top of the fitting that will extend 50 mm (2 inches) above finished floor and galvanized steel pipe extension in the bottom of the fitting that will extend through the floor slab. A waterproofed caulked joint shall be provided at the top hub.

B. Walls: See detail shown on drawings.

PART 3 - EXECUTION

3.1 PIPE INSTALLATION

A. The pipe installation shall comply with the requirements of the International Plumbing Code and these specifications.

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

C. Branch piping for chemical-waste piping system shall be installed and connected to all fixtures, valves, cocks, outlets, casework, cabinets and equipment, including those furnished by the Government or specified in other sections.

D. Piping shall be installed for reagent racks. The piping shall be arranged neatly and located as required by the equipment.

E. Pipe shall be round and straight. Cutting shall be done with proper tools. Pipe shall be reamed to full size after cutting.

F. All pipe runs shall be laid out to avoid interference with other work.

G. The piping shall be installed above accessible ceilings to allow for ceiling panel removal.

H. The piping shall be installed to permit valve servicing or operation.

I. The piping shall be installed at the indicated slopes or according to the International Plumbing Code.

J. The piping shall be installed free of sags and bends.

K. Seismic restraint shall be installed where required by code.

L. Changes in direction for chemical-waste drainage and vent piping shall be made using appropriate branches, bends and long sweep bends. Sanitary tees and short sweep quarter bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Long turn double wye branch and eighth bend fittings shall be used if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Proper size of standard increaser and reducers shall be used if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

M. Aboveground CPVC piping shall be installed according to ASTM F2618.

N. PVDF piping shall be installed according to ASTM F1673 and manufacturer’s recommendations.

O. Chemical-resistant vent pipe shall be independently vented through the roof.

3.2 JOINT CONSTRUCTION

A. Hub and spigot cast-iron piping with gasket joints shall be joined in accordance with CISPI’s “Cast-Iron Soil Pipe and Fittings Handbook” for compression joints.

B. Hub and spigot cast-iron piping with calked joints shall be joined in accordance with CISPI’s “Cast-Iron Soil Pipe and Fittings Handbook” for lead and oakum calked joints.

C. Hubless, cast-iron piping shall be joined in accordance with CISPI’s “Cast-Iron Soil Pipe and Fittings Handbook” for hubless piping coupling joints.

D. For threaded joints, thread pipe with tapered pipe threads according to ASME B1.20.1. The threads shall be cut full and clean using sharp disc cutters. Threaded pipe ends shall be reamed to remove burrs and restored to full pipe inside diameter. Pipe fittings and valves shall be joined as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is required by the pipe service.
2. Pipe sections with damaged threads shall be replaced with new sections of pipe.

E. For PVC piping, solvent cement joints shall be used for joints. All surfaces shall be cleaned and dry prior to applying the primer and solvent cement. Installation practices shall comply with ASTM F402. The joint shall conform to ASTM D2855, ASTM D2654, and ASTM D2665 appendixes.

3.3 SPECIALTY PIPE FITTINGS

A. Transition coupling shall be installed at pipe joints with small differences in pipe outside diameters.

B. Dielectric fittings shall be installed at connections of dissimilar metal piping and tubing.

C. All chemical-waste piping shall be joined with specialty fittings in accordance with referenced standards and manufacturer’s recommendations for the applications used.

3.4 LEAK-DETECTION SYSTEM INSTALLATION

A. Single-Pipe, Chemical-Waste Sewerage Piping: Install leak-detection system below piping.

B. Install panel in location indicated.

3.5 PIPE HANGERS, SUPPORTS, AND ACCESSORIES

A. All piping shall be supported and labeled according to the International Plumbing Code, Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, ASME A13.1, and these specifications.

B. Hangers, supports, rods, inserts and accessories used for Pipe supports shall be shop coated with zinc Chromate primer paint. Refer to Section 09 91 00, PAINTING.

C. Horizontal piping and tubing shall be supported within 305 mm (12 inches) of each fitting or coupling.

D. Vertical piping and tubing shall be supported at the base, at each floor, and at intervals no greater than 4.6 meters (15 feet).

E. In addition to the requirements in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, floor, Wall and Ceiling Plates, Supports, and Hangers shall have the following characteristics:

1. Solid or split unplated cast-iron.

2. All plates shall be provided with set screws.
3. Height adjustable clevis type pipe hangers.
4. Adjustable Floor Rests and Base Flanges shall be steel.
5. Hanger Rods shall be carbon steel, fully threaded or Threaded at each end with two removable nuts at each end for positioning rod and hanger and locking each in place.
6. Riser Clamps shall be malleable iron or steel.
7. Rollers shall be cast-iron.
8. Hangers and supports utilized with insulated pipe and tubing shall have 180 degree (min.) metal protection shield centered on and welded to the hanger and support. The shield shall be 100 mm (4 inches) in length and be 16 gauge steel. The shield shall be sized for the insulation.

F. Miscellaneous Materials: As specified, required, directed or as noted on the drawings for proper installation of hangers, supports and accessories.

G. Cast escutcheon with set screw shall be installed at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.

H. Penetrations:
1. Where pipes pass through fire partitions, fire walls, smoke partitions, or floors, install a firestop system that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING. Clearances between raceways and openings shall be completely filled and sealed with the firestopping materials.
2. At floor penetrations, Clearances around the pipe shall be completely sealed and made watertight with sealant as specified in Section 07 92 00, JOINT SEALANTS.

I. Chemical-waste and vent piping shall conform to the following:
1. Where waste lines from fixtures are shown on plans to be chemical resistant, vents from those fixtures shall also be chemical resistant.
2. Storage and installation for PVDF or CPVC chemical resistant pipe shall comply with ASTM D2665.

3. Mechanically Joined Polypropylene Pipe requires a pre-grooved pipe or cutting of a groove in each pipe section using a rotation cutting tool. Polypropylene chemical resistant pipe pitch shall be 6 mm (1/4 inch per foot) minimum. Mechanically joined pipe shall not be installed below grade.
4. Plastic chemical-waste pipe shall not be installed within 23 m (75 feet) of hot water appliances (autoclaves, dishwashers, sterilizers) and similar equipment.

3.6 TESTS

A. The chemical resistant pipe system shall be tested either in its entirety or in sections.

B. Tests for Chemical Resistant Waste, vent, and Silver Recovery Systems shall be conducted before trenches are backfilled or fixtures are connected. A water test or air test shall be conducted as directed.

1. Entire system is tested using a water test, tightly close all openings in pipes except highest opening, and fill system with water to point of overflow. If system is tested in sections, tightly plug each opening except highest opening of section under test, fill each section with water and test with at least a 3 m (10 foot) head of water. In testing successive sections, test at least upper 3 m (10 feet) of next preceding section so that each joint or pipe except upper most 3 m (10 feet) of system has been submitted to a test of at least a 3 m (10 foot) head of water. Water shall be kept in system, or in portion under test, for at least 15 minutes before inspection starts. System shall then be tight at all joints.
2. Entire system is tested using an air pressure test of 34 kPa (5 psig). Pressure shall be maintained for at least 15 minutes without leakage. A force pump and column gauge shall be used for the test.
3. Final Tests: Either one of the following tests may be used.
   a. Smoke Test: After fixtures are permanently connected and traps are filled with water, fill entire drainage and vent systems with smoke under pressure of 1.3 kPa (5 inch of water) with a smoke machine. Chemical smoke is prohibited.
   b. Peppermint Test: Introduce 60 ml (2 ounces) of peppermint into each line or stack.

3.7 STARTUP AND TESTING

A. Perform tests as recommended by product manufacturers and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.

B. The tests shall include system capacity, control function, and alarm functions.

C. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.

D. The CxA will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and CxA. Provide a minimum notice of 10 working days prior to startup and testing.

3.8 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.

3.9 DEMONSTRATION AND TESTING

A. Provide services of manufacturer’s technical representative for 4 hours to instruct each VA personnel responsible in operation and maintenance of the system.

B. Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

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SECTION 22 67 19.16
REVERSE-OSMOSIS WATER EQUIPMENT

PART 1 – GENERAL

1.1 DESCRIPTION

A. Provide complete industrial-type packaged reverse osmosis (RO) water treatment system producing high purity water by removal of dissolved minerals, bacteria, particles and organic impurities. Designed for continuous automatic operation. The system shall include pre-filter, product storage tank and all devices necessary for fully operational system. RO system operation shall be controlled by the water level in the product storage tank.

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 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

D. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

E. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Seismic Restraint.

F. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING: Systems for service other than boiler plant make-up water.

G. Section 22 07 11, PLUMBING INSULATION.

H. SECTION 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS. Requirements for commissioning, systems readiness checklist, and training.

I. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATION.

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 their basic designation only.

B. American Society of Mechanical Engineers (ASME):
B40.100-2013.....Pressure Gauges and Gauge Attachments

C. ASTM International (ASTM):
A269/A269M-2014e1.....Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service

D1785-2012.....Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

D. American Water Works Association (AWWA):

B300-2010.....Hypochlorites

B301-2010.....Liquid Chlorine

C651-2014.....Disinfecting Water Mains

E. National Electrical Manufacturers Association (NEMA):

ICS 6-1993 (R2001, R2006) Industrial Control and Systems Enclosures

F. National Fire Protection Association (NFPA):

70-2014.....National Electrical Code

G. Department of Health and Human Services, Food and Drug Administration (FDA):

CFR 21, Chapter 1, Part 175.300, Resinous and Polymeric Coatings

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 67 19.16, REVERSE-OSMOSIS WATER EQUIPMENT", 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. Catalog cuts, complete description and specifications of all equipment and accessories.
2. Accessories including filters, product storage tank, pressure gages and test kit.
3. Performance data including normal and maximum flow and pressure drop. Certification that required performance shall be achieved.
4. Piping.

D. Complete detailed layout, setting, arrangement, and installation drawings including. Drawings shall also show all parts of the apparatus including relative positions, dimensions, and sizes and general arrangement of connecting piping.

E. Completed System Readiness Checklist provided by the CxA and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

F. Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

1.5 QUALITY ASSURANCE

A. Manufacturer shall have been engaged in the manufacture of RO systems as a primary product for at least ten years. The ten year requirement supersedes any conflicting requirement in other parts of the project specification.

B. 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 PROJECT CONDITIONS

A. Influent Water Analysis:

Maximum Silt Density Index (SDI) Rating _____

Turbidity, NTU _____

Maximum Free Chlorine and/or Chloramine _____ppm

Color: _____

Maximum pH (continuous) ____8.8___

Minimum pH (continuous) ____6.7___

Maximum pH (cleaning-30 minutes) _____

Minimum pH (cleaning-30 minutes) _____

Confirm the analysis with current samples and tests.

B. Design Parameters:

Normal System Flow:(___30__gpm)

Maximum System Flow:(__108_gpm)

Daily Water Usage: (__4,400____gallons per day)

Daily Hours of Water Demand: ___12__

Operating Temperature Range: (_70__ to _150__ degrees F)

1.7 AS-BUILT DOCUMENTATION

A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.

B. Submit operation and maintenance data updated to include submittal review comments, substitutions and construction revisions shall be in electronic version on compact disc or DVD. 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 __2021__ provided on compact disk or DVD. Should the installing contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement.

D. Certification documentation shall be provided to COR 10 working days prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and a certification that all results of tests were within limits specified.

PART 2 - PRODUCTS

2.1 RO SYSTEM

A. Packaged automatic RO system mounted on steel frame, designed for project conditions. Equipment arranged on the frame to allow easy access for operating, maintenance and repair. Unit shall include RO

membrane, pressure vessels, pre-filtration system, high pressure pump and all required piping, wiring and controls for a fully operational system.

B. Performance Requirements:
   1. Membrane reject ratio: 98 percent minimum. TDS of product is 2 percent maximum of input TDS.
   2. Capture rate: 75 percent minimum. Maximum amount of water to drain 25 percent of input.

C. RO Membrane Elements: Thin-film composite with fiberglass reinforced polyester (FRP) over-wrap, anti-telescoping device, u-cup brine seal. The design salt rejection shall be 98 percent based on 2000 ppm water at 1550 kPa (225 psig) at 25 degrees C (77 degrees F).

D. RO Element Housings: Type 304 stainless steel with PVC end caps held in place with stainless steel bands. Each housing assembly complete with one set of O-rings and O-ring lubricant. (Bio-based materials shall be utilized when possible.) Housings for systems over 34,070 L per day (9,000 gallons per day) shall be constructed of FRP. Provide cleaning connections.

E. High Pressure Pumps and Motors: Single Duplex vertical multistage high efficiency centrifugal type with Type 304 stainless steel casing, shaft, impellers. Tungsten carbide and ceramic shaft seals. Cast iron frame with flanged piping connections. Premium efficiency TEFC motor selected to be non-overloading on the entire performance curve.

F. Manual Valves:
   1. Pump Throttle Valve: Type 316 stainless steel ball valve, socket welded.
   2. Concentrate Throttle Valve, Recycle Throttle Valve: In-line needle style, stainless steel, rated for 2070 kPa (300 psig) minimum.
   3. Inlet Isolation Valve, Product and Concentrate Check Valves: PVC with EPDM seats and seals.
   4. Feedwater Sample Valve, Product Water Sample Valve: PVC plug valve with EPDM seats and seals.
   5. High Pressure Sample Valve: Type 316 stainless steel plug valve.

G. Automatic Valves:
   1. Automatic Inlet Shut Off Valve: Solenoid type, diaphragm actuated, normally closed, constructed of glass-filled Noryl thermoplastic.

2. Automatic Membrane Flush Valve: Provide for purging the membranes with fresh water upon machine shut down.

H. Piping:

1. Low Pressure Feed, Reject and Recycle Piping 520 kPa (75 psig and under): ASTM D1785, Schedule 80 PVC, socket welded and flanged.
2. RO Product Tubing From Each Membrane Housing: ASTM D1785, Schedule 80 PVC, socket welded and flanged.
3. Low Pressure Control and Pressure Gage Tubing: Polyethylene.
4. High Pressure Reject and Recycle Piping 520 kPa (above 75 psig): ASTM A269/A269M, Type 304 Schedule 10 stainless steel with butt welded joints.
5. High Pressure Control and Pressure Gage Tubing: 6895 kPa (1000 psig) burst nylon.

I. Controls:

1. Electronic DDC controller providing automatic control for all operating functions. Motor starter panel. All in FRP enclosures rated NEMA 4. All wiring factory-installed and tested. Comply with Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES and NFPA 70.
2. Autoflush indicator and control to flush RO concentrate at shut down or at predetermined intervals.
3. Warning Alarms: Low quality product, low feed pressure, high feed temperature. Connect to BAS system.
4. Automatic Shutdowns and Alarms: Low feed pressure, low product quality, pretreatment out of service, storage tank full.
5. Status Indicators: Low feed pressure, low quality, flow alarm, high feed water temperature, product divert to drain valve open, pretreatment lockout, storage tank full.
6. Low and High pressure safety switches.
7. Tank water level control switches.
8. Pump Motor Starter: Comply with Section 26 29 11, MOTOR CONTROLLERS.
9. Miscellaneous Controls: Elapsed run time indicator, alarm horn, chemical pump receptacles, convenience receptacles, minimum 8 auxiliary contacts 2DI, 2DO, 2AI, 2AO.

J. Instrumentation and Displays:
   1. All instrumentation readouts panel-mounted in FRP enclosures rated NEMA 4. All factory wiring. Comply with NFPA 70.
   2. Digital flow indicators for, product, reject, recycle.
   3. Pressure gages for inlet, cartridge filter outlet, RO feed, RO concentrate, and RO product.
   4. Conductivity indicator measuring product quality with digital displays, alarm relays and automatic temperature compensation.
   5. Conductivity probe mounted in the RO product.

K. Skid and Frame Assembly: RO machine shall be built on a skid and frame constructed of welded structural carbon steel. The entire surface shall be sand-blasted and coated with high solids epoxy coating. Bio-based materials shall be utilized when possible.

L. Reassembly: Unit shall be shipped to the site completely assembled and tested. If units or sections are to be disassembled at the site to allow for installation in a limited space, the unit shall be reassembled and tested for intended operation by a factory authorized technical representative.

2.2 PRE-FILTER

A. Single multi-media filter sized for the RO machine inlet flow rate. Filter designed for suspended solids removal down to 10 microns and automatic backwash cycle.

B. Media Tank: FRP designed for 1035 kPa (150 psig). Pre-piped internal backwash distributor and filtered water collector.

C. Filter Media: Top layer of anthracite, middle layer of silica sand, bottom layer of multi-grade garnet. Install filter media at job site.

D. Backwash Cycle: Top-mounted, piston-operated control valve with pre-sized drain line flow control orifice. The cycle shall be initiated by and adjustable seven day electronic time clock. Include RO lockout switch.

E. Replacement Filter Media: Provide elements for one complete replacement.

2.3 ACTIVATED CARBON FILTER

A. Single filter sized for the RO machine inlet flow rate. Designed to remove chlorine and prevent RO membrane damage.

B. Media Tank: FRP designed for 1035 kPa (150 psig). Pre-piped internal backwash distributor and filtered water collector.

C. Filter Media: 12 x 40 mesh bituminous coal-based activated carbon. Install media at job site.

D. Backwash Cycle: Top-mounted, piston-operated control valve with pre-sized drain line flow control orifice. The cycle shall be initiated by and adjustable seven day electronic time clock. Include RO lockout switch.

2.4 RO WATER STORAGE TANK

A. Free-standing, closed-top, flat-bottom, (750 gallon) total volume. Top access manway, PVC bulkhead fittings for high and low level alarm switches, RO permeate inlet, RO permeate discharge and drain. Install 0.2 micron tank vent filter at the top head. Vented to atmosphere.

B. Materials of Construction: Linear polyethylene in one piece.

C. Tank Water Level Control: Adjustable float switch that signal starting and stopping RO pump. High and low level alarm switches.

2.5 PRESSURE GAGES

A. ASME B40.100, Grade A, 1 percent accuracy, 115 mm (4-1/2 inches) diameter, all metal case, bottom connected. White dials, black hands, graduated from 0 to 690 kPa (0 to 100 psig) and identity labeled.

2.6 WATER TESTING EQUIPMENT

A. Furnish water testing equipment in a portable cabinet specially made for the installed equipment. Include sufficient materials for 6 months of normal testing procedures.

B. Silt Density Index (SDI) apparatus to measure degree of suspended solids feeding the RO membranes. Include pressure regulator, pressure gage, filter holder, 600 mL (20 ounce) beaker, sample valve, tubing and 0.45 micron filter papers.

C. Test kit to measure total water hardness, total iron, free chlorine, pH.

PART 3 - EXECUTION

3.1 REQUIRED TECHNICAL SERVICES

A. Provide services of a qualified manufacturer's representative to check complete installation for conformance to manufacturer's recommendations, put system into service, make all adjustments required

for full conformance to design and specified requirements, and perform all demonstrations and tests.

3.2 FLUSHING AND DISINFECTING

A. Flush and disinfect new water lines and RO system and tank interiors in accordance with AWWA C651.

B. Material:

1. Liquid chlorine: AWWA B301.
2. Hypochlorite: AWWA B300.

3.3 STARTUP AND TESTING

A. Operating: Tests shall be run in presence of COR.

B. Procedure:

1. Operate RO system at constant maximum required capacity for one hour after demineralized RO product water is produced. When necessary, waste product water to sewer to maintain above flow rate. Product water production shall begin when a sample shows that demineralization complies with requirements.
2. Demonstrate all features of the control system including diagnostics and flow and cycle indications.

C. The CxA will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and CxA. Contractor shall provide a minimum of 10 working days prior to startup and testing.

3.4 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

B. Components provided under this section of the specification will be tested as part of a larger system.

3.5 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer’s technical representative for four hours to instruct VA Personnel in operation and maintenance of the system.

B. Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

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CONSTRUCTION DOCUMENTS (100%)

SPECIFICATIONS

VOLUME II
DIV 23 – DIV 28

RENOVATE SPS SPACE
Project No. 534-24-102

Department of Veterans Affairs
Robert H. Johnson VA Health Care System
Charleston, SC

MILLER★REMICK
1040 Kings Highway North
Suite 700
Cherry Hill, New Jersey 08034
(856) 429-4000

December 12, 2025

PROFESSIONAL REGISTRATIONS & ACCREDITATIONS

COMMONWEALTH OF PENNSYLVANIA REGISTERED PROFESSIONAL ANTHONY D. PACARO, JR. ENGINEER No. PE062779 12.12.2025	COMMONWEALTH OF PENNSYLVANIA REGISTERED PROFESSIONAL THOMAS REGINO ENGINEER No. PE094195 12/12/25	COMMONWEALTH OF PENNSYLVANIA REGISTERED PROFESSIONAL STEPHEN FAVIERI ENGINEER No. PE093994 12/12/25
ENGINEER OF RECORD / MECHANICAL ENGINEERING	ELECTRICAL ENGINEERING	STRUCTURAL ENGINEERING

LICENSED PROFESSIONAL ENGINEER KEVIN FEAK FP 2304 FIRE PROTECTION STATE OF CALIFORNIA	STATE OF SOUTH CAROLINA LAWRENCE C. WITKOWSKI CHARLOTTE, NC 7559 REGISTERED ARCHITECT	STATE OF MARYLAND THOMAS C. KANE 54025 PROFESSIONAL ENGINEER 12 / 12 / 2025
LIFE SAFETY	ARCHITECTURE	FIRE SUPPRESSION / FIRE ALARM

Department of Veterans Affairs
Ralph H. Johnson VA Health Care System
Charleston, SC

VA Project No.534-24-102
Renovate SPS Spaces
Construction Documents (100%): 12/12/2025

06-01-24

DEPARTMENT OF VETERANS AFFAIRS
VHA MASTER SPECIFICATIONS

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SECTION 23 05 11

COMMON WORK RESULTS FOR HVACHERE I COME

PART 1 - GENERAL

1.1 DESCRIPTION

A. The requirements of this Section apply to all sections of Division 23.

B. Definitions:

1. Exposed: Piping, ductwork, and equipment exposed to view in finished rooms.
2. Exterior: Piping, ductwork, and equipment exposed to weather be it temperature, humidity, precipitation, wind, or solar radiation.

C. Abbreviations/Acronyms:

1. ac: Alternating Current
2. AC: Air Conditioning
3. ACU: Air Conditioning Unit
4. ACR: Air Conditioning and Refrigeration
5. AI: Analog Input
6. AISI: American Iron and Steel Institute
7. AO: Analog Output
8. ASJ: All Service Jacket
9. AWG: American Wire Gauge
10. BACnet: Building Automation and Control Networking Protocol
11. BAg: Silver-Copper-Zinc Brazing Alloy
12. BAS: Building Automation System
13. BCuP: Silver-Copper-Phosphorus Brazing Alloy
14. bhp: Brake Horsepower
15. Btu: British Thermal Unit
16. Btu/h: British Thermal Unit Per Hour
17. CDA: Copper Development Association
18. C: Celsius
19. CD: Compact Disk
20. CFM: Cubic Foot Per Minute
21. CH: Chilled Water Supply
22. CHR: Chilled Water Return
23. CLR: Color

24. CO: Carbon Monoxide
25. COR: Contracting Officer’s Representative
26. CPD: Condensate Pump Discharge
27. CPM: Cycles Per Minute
28. CPVC: Chlorinated Polyvinyl Chloride
29. CRS: Corrosion Resistant Steel
30. CTPD: Condensate Transfer Pump Discharge
31. CTPS: Condensate Transfer Pump Suction
32. CW: Cold Water
33. CWP: Cold Working Pressure
34. CxA: Commissioning Agent
35. dB: Decibels
36. dB(A): Decibels (A weighted)
37. DDC: Direct Digital Control
38. DI: Digital Input
39. DO: Digital Output
40. DVD: Digital Video Disc
41. DN: Diameter Nominal
42. DWV: Drainage, Waste and Vent
43. EPDM: Ethylene Propylene Diene Monomer
44. EPT: Ethylene Propylene Terpolymer
45. ETO: Ethylene Oxide
46. F: Fahrenheit
47. FAR: Federal Acquisition Regulations
48. FD: Floor Drain
49. FED: Federal
50. FG: Fiberglass
51. FGR: Flue Gas Recirculation
52. FOS: Fuel Oil Supply
53. FOR: Fuel Oil Return
54. FSK: Foil-Scrim-Kraft facing
55. FWPD: Feedwater Pump Discharge
56. FWPS: Feedwater Pump Suction
57. GC: Chilled Glycol Water Supply
58. GCR: Chilled Glycol Water Return
59. GH: Hot Glycol Water Heating Supply

60. GHR: Hot Glycol Water Heating Return
61. gpm: Gallons Per Minute
62. HDPE: High Density Polyethylene
63. Hg: Mercury
64. HOA: Hands-Off-Automatic
65. hp: Horsepower
66. HPS: High Pressure Steam (414 kPa (60 psig) and above)
67. HPR: High Pressure Steam Condensate Return
68. HW: Hot Water
69. HWH: Hot Water Heating Supply
70. HWHR: Hot Water Heating Return
71. Hz: Hertz
72. ID: Inside Diameter
73. IPS: Iron Pipe Size
74. kg: Kilogram
75. klb: 1000 lb
76. kPa: Kilopascal
77. lb: Pound
78. lb/hr: Pounds Per Hour
79. L/s: Liters Per Second
80. L/min: Liters Per Minute
81. LPS: Low Pressure Steam (103 kPa (15 psig) and below)
82. LPR: Low Pressure Steam Condensate Gravity Return
83. MAWP: Maximum Allowable Working Pressure
84. MAX: Maximum
85. MBtu/h: 1000 Btu/h
86. MBtu: 1000 Btu
87. MED: Medical
88. m: Meter
89. MFG: Manufacturer
90. mg: Milligram
91. mg/L: Milligrams Per Liter
92. MIN: Minimum
93. MJ: Megajoules
94. ml: Milliliter
95. mm: Millimeter

96. MPS: Medium Pressure Steam (110 kPa (16 psig) through 414 kPa (60 psig))
97. MPR: Medium Pressure Steam Condensate Return
98. MW: Megawatt
99. NC: Normally Closed
100. NF: Oil Free Dry (Nitrogen)
101. Nm: Newton Meter
102. NO: Normally Open
103. NOx: Nitrous Oxide
104. NPT: National Pipe Thread
105. NPS: Nominal Pipe Size
106. OD: Outside Diameter
107. OSD: Open Sight Drain
108. OS&Y: Outside Stem and Yoke
109. PC: Pumped Condensate
110. PID: Proportional-Integral-Differential
111. PLC: Programmable Logic Controllers
112. PP: Polypropylene
113. PPE: Personal Protection Equipment
114. ppb: Parts Per Billion
115. ppm: Parts Per Million
116. PRV: Pressure Reducing Valve \
117. PSIA: Pounds Per Square Inch Absolute
118. psig: Pounds Per Square Inch Gauge
119. PTFE: Polytetrafluoroethylene
120. PVC: Polyvinyl Chloride
121. PVDC: Polyvinylidene Chloride Vapor Retarder Jacketing, White
122. PVDF: Polyvinylidene Fluoride
123. rad: Radians
124. RH: Relative Humidity
125. RO: Reverse Osmosis
126. rms: Root Mean Square
127. RPM: Revolutions Per Minute
128. RS: Refrigerant Suction
129. RTD: Resistance Temperature Detectors
130. RTRF: Reinforced Thermosetting Resin Fittings

131. RTRP: Reinforced Thermosetting Resin Pipe
132. SCFM: Standard Cubic Feet Per Minute
133. SPEC: Specification
134. SPS: Sterile Processing Services
135. STD: Standard
136. SDR: Standard Dimension Ratio
137. SUS: Saybolt Universal Second
138. SW: Soft water
139. SWP: Steam Working Pressure
140. TAB: Testing, Adjusting, and Balancing
141. TDH: Total Dynamic Head
142. TEFC: Totally Enclosed Fan-Cooled
143. TFE: Tetrafluoroethylene
144. THERM: 100,000 Btu
145. THHN: Thermoplastic High-Heat Resistant Nylon Coated Wire
146. THWN: Thermoplastic Heat & Water-Resistant Nylon Coated Wire
147. T/P: Temperature and Pressure
148. USDA: U.S. Department of Agriculture
149. V: Volt
150. VAC: Vacuum
151. VA: Veterans Administration
152. VAC: Voltage in Alternating Current
153. VA CFM: VA Construction & Facilities Management
154. VA CFM CSS: VA Construction & Facilities Management, Consulting Support Service
155. VAMC: Veterans Administration Medical Center
156. VHA OCAMES: Veterans Health Administration – Office of Capital Asset Management Engineering and Support
157. VR: Vacuum condensate return
158. WCB: Wrought Carbon Steel, Grade B
159. WG: Water Gauge or Water Column
160. WOG: Water, Oil, Gas

1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.

B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT.

D. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

E. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

F. Section 07 84 00, FIRESTOPPING.

G. Section 07 92 00, JOINT SEALANTS.

H. Section 09 91 00, PAINTING.

I. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

J. Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC and STEAM GENERATION.

K. Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT.

L. Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.

M. Section 23 07 11, HVAC AND BOILER PLANT INSULATION.

N. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

O. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

P. Section 23 36 00, AIR TERMINAL UNITS.

Q. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

R. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES.

1.3 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Where conflicts occur these specifications and the VHA standard will govern.

B. Air Movement and Control Association (AMCA):

410-1996.....Recommended Safety Practices for Users and Installers of Industrial and Commercial Fans

C. American Society of Mechanical Engineers (ASME):

B31.1-2018.....Power Piping

B31.9-2014.....Building Services Piping

ASME Boiler and Pressure Vessel Code:

BPVC Section IX-2019 Welding, Brazing, and Fusing Qualifications

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

A36/A36M-2014.....Standard Specification for Carbon Structural Steel

A575-1996(R2018).....Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades

E. Association for Rubber Products Manufacturers (ARPM):

IP-20-2015.....Specifications for Drives Using Classical V-Belts and Sheaves

IP-21-2016.....Specifications for Drives Using Double-V (Hexagonal) Belts

IP-24-2016.....Specifications for Drives Using Synchronous Belts

IP-27-2015.....Specifications for Drives Using Curvilinear Toothed Synchronous Belts

F. Manufacturers Standardization Society (MSS) of the Valve and Fittings Industry, Inc.:

SP-58-2018.....Pipe Hangers and Supports-Materials, Design, Manufacture, Selection, Application, and Installation

SP-127-2014a.....Bracing for Piping Systems: Seismic-Wind-Dynamic Design, Selection, and Application

G. Military Specifications (MIL):

MIL-P-21035B-2013.....Paint High Zinc Dust Content, Galvanizing Repair (Metric)

H. National Fire Protection Association (NFPA):

70-2017.....National Electrical Code (NEC)

101-2018.....Life Safety Code

I. Department of Veterans Affairs (VA):

PG-18-10-2016.....Physical Security and Resiliency Design Manual

1.4 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 23 05 11, COMMON WORK RESULTS FOR HVAC", with applicable paragraph identification.

C. If the project is phased submit complete phasing plan/schedule with manpower levels prior to commencing work. The phasing plan shall be detailed enough to provide milestones in the process that can be verified.

D. Contractor shall make all necessary field measurements and investigations to assure that the equipment and assemblies will meet contract requirements, and all equipment that requires regular maintenance, calibration, etc are accessable from the floor or permanent work platform. It is the Contractor's responsibility to ensure all submittals meet the VA specifications and requirements and it is assumed by the VA that all submittals do meet the VA specifications unless the Contractor has requested a variance in writing and approved by COR prior to the submittal. If at any time during the project it is found that any item does not meet the VA specifications and there was no variance approval the Contractor shall correct at no additional cost or time to the Government even if a submittal was approved.

E. If equipment is submitted which differs in arrangement from that shown, provide documentation proving equivalent performance, design standards and drawings that show the rearrangement of all associated systems. Additionally, any impacts on ancillary equipment or services such as foundations, piping, and electrical shall be the Contractor's responsibility to design, supply, and install at no additional cost or time to the Government. VA approval will be given only if all features of the equipment and associated systems, including accessibility, are equivalent to that required by the contract.

F. Prior to submitting shop drawings for approval, Contractor shall certify in writing that manufacturers of all major items of equipment have each reviewed contract documents, and have jointly coordinated and properly integrated their equipment and controls to provide a complete and efficient installation.

G. Submittals and shop drawings for interdependent items, containing applicable descriptive information, shall be furnished together. Coordinate and properly integrate materials and equipment to provide a completely compatible and efficient installation.

H. Coordination/Shop Drawings:

1. Submit complete consolidated and coordinated shop drawings for all new systems, and for existing systems that are in the same areas.
2. The coordination/shop drawings shall include plan views, elevations and sections of all systems and shall be on a scale of not less than

1:32 (3/8-inch equal to one foot). Clearly identify and dimension the proposed locations of the principal items of equipment. The drawings shall clearly show locations and adequate clearance for all equipment, piping, valves, control panels and other items. Show the access means for all items requiring access for operations and maintenance. Provide detailed coordination/shop drawings of all piping and duct systems. The drawings should include all lockout/tagout points for all energy/hazard sources for each piece of equipment. Coordinate lockout/tagout procedures and practices with local VA requirements.

3. Do not install equipment foundations, equipment or piping until coordination/shop drawings have been approved.
4. In addition, for HVAC systems, provide details of the following:
   a. Mechanical equipment rooms.
   b. Hangers, inserts, supports, and bracing.
   c. Pipe sleeves.
   d. Duct or equipment penetrations of floors, walls, ceilings, or roofs.

I. Manufacturer's Literature and Data: Include full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity. Submit under the pertinent section rather than under this section.
   1. Submit belt drive with the driven equipment. Submit selection data for specific drives when requested by the COR.
   2. Submit electric motor data and variable speed drive data with the driven equipment.
   3. Equipment and materials identification.
   4. Fire-stopping materials.
   5. Hangers, inserts, supports and bracing. Provide complete stress analysis for variable spring and constant support hangers.
   6. Wall, floor, and ceiling plates.

J. Rigging Plan: Provide documentation of the capacity and weight of the rigging and equipment intended to be used. The plan shall include the

path of travel of the load, the staging area and intended access, and qualifications of the operator and signal person.

K. HVAC Maintenance Data and Operating Instructions:

1. Maintenance and operating manuals in accordance with Section 01 00 00, GENERAL REQUIREMENTS, Article, INSTRUCTIONS, for systems and equipment.
2. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replacement parts, and troubleshooting guide:
   a. Include complete list indicating all components of the systems.
   b. Include complete diagrams of the internal wiring for each item of equipment.
   c. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.
3. Provide a listing of recommended replacement parts for keeping in stock supply, including sources of supply, for equipment. Include in the listing belts for equipment: Belt manufacturer, model number, size and style, and distinguished whether of multiple belt sets.

L. Provide copies of approved HVAC equipment submittals to the TAB and Commissioning Subcontractor.

M. Completed System Readiness Checklist provided by the Commissioning Agent and completed by the Contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

N. Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

1.5 QUALITY ASSURANCE

A. Mechanical, electrical and associated systems shall be safe, reliable, efficient, durable, easily and safely operable and maintainable, easily and safely accessible, and in compliance with applicable codes as specified. The systems shall be comprised of high quality institutional-class and industrial-class products of manufacturers that are experienced specialists in the required product lines. All construction firms and personnel shall be experienced and qualified specialists in industrial and institutional HVAC.

B. Flow Rate Tolerance for HVAC Equipment: Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.

C. Equipment Vibration Tolerance:

1. Refer to Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT. Equipment shall be factory-balanced to this tolerance and re-balanced on site, as necessary.
2. After HVAC air balance work is completed and permanent drive sheaves are in place, perform field mechanical balancing and adjustments required to meet the specified vibration tolerance.

D. Products Criteria:

1. Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 3 years (or longer as specified elsewhere). The design, model and size of each item shall have been in satisfactory and efficient operation on at least three installations for approximately three years. However, digital electronics devices, software and systems such as controls, instruments, computer work station, shall be the current generation of technology and basic design that has a proven satisfactory service record of at least three years. See other specification sections for any exceptions and/or additional requirements.
2. Refer to all other sections for quality assurance requirements for systems and equipment specified therein.
3. All items furnished shall be free from defects that would adversely affect the performance, maintainability and appearance of individual components and overall assembly.
4. The products and execution of work specified in Division 33 shall conform to the referenced codes and standards as required by the specifications. Local codes and amendments shall be enforced, along with requirements of local utility companies. The most stringent requirements of these specifications, local codes, or utility company requirements shall always apply. Any conflicts shall be brought to the attention of the COR.
5. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be of the same manufacturer and model number, or if different models are

required they shall be of the same manufacturer and identical to the greatest extent possible (i.e., same model series).

6. Assembled Units: Performance and warranty of all components that make up an assembled unit shall be the responsibility of the manufacturer of the completed assembly.
7. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.
8. Use of asbestos products or equipment or materials containing asbestos is prohibited.

E. HVAC Equipment Service Providers: Service providers shall be authorized and trained by the manufacturers of the equipment supplied. These providers shall be capable of responding onsite and provide acceptable service to restore equipment operations within 4 hours of receipt of notification by phone, e-mail or fax in event of an emergency, such as the shutdown of equipment; or within 24 hours in a non-emergency. Submit names, mail and e-mail addresses and phone numbers of service personnel and companies providing service under these conditions for (as applicable to the project): fans, air handling units, systems, pumps, critical instrumentation, computer workstation and programming.

F. HVAC Mechanical Systems Welding: Before any welding is performed, Contractor shall submit a certificate certifying that welders comply with the following requirements:

1. Qualify welding processes and operators for piping according to ASME BPVC Section IX. Provide proof of current certification.
2. Comply with provisions of ASME B31 series "Code for Pressure Piping".
3. Certify that each welder and welding operator has passed American Welding Society (AWS) qualification tests for the welding processes involved, and that certification is current.
4. All welds shall be stamped according to the provisions of the AWS or ASME as required herein and by the associated code.

G. Manufacturer's Recommendations: Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of

these recommendations shall be furnished to the COR with submittals. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material and removal by the Contractor and no additional cost or time to the Government.

H. Execution (Installation, Construction) Quality:

1. Apply and install all items in accordance with manufacturer's written instructions. Refer conflicts between the manufacturer's instructions and the contract documents to the COR for resolution. Provide written hard copies and computer files on CD or DVD of manufacturer’s installation instructions to the COR with submittals prior to commencing installation of any item. Installation of the item will not be allowed to proceed until the recommendations are received and approved by the VA. Failure to furnish these recommendations is a cause for rejection of the material.
2. All items that require access, such as for operating, cleaning, servicing, maintenance, and calibration, shall be easily and safely accessible by persons standing at floor level, or standing on permanent platforms, without the use of portable ladders. Examples of these items include, but are not limited to, all types of valves, filters and strainers, transmitters, control devices. Prior to commencing installation work, refer conflicts between this requirement and contract documents to the COR for resolution. Failure of the Contractor to resolve, or point out any issues will result in the Contractor correcting at no additional cost or time to the Government.
3. Complete coordination/shop drawings shall be required in accordance with Article, SUBMITTALS. Construction work shall not start on any system until the coordination/shop drawings have been approved by VA.
4. Workmanship/craftsmanship will be of the highest quality and standards. The VA reserves the right to reject any work based on poor quality of workmanship this work shall be removed and done again at no additional cost or time to the Government.

I. Upon request by Government, provide lists of previous installations for selected items of equipment. Include contact persons who will serve as references, with current telephone numbers and e-mail addresses.

J. Guaranty: Warranty of Construction, FAR Clause 52.246-21.

1.6 DELIVERY, STORAGE AND HANDLING

A. Protection of Equipment:

1. Equipment and material placed on the job site shall remain in the custody of the Contractor until phased acceptance, whether or not the Government has reimbursed the Contractor for the equipment and material. The Contractor is solely responsible for the protection of such equipment and material against any damage or theft.
2. Large equipment such as fans and coils if shipped on open trailer trucks shall be covered with shrink on plastics or water proof tarpaulins that provide protection from exposure to rain, road salts and other transit hazards. Protection shall be kept in place until equipment is moved into a building or installed as designed.
3. Repair damaged equipment in first class, new operating condition and appearance; or, replace same as determined and directed by the COR. Such repair or replacement shall be at no additional cost or time to the Government.
4. Protect interiors of new equipment and piping systems against entry of foreign matter. Clean both inside and outside before painting or placing equipment in operation.
5. 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.
6. Protect plastic piping and tanks from ultraviolet light (sunlight).

B. Cleanliness of Piping and Equipment Systems:

1. Exercise care in storage and handling of equipment and piping material to be incorporated in the work. Remove debris arising from cutting, threading and welding of piping.
2. Piping systems shall be flushed, blown or pigged as necessary to deliver clean systems.
3. Clean interior of all tanks prior to delivery for beneficial use by the Government.

4. Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems.

1.7 AS-BUILT DOCUMENTATION

A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.

B. Submit operation and maintenance data updated to include submittal review comments, VA approved substitutions and construction revisions shall be in electronic version on CD or DVD inserted into a three-ring binder. All aspects of system operation and maintenance procedures, including applicable piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices shall be included. A List of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.

C. The installing Contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. Should the installing Contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement. Provide record drawings as follows:

1. As-built drawings are to be provided, with a copy of them on AutoCAD version provided on CD or DVD. The CAD drawings shall use multiple line layers with a separate individual layer for each system.

D. The as-built drawings shall indicate the location and type of all lockout/tagout points for all energy sources for all equipment and pumps to include breaker location and numbers, valve tag numbers, etc. Coordinate lockout/tagout procedures and practices with local VA requirements.

E. Certification documentation shall be provided to COR 21 working days prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and provide documentation/certification that all results of tests were within limits specified. Test results shall contain written sequence of test procedure with written test results annotated at each step along with the expected outcome or setpoint. The results shall include all readings, including but not limited to data on device (make, model and performance characteristics_), normal pressures, switch ranges, trip points, amp readings, and calibration data to include equipment serial numbers or individual identifications, etc.

1.8 JOB CONDITIONS – WORK IN EXISTING BUILDING

A. Building Operation: Government employees will be continuously operating and managing all facilities, including temporary facilities that serve the VAMC.

B. Maintenance of Service: Schedule all work to permit continuous service as required by the VAMC.

C. Steam and Condensate Service Interruptions: Limited steam and condensate service interruptions, as required for interconnections of new and existing systems, will be permitted by the COR during periods when the demands are not critical to the operation of the VAMC. These non-critical periods are limited to between 8 pm and 5 am in the appropriate off-season (if applicable). Provide at least 10 working days advance notice to the COR. The request shall include a detailed plan on the proposed shutdown and the intended work to be done along with manpower levels. All equipment and materials must be onsite and verified with plan 5 days prior to the shutdown or it will need to be rescheduled.

D. Phasing of Work: Comply with all requirements shown on contract documents. Contractor shall submit a complete detailed phasing plan/schedule with manpower levels prior to commencing work. The phasing plan shall be detailed enough to provide milestones in the process that can be verified.

E. Building Working Environment: Maintain the architectural and structural integrity of the building and the working environment at all times. Maintain the interior of building at 18 degrees C (65 degrees F) minimum. Limit the opening of doors, windows or other access openings to brief periods as necessary for rigging purposes. Storm water or ground water leakage is prohibited. Provide daily clean-up of construction and demolition debris on all floor surfaces and on all equipment being operated by VA. Maintain all egress routes and safety systems/devices.

F. Acceptance of Work for Government Operation: As new equipment, systems and facilities are made available for operation and these items are deemed of beneficial use to the Government, inspections will be made and tests will be performed. Based on the inspections, a list of contract deficiencies will be issued to the Contractor. After correction of deficiencies as necessary for beneficial use, the Contracting Officer will process necessary acceptance and the equipment will then be under the control and operation of Government personnel.

PART 2 - PRODUCTS

2.1 FACTORY-ASSEMBLED PRODUCTS

A. Provide maximum standardization of components to reduce spare part requirements.

B. Performance and warranty of all components that make up an assembled unit shall be the responsibility of the manufacturer of the completed assembly.

1. All components of an assembled unit need not be products of same manufacturer.
2. Constituent parts that are alike shall be products of a single manufacturer.
3. Components shall be compatible with each other and with the total assembly for intended service.
4. Contractor shall guarantee performance of assemblies of components, and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.

C. Equipment and components of equipment shall bear manufacturer's name and trademark, model number, serial number and performance data on a nameplate securely affixed in a conspicuous place, or cast integral

with, stamped or otherwise permanently marked upon the components of the equipment.

D. Major items of equipment, which serve the same function, must be the same make and model. Exceptions must be approved by the VA, but may be permitted if performance requirements cannot be met.

2.2 COMPATIBILITY OF RELATED EQUIPMENT

A. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that the result will be a complete and fully operational plant that conforms to contract requirements.

2.3 V-BELT DRIVES

A. Type: ARPM standard V-belts with proper motor pulley and driven sheave. Belts shall be constructed of reinforced cord and rubber.

B. Dimensions, rating and selection standards: ARPM IP-20 and ARPM IP-21.

C. Minimum Horsepower Rating: Motor horsepower plus recommended ARPM service factor (not less than 20 percent) in addition to the ARPM allowances for pitch diameter, center distance, and arc of contact.

D. Maximum Speed: 25 m/s (5000 feet per minute).

E. Adjustment Provisions: For alignment and ARPM standard allowances for installation and take-up.

F. Drives may utilize a single V-Belt (any cross section) when it is the manufacturer's standard.

G. Multiple Belts: Matched to ARPM specified limits by measurement on a belt measuring fixture. Seal matched sets together to prevent mixing or partial loss of sets. Replacement, when necessary, shall be an entire set of new matched belts.

H. Sheaves and Pulleys:

1. Material: Pressed steel, or close-grained cast iron.
2. Bore: Fixed or bushing type for securing to shaft with keys.
3. Balanced: Statically and dynamically.
4. Groove spacing for driving and driven pulleys shall be the same.

I. Drive Types, Based on ARI 435:

1. Provide adjustable-pitch or fixed-pitch drive as follows:
   a. Fan speeds up to 1800 RPM: 7.5 kW (10 horsepower) and smaller.
   b. Fan speeds over 1800 RPM: 2.2 kW (3 horsepower) and smaller.

2. Provide fixed-pitch drives for drives larger than those listed above.
3. The final fan speeds required to just meet the system CFM and pressure requirements, without throttling the design air flow branch, shall be determined by adjustment of a temporary adjustable-pitch motor sheave or by fan law calculation if a fixed-pitch drive is used initially.

J. Final Drive Set: If adjustment is required beyond the capabilities of the factory drive set, the final drive set shall be provided as part of this contract at no additional cost or time to the Government.

2.4 SYNCHRONOUS BELT DRIVES

A. Type: ARPM synchronous belts with proper motor pulley and driven sheave. Belts shall be constructed of reinforced cord and rubber.
B. Dimensions, rating and selection standards: ARPM IP-24 and ARPM IP-27.
C. Minimum Horsepower Rating: Motor horsepower plus recommended ARPM service factor (not less than 20 percent) in addition to the ARPM allowances for pitch diameter, center distance, and arc of contact.
D. Maximum Speed: 25 m/s (5000 feet per minute).
E. Adjustment Provisions: For alignment and ARPM standard allowances for installation and take-up.
F. Drives may utilize a single belt of manufacturer’s standard width for the application.
G. Multiple Belts: Matched to ARPM specified limits by measurement on a belt measuring fixture. Seal matched sets together to prevent mixing or partial loss of sets. Replacement, when necessary, shall be an entire set of new matched belts.
H. Sheaves and Pulleys:
   1. Material: Pressed steel, or close-grained cast iron.
   2. Bore: Fixed or bushing type for securing to shaft with keys.
   3. Balanced: Statically and dynamically.
I. Final Drive Set: The final fan speeds required to just meet the system CFM and pressure requirements, without throttling the design air flow branch, shall be determined by fan law calculation. If adjustment is required beyond the capabilities of the factory drive set, the final drive set shall be provided as part of this contract at no additional cost or time to the Government.

2.5 DRIVE GUARDS

A. For machinery and equipment, provide guards as shown in AMCA 410 for belts, chains, couplings, pulleys, sheaves, shafts, gears and other moving parts regardless of height above the floor to prevent damage to equipment and injury to personnel. Drive guards may be excluded where motors and drives are inside factory-fabricated air handling unit casings.

B. Pump shafts and couplings shall be fully guarded by a sheet steel guard, covering coupling and shaft but not bearings. Material shall be minimum 16-gauge sheet steel; all edges shall be hemmed and ends shall be bent into flanges and the flanges shall be drilled and attached to pump base with minimum of four 6 mm (1/4 inch) bolts. Reinforce guard as necessary to prevent side play forcing guard onto couplings.

C. V-belt and sheave assemblies shall be totally enclosed, firmly mounted, non-resonant. Guard shall be an assembly of minimum 22-gauge sheet steel and expanded or perforated metal to permit observation of belts. 25 mm (1 inch) diameter hole shall be provided at each shaft centerline to permit speed measurement.

D. Materials: Sheet steel, expanded metal or wire mesh rigidly secured so as to be removable without disassembling pipe, duct, or electrical connections to equipment.

E. Access for Speed Measurement: 25 mm (1 inch) diameter hole at each shaft center.

2.6 LIFTING ATTACHMENTS

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

2.7 ELECTRIC MOTORS

A. All material and equipment furnished and installation methods shall conform to the requirements of Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC AND STEAM GENERATION EQUIPMENT; and, Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES. Provide all electrical wiring, conduit, and devices necessary for the proper

connection, protection and operation of the systems. Provide special energy efficient premium efficiency type motors as scheduled.

2.8 VARIABLE SPEED MOTOR CONTROLLERS

A. Refer to Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS for specifications.

B. Coordinate variable speed motor controller communication protocol with Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

C. Provide variable speed motor controllers with or without a bypass contactor as indicated in contract drawings.

D. The combination of controller and motor shall be provided by the manufacturer of the driven equipment, such as pumps and fans, and shall be rated for 100 percent output performance. Multiple units of the same class of equipment, i.e. air handlers, fans, pumps, shall be product of a single manufacturer.

E. Motors shall be premium efficiency type and be approved by the motor controller manufacturer. The controller-motor combination shall be guaranteed to provide full motor nameplate horsepower in variable frequency operation. Both driving and driven motor/fan sheaves shall be fixed pitch.

F. Controller shall not add any current or voltage transients to the input ac power distribution system, DDC controls, sensitive medical equipment, etc., nor shall be affected from other devices on the ac power system.

2.9 EQUIPMENT AND MATERIALS IDENTIFICATION

A. Use symbols, nomenclature and equipment numbers specified, shown on the contract documents and shown in the maintenance manuals. Identification for piping is specified in Section 09 91 00, PAINTING.

B. Use symbols, nomenclature and equipment numbers specified, shown on the contract documents and shown in the maintenance manuals. In addition, provide bar code identification nameplate for all equipment which will allow the equipment identification code to be scanned into the system for maintenance and inventory tracking. Identification for piping is specified in Section 09 91 00, PAINTING.

C. Interior (Indoor) Equipment: Engraved nameplates, with letters not less than 5 mm (3/16 inch) high of brass with black-filled letters, or rigid black plastic with white letters specified in Section 09 91 00,

PAINTING permanently fastened to the equipment. Identify unit components such as coils, filters, fans, etc.

D. Exterior (Outdoor) Equipment: Brass nameplates, with engraved black filled letters, not less than 5 mm (3/16 inch) high riveted or bolted to the equipment.

E. Control Items: Label all instrumentation, temperature and humidity sensors, controllers and control dampers. Identify and label each item as they appear on the control diagrams.

F. Valve Tags and Lists:

1. HVAC and Mechanical Rooms: Provide for all valves other than for equipment in Section 23 36 00, AIR TERMNAL UNITS.
2. Valve tags: Engraved black filled numbers and letters not less than 15 mm (1/2 inch) high for number designation, and not less than 6 mm (1/4 inch) for service designation on 19-gauge 40 mm (1-1/2 inches) round brass disc, attached with brass "S" hook or brass chain.
3. Valve lists: Typed or printed plastic coated card(s), sized 215 mm (8-1/2 inches) by 275 mm (11 inches) showing tag number, valve function and area of control, for each service or system. Punch sheets for a 3-ring notebook.
4. Provide detailed plan for each floor of the building indicating the location and valve number for each valve. Identify location of each valve with a color-coded thumb tack in ceiling.

G. Ceiling Grid Labels:

1. 50 mm (2 inch) long by 15 mm (1/2 inch) wide by 0.025 mm (1 mil) thick UV resistant metalized polyester label with red border color and black custom lettering on white background interior. Peel and stick adhesive backing. Label and adhesive manufactured specifically for use in equipment inventory tagging.
2. Custom print labels with above ceiling HVAC equipment numbers.

2.10 FIRESTOPPING

A. Section 07 84 00, FIRESTOPPING specifies an effective barrier against the spread of fire, smoke and gases where penetrations occur for piping and ductwork. Refer to Section 23 07 11, HVAC AND BOILER PLANT INSULATION, for firestop pipe and duct insulation.

2.11 GALVANIZED REPAIR COMPOUND

A. Mil-P-21035B, paint form.

2.12 HVAC PIPE AND EQUIPMENT SUPPORTS AND RESTRAINTS

A. Vibration Isolators: Refer to Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.

B. Supports for Roof Mounted Items:

1. Equipment: Equipment rails shall be galvanized steel, minimum 1.3 mm (18 gauge), with integral baseplate, continuous welded corner seams, factory installed 50 by 100 mm (2 by 4 inches) treated wood nailer, 1.3 mm (18 gauge) galvanized steel counter flashing cap with screws, built-in cant strip, (except for gypsum or tectum deck), minimum height 275 mm (11 inches). For surface insulated roof deck, provide raised cant strip to start at the upper surface of the insulation.
2. Pipe/duct pedestals: Provide a galvanized Unistrut channel welded to U-shaped mounting brackets which are secured to side of rail with galvanized lag bolts.

C. Pipe Supports: Comply with MSS SP-58. Type Numbers specified refer to this standard. For selection and application comply with MSS SP-58.

D. Attachment to Concrete Building Construction:

1. Concrete insert: MSS SP-58, Type 18.
2. Self-drilling expansion shields and machine bolt expansion anchors: Permitted in concrete not less than 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.

E. Attachment to Steel Building Construction:

1. Welded attachment: MSS SP-58, Type 22.
2. Beam clamps: MSS SP-58, Types 20, 21, 28 or 29. Type 23 C-clamp may be used for individual copper tubing up to 23 mm (7/8 inch) outside diameter.

F. Attachment to existing structure: Support from existing floor/roof frame.

G. Attachment to Wood Construction: Wood screws or lag bolts.

H. Hanger Rods: Hot-rolled steel, ASTM A36/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.

I. Hangers Supporting Multiple Pipes (Trapeze Hangers): Galvanized, cold formed, lipped steel channel horizontal member, not less than 41 mm by 41 mm (1-5/8 inches by 1-5/8 inches), 2.7 mm (12 gauge), designed to accept special spring held, hardened steel nuts. Trapeze hangers are prohibited for use for steam supply and condensate piping.
   1. Allowable hanger load: Manufacturers rating less 91 kg (200 pounds).
   2. Guide individual pipes on the horizontal member of every other trapeze hanger with 6 mm (1/4 inch) U-bolt fabricated from steel rod. Provide Type 40 insulation shield, secured by two 15 mm (1/2 inch) galvanized steel bands, or preinsulated calcium silicate shield for insulated piping at each hanger.

J. Supports for Piping Systems:
   1. Select hangers sized to encircle insulation on insulated piping. Refer to Section 23 07 11, HVAC AND BOILER PLANT INSULATION for insulation thickness. To protect insulation, provide Type 39 saddles for roller type supports or preinsulated calcium silicate shields. Provide Type 40 insulation shield or preinsulated calcium silicate shield at all other types of supports and hangers including those for preinsulated piping.
   2. Piping Systems except High and Medium Pressure Steam (MSS SP-58):
      a. Standard clevis hanger: Type 1; provide locknut.
      b. Riser clamps: Type 8.
      c. Wall brackets: Types 31, 32 or 33.
      d. Roller supports: Type 41, 43, 44 and 46.
      e. Saddle support: Type 36, 37 or 38.
      f. Turnbuckle: Types 13 or 15. Preinsulate.
      g. U-bolt clamp: Type 24.
      h. Copper Tube:
         1) Hangers, clamps and other support material in contact with tubing shall be painted with copper colored epoxy paint, plastic coated or taped with non-adhesive isolation tape to prevent electrolysis.
         2) For vertical runs use epoxy painted or plastic-coated riser clamps.

3) For supporting tube to strut: Provide epoxy painted pipe straps for copper tube or plastic inserted vibration isolation clamps.
4) Insulated Lines: Provide pre-insulated calcium silicate shields sized for copper tube.

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

3. High and Medium Pressure Steam (MSS SP-58):
   a. Provide eye rod or Type 17 eye nut near the upper attachment.
   b. Piping 50 mm (2 inches) and larger: Type 43 roller hanger. For roller hangers requiring seismic bracing provide a Type 1 clevis hanger with Type 41 roller attached by flat side bars.
   c. Piping with Vertical Expansion and Contraction:
      1) Movement up to 20 mm (3/4 inch): Type 51 or 52 variable spring unit with integral turn buckle and load indicator.
      2) Movement more than 20 mm (3/4 inch): Type 54 or 55 constant support unit with integral adjusting nut, turn buckle and travel position indicator.
4. Convertor and Expansion Tank Hangers: May be Type 1 sized for the shell diameter. Insulation where required will cover the hangers.

K. 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 chilled or cold water shall have insulation that extends a minimum of 25 mm (1 inch) past the sheet metal. Provide for an adequate vapor barrier in chilled lines.
   b. The pre-insulated calcium silicate shield shall support the maximum allowable water filled span as indicated in MSS SP-58. To

support the load, the shields may 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, roller supports or flat surfaces.

L. Seismic Restraint of Piping and Ductwork: Refer to Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS. Comply with MSS SP-127.

2.13 PIPE PENETRATIONS

A. Install sleeves during construction for other than blocked out floor openings for risers in mechanical bays.

B. To prevent accidental liquid spills from passing to a lower level, provide the following:

1. For sleeves: Extend sleeve 25 mm (1 inch) above finished floor and provide sealant for watertight joint.
2. For blocked out floor openings: Provide 40 mm (1-1/2 inch) angle set in silicone adhesive around opening.
3. For drilled penetrations: Provide 40 mm (1-1/2 inch) angle ring or square set in silicone adhesive around penetration.

C. Penetrations through beams or ribs are prohibited, but may be installed in concrete beam flanges. Any deviation from these requirements must receive prior approval of COR.

D. Sheet Metal, Plastic, or Moisture-resistant Fiber Sleeves: Provide for pipe passing through floors, interior walls, and partitions, unless brass or steel pipe sleeves are specifically called for below.

E. Cast Iron or Zinc Coated Pipe Sleeves: Provide for pipe passing through exterior walls below grade. Make space between sleeve and pipe watertight with a modular or link rubber seal. Seal shall be applied at both ends of sleeve.

F. Galvanized Steel or an alternate Black Iron Pipe with asphalt coating Sleeves: Provide for pipe passing through concrete beam flanges, except where brass pipe sleeves are called for. Provide sleeve for pipe passing through floor of mechanical rooms, laundry work rooms, and

animal rooms above basement. Except in mechanical rooms, connect sleeve with floor plate.

G. Brass Pipe Sleeves: Provide for pipe passing through quarry tile, terrazzo or ceramic tile floors. Connect sleeve with floor plate.

H. Sleeves are not required for wall hydrants for fire department connections or in drywall construction.

I. Sleeve Clearance: Sleeve through floors, walls, partitions, and beam flanges shall be one inch greater in diameter than external diameter of pipe. Sleeve for pipe with insulation shall be large enough to accommodate the insulation. Interior openings shall be caulked tight with fire stopping material and sealant to prevent the spread of fire, smoke, and gases.

J. Sealant and Adhesives: Shall be as specified in Section 07 92 00, JOINT SEALANTS.

2.14 DUCT PENETRATIONS

A. Provide curbs for roof mounted piping, ductwork and equipment. Curbs shall be 450 mm (18 inches) high with continuously welded seams, built-in cant strip, interior baffle with acoustic insulation, curb bottom, hinged curb adapter.

B. Provide firestopping for openings through fire and smoke barriers, maintaining minimum required rating of floor, ceiling or wall assembly. See section 07 84 00, FIRESTOPPING.

2.15 SPECIAL TOOLS AND LUBRICANTS

A. Furnish, and turn over to the COR, tools not readily available commercially, that are required for disassembly or adjustment of equipment and machinery furnished.

B. Grease Guns with Attachments for Applicable Fittings: One for each type of grease required for each motor or other equipment.

C. Refrigerant Tools: Provide system charging/Evacuation equipment, gauges, fittings, and tools required for maintenance of furnished equipment.

D. Tool Containers: Hardwood or metal, permanently identified for intended service and mounted, or located, where directed by the COR.

E. Lubricants: A minimum of 0.95 L (1 quart) of oil, and 0.45 kg (1 pound) of grease, of equipment manufacturer's recommended grade and type, in

unopened containers and properly identified as to use for each different application.

2.16 WALL, FLOOR AND CEILING PLATES

A. Material and Type: Chrome plated brass or chrome plated steel, one piece or split type with concealed hinge, with set screw for fastening to pipe, or sleeve. Use plates that fit tight around pipes, cover openings around pipes and cover the entire pipe sleeve projection.

B. Thickness: Not less than 2.4 mm (3/32 inch) for floor plates. For wall and ceiling plates, not less than 0.64 mm (0.025 inch) for up to 80 mm (3-inch pipe), 0.89 mm (0.035 inch) for larger pipe.

C. Locations: Use where pipe penetrates floors, walls and ceilings in exposed locations, in finished areas only. Provide a watertight joint in spaces where brass or steel pipe sleeves are specified.

2.17 ASBESTOS

A. Materials containing asbestos are prohibited.

PART 3 - EXECUTION

3.1 GENERAL

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

3.2 ARRANGEMENT AND INSTALLATION OF EQUIPMENT AND PIPING

A. Location of piping, sleeves, inserts, hangers, and equipment, access provisions shall be coordinated with the work of all trades. The coordination/shop drawings shall be submitted for review. Locate piping, sleeves, inserts, hangers, ductwork and equipment clear of windows, doors, openings, light outlets, and other services and utilities. Equipment coordination/shop drawings shall be prepared to coordinate proper location and personnel access of all facilities. The drawings shall be submitted for review. Follow manufacturer's published recommendations for installation methods not otherwise specified.

B. Operating Personnel Access and Observation Provisions: Select and arrange all equipment and systems to provide clear view and easy access, without use of portable ladders, for maintenance and operation of all devices including, but not limited to: all equipment items, valves, filters, strainers, transmitters, sensors, control devices. All gauges and indicators shall be clearly visible by personnel standing on

the floor or on permanent platforms. Do not reduce or change maintenance and operating space and access provisions that are shown on the contract documents.

C. Equipment and Piping Support: Coordinate structural systems necessary for pipe and equipment support with pipe and equipment locations to permit proper installation.

D. Location of pipe sleeves, trenches and chases shall be accurately coordinated with equipment and piping locations.

E. Cutting Holes:

1. Cut holes through concrete and masonry by rotary core drill. Pneumatic hammer, impact electric, and hand or manual hammer type drill is prohibited, except as permitted by COR where working area space is limited.
2. Locate holes to avoid interference with structural members such as slabs, columns, ribs, beams or reinforcing. Holes shall be laid out in advance and drilling done only after approval by COR. If the Contractor considers it necessary to drill through structural members, this matter shall be referred to COR for approval.
3. Do not penetrate membrane waterproofing.

F. Minor Piping: Generally, small diameter pipe runs from drips and drains, water cooling, and other service are not shown but must be provided.

G. Electrical Interconnection of Instrumentation or Controls: This generally not shown but must be provided. This includes interconnections of sensors, transmitters, transducers, control devices, control and instrumentation panels, instruments and computer workstations. Devices shall be located so they are easily accessible for testing, maintenance, calibration, etc. The COR has the final determination on what is accessible and what is not. Comply with NFPA 70.

H. Protection and Cleaning:

1. Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations and as approved by the COR. Damaged or defective items in the opinion of the COR, shall be replaced.

2. Protect all finished parts of equipment, such as shafts and bearings where accessible, from rust prior to operation by means of protective grease coating and wrapping. Close pipe openings with caps or plugs during installation. Tightly cover and protect fixtures and equipment against dirt, water chemical, or mechanical injury. At completion of all work thoroughly clean fixtures, exposed materials and equipment.

I. Install gauges, thermometers, valves and other devices with due regard for ease in reading or operating and maintaining said devices. Locate and position thermometers and gauges to be easily read by operator or staff standing on floor or walkway provided. Servicing shall not require dismantling adjacent equipment or pipe work.

J. Install steam piping expansion joints as per manufacturer’s recommendations.

K. Work in Existing Building:

1. Perform as specified in Article, OPERATIONS AND STORAGE AREAS, Article, ALTERATIONS, and Article, RESTORATION of the Section 01 00 00, GENERAL REQUIREMENTS for relocation of existing equipment, alterations and restoration of existing building(s).
2. As specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, OPERATIONS AND STORAGE AREAS, make alterations to existing service piping at times that will least interfere with normal operation of the facility.

L. Work in Animal Research Areas: Seal all pipe and duct penetrations with silicone sealant to prevent entrance of insects.

M. Switchgear/Electrical Equipment Drip Protection: Every effort shall be made to eliminate the installation of pipe above electrical and data/telephone switchgear. If this is not possible, encase pipe in a second pipe with a minimum of joints. Installation of piping, ductwork, leak protection apparatus or other installations foreign to the electrical installation shall not be located in the space equal to the width and depth of the equipment and extending from to a height of 1.8 m (6 feet) above the equipment or to ceiling structure, whichever is lower (NFPA 70).

N. Inaccessible Equipment:

1. Where the Government determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance or inspections, equipment shall be removed, and reinstalled or remedial action performed as directed at no additional cost or time to the Government.
2. The term "conveniently accessible" is defined as capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to motors, fans, pumps, belt guards, transformers, high voltage lines, conduit and raceways, piping, hot surfaces, and ductwork. The COR has final determination on whether an installation meets this requirement or not.

3.3 TEMPORARY PIPING AND EQUIPMENT

A. Continuity of operation of existing facilities will generally require temporary installation or relocation of equipment and piping.

B. The Contractor shall provide all required facilities in accordance with the requirements of phased construction and maintenance of service. All piping and equipment shall be properly supported, sloped to drain, operate without excessive stress, and shall be insulated where injury can occur to personnel by contact with operating facilities. The requirements of Article, ARRANGEMENT AND INSTALLATION OF EQUIPMENT AND PIPING apply.

C. Temporary facilities and piping shall be completely removed and any openings in structures sealed. Provide necessary blind flanges and caps to seal open piping remaining in service.

3.4 RIGGING

A. Design is based on application of available equipment. Openings in building structures are planned to accommodate design scheme.

B. Alternative methods of equipment delivery may be offered by Contractor and will be considered by Government under specified restrictions of phasing and maintenance of service requirements as well as structural integrity of the building.

C. Close all openings in the building when not required for rigging operations to maintain proper environment in the facility for Government operation and maintenance of service.

D. Contractor shall provide all facilities required to deliver specified equipment and place on foundations. Attachments to structures for rigging purposes and support of equipment on structures shall be Contractor's full responsibility. Upon request, the Government will check structure adequacy and advise Contractor of recommended restrictions.

E. Contractor shall check all clearances, weight limitations and shall offer a rigging plan designed by a Registered Professional Engineer. All modifications to structures, including reinforcement thereof, shall be at Contractor's cost, time and responsibility.

F. Follow approved rigging plan.

G. Restore building to original condition upon completion of rigging work.

3.5 PIPE AND EQUIPMENT SUPPORTS

A. Where hanger spacing does not correspond with joist or rib spacing, use structural steel channels designed by a structural engineer, secured directly to joist and rib structure that will correspond to the required hanger spacing, and then suspend the equipment and piping from the channels. Drill or burn holes in structural steel only with the prior approval of the COR.

B. Use of chain pipe supports; wire or strap hangers; wood for blocking, stays and bracing; or, hangers suspended from piping above are prohibited. Replace or thoroughly clean rusty products and paint with zinc primer.

C. Hanger rods shall be used that are straight and vertical. Turnbuckles for vertical adjustments may be omitted where limited space prevents use. Provide a minimum of 15 mm (1/2 inch) clearance between pipe or piping covering and adjacent work.

D. HVAC Horizontal Pipe Support Spacing: Refer to MSS SP-58. Provide additional supports at valves, strainers, in-line pumps and other heavy components. Provide a support within one foot of each elbow.

E. HVAC Vertical Pipe Supports:

1. Up to 150 mm (6-inch pipe), 9 m (30 feet) long, bolt riser clamps to the pipe below couplings, or welded to the pipe and rests supports securely on the building structure.
2. Vertical pipe larger than the foregoing, support on base elbows or tees, or substantial pipe legs extending to the building structure.

F. Overhead Supports:
   1. The basic structural system of the building is designed to sustain the loads imposed by equipment and piping to be supported overhead.
   2. Provide steel structural members, in addition to those shown, of adequate capability to support the imposed loads, located in accordance with the final approved layout of equipment and piping.
   3. Tubing and capillary systems shall be supported in channel troughs.
G. Floor Supports:
   1. Provide concrete bases, concrete anchor blocks and pedestals, and structural steel systems for support of equipment and piping. 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. Chiller foundations shall have horizontal dimensions that exceed chiller base frame dimensions by at least 150 mm (6 inches) on all sides. Structural contract documents 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 granular material to permit alignment and realignment.
   4. For seismic anchoring, refer to Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

3.6 MECHANICAL DEMOLITION

A. Rigging access, other than indicated on the contract documents, shall be provided by the Contractor after approval for structural integrity by the COR. Such access shall be provided without additional cost or time to the Government. Where work is in an operating plant, provide approved protection from dust and debris at all times for the safety of plant personnel and maintenance of plant operation and environment of the plant.

B. In an operating facility, maintain the operation, cleanliness and safety. Government personnel will be carrying on their normal duties of operating, cleaning and maintaining equipment and plant operation. Confine the work to the immediate area concerned; maintain cleanliness and wet down demolished materials to eliminate dust. Debris accumulated in the area to the detriment of plant operation is prohibited. Perform all flame cutting to maintain the fire safety integrity of this plant. Adequate fire extinguishing facilities shall be available at all times. Perform all work in accordance with recognized fire protection standards. Inspection will be made by personnel of the VAMC, and Contractor shall follow all directives of the COR with regard to rigging, safety, fire safety, and maintenance of operations.

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 pads, pipe, valves, fittings, insulation, and all hangers including the top connection and any fastenings to building structural systems. All openings shall be sealed after removal of equipment, pipes, ducts, and other penetrations in roof, walls, floors, in an approved manner and in accordance with contract documents where specifically covered. Structural integrity of the building system shall be maintained. Reference shall also be made to the contract documents of the other disciplines in the project for additional facilities to be demolished or handled.

D. All indicated valves including gate, globe, ball, butterfly and check, all pressure gauges and thermometers with wells shall remain Government property and shall be removed and delivered to COR and stored as directed. The Contractor shall remove all other material and equipment, devices and demolition debris under these contract documents. Such material shall be removed from Government property expeditiously and shall not be allowed to accumulate.

3.7 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. Repair scratches, scuffs, and abrasions prior to applying prime and finish coats.
2. The following material and equipment shall not be painted:
   a. Motors, controllers, control switches, and safety switches.
   b. Control and interlock devices.
   c. Regulators.
   d. Pressure reducing valves.
   e. Control valves and thermostatic elements.
   f. Lubrication devices and grease fittings.
   g. Copper, brass, aluminum, stainless steel and bronze surfaces.
   h. Valve stems and rotating shafts.
   i. Pressure gauges and thermometers.
   j. Glass.
   k. Nameplates.
3. Control and instrument panels shall be cleaned, damaged surfaces repaired, and shall be touched-up with matching paint obtained from panel manufacturer.
4. Pumps, motors, steel and cast-iron bases, and coupling guards shall be cleaned, and shall be touched-up with the same paint type and color as utilized by the pump manufacturer.
5. Temporary Facilities: Apply paint to surfaces that do not have existing finish coats. This may include painting exposed metals where hangers were removed or where equipment was moved or removed.
6. Paint shall withstand the following temperatures without peeling or discoloration:
   a. Condensate and Feedwater: 38 degrees C (100 degrees F) on insulation jacket surface and 121 degrees C (250 degrees F) on metal pipe surface.
   b. Steam: 52 degrees C (125 degrees F) on insulation jacket surface and 190 degrees C (374 degrees F) on metal pipe surface.

7. Final result shall be smooth, even-colored, even-textured factory finish on all items. Completely repaint the entire piece of equipment if necessary to achieve this.
8. Lead based paints are prohibited.

3.8 IDENTIFICATION SIGNS

A. Provide laminated plastic signs, with engraved lettering not less than 5 mm (3/16 inch) high, designating functions, for all equipment, switches, motor controllers, relays, meters, control devices, including automatic control valves. Nomenclature and identification symbols shall correspond to that used in maintenance manual, and in diagrams specified elsewhere. Attach by chain, adhesive, or screws.

B. Factory Built Equipment: Metal plate, securely attached, with name and address of manufacturer, serial number, model number, size, performance.

C. Pipe Identification: Refer to Section 09 91 00, PAINTING.

D. Attach ceiling grid label on ceiling grid location directly underneath above-ceiling air terminal, control system component, valve, filter unit, fan etc.

3.9 MOTOR AND DRIVES

A. Use synchronous belt drives only on equipment controlled by soft starters or variable frequency drive motor controllers without a bypass contactor. Use V-belt drives on all other applications.

B. Alignment of V-Belt Drives: Set driving and driven shafts parallel and align so that the corresponding grooves are in the same plane.

C. Alignment of Synchronous Belt Drives: Set driving and driven shafts parallel and align so that the corresponding pulley flanges are in the same plane.

D. Alignment of Direct-Connect Drives: Securely mount motor in accurate alignment so that shafts are per coupling manufacturer’s tolerances when both motor and driven machine are operating at normal temperatures.

3.10 LUBRICATION

A. All equipment and devices requiring lubrication shall be lubricated prior to initial operation. Field-check all devices for proper lubrication.

B. All devices and equipment shall be equipped with required lubrication fittings or devices. A minimum of 0.95 liter (1 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; also provide 12 grease sticks for lubricated plug valves. Deliver all materials to COR in unopened containers that are properly identified as to application.

C. All lubrication points shall be accessible without disassembling equipment, except to remove access plates.

D. All lubrication points shall be extended to one side of the equipment.

3.11 STARTUP, TEMPORARY OPERATION AND TESTING

A. Perform tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.

B. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.

C. The Commissioning Agent will observe startup and Contractor testing of selected equipment. Coordinate the startup and Contractor testing schedules with COR and Commissioning Agent. Provide a minimum notice of 10 working days prior to startup and testing.

D. Startup of equipment shall be performed as described in equipment specifications. Vibration within specified tolerance shall be verified prior to extended operation. Temporary use of equipment is specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, TEMPORARY USE OF MECHANICAL AND ELECTRICAL EQUIPMENT.

3.12 OPERATING AND PERFORMANCE TESTS

A. Prior to the final inspection, perform required tests as specified in Section 01 00 00, GENERAL REQUIREMENTS Article, TESTS, and in individual Division 23 specification sections and submit the test reports and records to the COR.

B. Should evidence of malfunction in any tested system, or piece of equipment or component part thereof, occur during or as a result of tests, make proper corrections, repairs or replacements, and repeat tests at no additional cost or time to the Government.

C. When completion of certain work or system occurs at a time when final control settings and adjustments cannot be properly made to make performance tests, then conduct such performance tests and finalize control settings for heating systems and for cooling systems respectively during first actual seasonal use of respective systems following completion of work. Rescheduling of these tests shall be requested in writing to COR for approval.

D. No adjustments may be made during the acceptance inspection. All adjustments shall have been made by this point.

E. Perform tests as required for commissioning provisions in accordance with Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS and Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

3.13 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

B. Components provided under this section of the specification will be tested as part of a larger system.

3.14 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer’s technical representative for 4 hours to instruct each VA personnel responsible in operation and maintenance of the system.

B. Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

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SECTION 23 05 12

GENERAL MOTOR REQUIREMENTS FOR HVAC AND STEAM GENERATION EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation and connection of motors for HVAC and steam generation equipment.

B. A complete listing of common acronyms and abbreviations are included in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.

B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

D. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

E. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

F. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

G. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.3 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Where conflicts occur these specifications and the VHA standards will govern.

B. American Bearing Manufacturers Association (ABMA):

9-2015.....Load Ratings and Fatigue Life for Ball Bearings

11-2014.....Load Ratings and Fatigue Life for Roller Bearings

C. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):

90.1-2019.....Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings

D. Institute of Electrical and Electronics Engineers (IEEE):

112-2017.....Standard Test Procedure for Polyphase Induction Motors and Generators

841-2009.....IEEE Standard for Petroleum and Chemical Industry-Premium-Efficiency, Severe-Duty,

Totally Enclosed Fan-Cooled (TEFC) Squirrel Cage Induction Motors--Up to and Including 370 kW (500 hp)

E. National Electrical Manufacturers Association (NEMA):
MG 1-2016 (R2019).....Motors and Generators
MG 2-2014.....Safety Standard for Construction and Guide for Selection, Installation and Use of Electric Motors and Generators
250-2020.....Enclosures for Electrical Equipment (1000 Volts Maximum)

F. National Fire Protection Association (NFPA):
70-2020.....National Electrical Code (NEC)

1.4 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC AND STEAM GENERATION EQUIPMENT", with applicable paragraph identification.

C. Submit motor submittals with driven equipment.

D. Shop Drawings:
1. Provide documentation to demonstrate compliance with contract documents.
2. Motor nameplate information shall be submitted including electrical ratings, efficiency, bearing data, power factor, frame size, dimensions, mounting details, materials, horsepower, voltage, phase, speed (RPM), enclosure, starting characteristics, torque characteristics, code letter, full load and locked rotor current, service factor, and lubrication method.

E. 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.

F. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replacement parts, and troubleshooting guide:
   1. Include complete list indicating all components of the systems.
   2. Include complete diagrams of the internal wiring for each item of equipment.
   3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

G. Certification: Two weeks prior to final inspection, unless otherwise noted, certification shall be submitted to the COR stating that the motors have been properly applied, installed, adjusted, lubricated, and tested.

H. 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 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

I. Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

1.5 AS-BUILT DOCUMENTATION

A. Comply with requirements in Paragraph “AS-BUILT DOCUMENTATION” in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

PART 2 - PRODUCTS

2.1 MOTORS

A. For alternating current, fractional and integral horsepower motors, NEMA MG 1 and NEMA MG 2 shall apply.

B. For severe duty TEFC motors, IEEE 841 shall apply.

C. All material and equipment furnished and installation methods shall conform to the requirements of Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES. Provide all electrical wiring, conduit, and devices necessary for the proper connection, protection and operation of the systems. Provide premium efficiency type motors. Unless otherwise specified for a particular application, use electric motors with the following requirements.

D. Single-phase Motors:

1. Motors for centrifugal fans and pumps may be split phase or permanent split capacitor (PSC) type. Provide capacitor-start type for hard starting applications.
   a. In order to meet ASHRAE 90.1 requirements, motors for small packaged HVAC equipment may be Electrically Commutated motor (EC type). Motor shall be brushless DC type specifically designed for applications with heavy duty ball bearings and electronic communication. The motor shall be speed controllable down to 20 percent of full speed and 85 percent efficient at all speeds.

E. Poly-phase Motors: NEMA Design B, Squirrel cage, induction type.
   1. Two Speed Motors: Each two-speed motor shall have two separate windings. Provide a time- delay (20 seconds minimum) relay for switching from high to low speed.

F. Voltage ratings shall be as follows:
   1. Single phase:
      a. Motors connected to 120-volt systems: 115 volts.
      b. Motors connected to 208-volt systems: 200 volts.
      c. Motors connected to 240-volt or 480-volt systems: 230/460 volts, dual connection.
   2. Three phase:
      a. Motors connected to 208-volt systems: 200 volts.
      b. Motors, less than 74.6 kW (100 hp), connected to 240-volt or 480-volt systems: 208-230/460 volts, dual connection.
      c. Motors, 74.6 kW (100 hp) or greater, connected to 240-volt systems: 230 volts.
      d. Motors, 74.6 kW (100 hp) or greater, connected to 480-volt systems: 460 volts.
      e. Motors connected to high voltage systems (Over 600V): Shall conform to NEMA MG 1 for connection to the nominal system voltage shown in the contract documents.

G. Number of phases shall be as follows:
   1. Motors, less than 373 W (1/2 hp): Single phase.
   2. Motors, 373 W (1/2 hp) and greater: 3 phase.
   3. Exceptions:
      a. Hermetically sealed motors.

b. Motors for equipment assemblies, less than 746 W (1 hp), shall be single phase provided the manufacturer of the proposed assemblies cannot supply the assemblies with three phase motors.

H. Horsepower ratings shall be adequate for operating the connected loads continuously in the prevailing ambient temperatures in areas where the motors are installed, without exceeding the NEMA standard temperature rises for the motor insulation.

I. Motor designs, as indicated by the NEMA code letters, shall be coordinated with the connected loads to assure adequate starting, acceleration, and running torque without exceeding nameplate ratings or considering service factor.

J. Motor Enclosures:

1. Shall be the NEMA types as specified and/or shown in the contract documents.
2. Where the types of motor enclosures are not shown in the contract documents, they shall be the NEMA types per NEMA 250, which are most suitable for the environmental conditions where the motors are being installed. Enclosure requirements for certain conditions are as follows:
   a. Motors located outdoors, indoors in wet or high humidity locations, or in unfiltered airstreams shall be totally enclosed type.
   b. Where motors are located in an NEC 511 classified area, provide TEFC explosion proof motor enclosures.
   c. Where motors are located in a corrosive environment, provide TEFC enclosures with corrosion resistant finish.
3. Enclosures shall be primed and finish coated at the factory with manufacturer's prime coat and standard finish.

K. Electrical Design Requirements:

1. Motors shall be continuous duty.
2. The insulation system shall be rated minimum of Class B, 130 degrees C (266 degrees F).
3. The maximum temperature rise by resistance at rated power shall not exceed Class B limits, 80 degrees C (176 degrees F).
4. The speed/torque and speed/current characteristics shall comply with NEMA Design A or B, as specified.

5. Motors shall be suitable for full voltage starting, unless otherwise noted. Coordinate motor features with applicable motor controllers.
6. Motors for variable frequency drive applications shall adhere to NEMA MG 1, Part 30, Application Considerations for Constant Speed Motors Used on a Sinusoidal Bus with Harmonic Content and General-Purpose Motors Used with Adjustable-Voltage or Adjustable-Frequency Controls or Both, or NEMA MG 1, Part 31, Definite-Purpose Inverter-Fed Polyphase Motors.

L. Mechanical Design Requirements:

1. Bearings shall be rated in accordance with ABMA 9 or ABMA 11 for a minimum fatigue life of 26,280 hours for belt-driven loads and 100,000 hours for direct-drive loads based on L10 (Basic Rating Life) at full load direct coupled, except vertical high thrust motors which require a 40,000 hours rating. A minimum fatigue life of 40,000 hours is required for VFD drives.
2. Vertical motors shall be capable of withstanding a momentary up thrust of at least 30 percent of normal down thrust.
3. Grease lubricated bearings shall be designed for electric motor use. Grease shall be capable of the temperatures associated with electric motors and shall be compatible with Polyurea based greases.
4. Grease fittings, if provided, shall be Alemite type or equivalent.
5. Oil lubricated bearings, when specified, shall have an externally visible sight glass to view oil level.
6. Vibration shall not exceed 3.8 mm (0.15 inch) per second, unfiltered peak.
7. Noise level shall meet the requirements of the application.
8. Motors on 180 frames and greater shall have provisions for lifting eyes or lugs capable of a safety factor of 5.
9. All external fasteners shall be corrosion resistant.
10. Condensation heaters, when specified, shall keep motor windings at least 5 degrees C (9 degrees F) above ambient temperature.
11. Winding thermostats, when specified shall be normally closed, connected in series.
12. Grounding provisions shall be in the main terminal box.

M. 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, controls and interlocks on factory assembled and wired devices shall be in accordance with the requirements of this specification.
3. Wire and cable materials specified in the electrical division of the specifications shall be modified as follows:
   a. Wiring material located where temperatures can exceed 71 degrees C (160 degrees F) shall be stranded copper with Teflon FEP insulation with jacket. This includes wiring on the boilers.
   b. Other wiring at boilers and to control panels shall be NFPA 70 designation THWN.
   c. Provide shielded conductors or wiring in separate conduits for all instrumentation and control systems where recommended by manufacturer of equipment.
4. Select motor sizes so that the motors do not operate into the service factor at maximum required loads on the driven equipment. Motors on pumps shall be sized for non-overloading at all points on the pump performance curves.
5. Motors utilized with variable frequency drives shall be rated “inverter-duty” per NEMA MG 1, Part 31, Definite-Purpose Inverter-Fed Polyphase Motors. Provide motor shaft grounding apparatus that shall protect bearings from damage from stray currents.

N. Additional requirements for specific motors, as indicated in the other sections listed in Article, RELATED SECTIONS shall also apply.

O. NEMA Premium Efficiency Electric Motors (Motor Efficiencies): All permanently wired polyphase motors of 746 W (1 hp) or more shall meet the minimum full-load efficiencies as indicated in the following table. Motors of 746 W (1 hp) or more with open, drip-proof, or TEFC enclosures shall be NEMA premium efficiency type, unless otherwise indicated. Motors provided as an integral part of motor driven equipment are excluded from this requirement if a minimum seasonal or

overall efficiency requirement is indicated for that equipment by the provisions of another section.

Minimum Premium Efficiencies Open Drip-Proof				**Minimum Premium Efficiencies Totally Enclosed Fan-Cooled (TEFC)**			
Rating kW (hp)	**1200 RPM**	**1800 RPM**	**3600 RPM**	**Rating kW (hp)**	**1200 RPM**	**1800 RPM**	**3600 RPM**
0.746 (1)	82.5%	85.5%	77.0%	0.746 (1)	82.5%	85.5%	77.0%
1.12 (1.5)	86.5%	86.5%	84.0%	1.12 (1.5)	87.5%	86.5%	84.0%
1.49 (2)	87.5%	86.5%	85.5%	1.49 (2)	88.5%	86.5%	85.5%
2.24 (3)	88.5%	89.5%	85.5%	2.24 (3)	89.5%	89.5%	86.5%
3.73 (5)	89.5%	89.5%	86.5%	3.73 (5)	89.5%	89.5%	88.5%
5.60 (7.5)	90.2%	91.0%	88.5%	5.60 (7.5)	91.0%	91.7%	89.5%
7.46 (10)	91.7%	91.7%	89.5%	7.46 (10)	91.0%	91.7%	90.2%
11.2 (15)	91.7%	93.0%	90.2%	11.2 (15)	91.7%	92.4%	91.0%
14.9 (20)	92.4%	93.0%	91.0%	14.9 (20)	91.7%	93.0%	91.0%
18.7 (25)	93.0%	93.6%	91.7%	18.7 (25)	93.0%	93.6%	91.7%
22.4 (30)	93.6%	94.1%	91.7%	22.4 (30)	93.0%	93.6%	91.7%
29.8 (40)	94.1%	94.1%	92.4%	29.8 (40)	94.1%	94.1%	92.4%
37.3 (50)	94.1%	94.5%	93.0%	37.3 (50)	94.1%	94.5%	93.0%
44.8 (60)	94.5%	95.0%	93.6%	44.8 (60)	94.5%	95.0%	93.6%
56.9 (75)	94.5%	95.0%	93.6%	56.9 (75)	94.5%	95.4%	93.6%
74.6 (100)	95.0%	95.4%	93.6%	74.6 (100)	95.0%	95.4%	94.1%
93.3 (125)	95.0%	95.4%	94.1%	93.3 (125)	95.0%	95.4%	95.0%
112 (150)	95.4%	95.8%	94.1%	112 (150)	95.8%	95.8%	95.0%
149.2 (200)	95.4%	95.8%	95.0%	149.2 (200)	95.8%	96.2%	95.4%

P. Minimum Power Factor at Full Load and Rated Voltage: 90 percent at 1200 RPM, 1800 RPM, and 3600 RPM. Power factor correction capacitors shall be provided unless the motor meets the 0.90 requirement without it or if the motor is controlled by a variable frequency drive. The power factor correction capacitors shall be able to withstand high voltage transients and power line variations without breakdown.

Q. Energy Efficiency of Small Motors (Motor Efficiencies): All motors under 746 W (1 hp) shall meet the requirements of the DOE Small Motor Regulation.

Polyphase Open Motors Average full load efficiency				**Capacitor-start capacitor-run and capacitor-start induction run open motors Average full load efficiency**			
Rating kW (hp)	**6 poles**	**4 poles**	**2 poles**	**Rating kW (hp)**	**6 poles**	**4 poles**	**2 poles**
0.18 (0.25)	67.5	69.5	65.6	0.18 (0.25)	62.2	68.5	66.6
0.25 (0.33)	71.4	73.4	69.5	0.25 (0.33)	66.6	72.4	70.5
0.37 (0.5)	75.3	78.2	73.4	0.37 (0.5)	76.2	76.2	72.4
0.55 (0.75)	81.7	81.1	76.8	0.55 (0.75)	80.2	81.8	76.2

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install motors in accordance with manufacturer’s recommendations, the NEC, NEMA, as shown in the contract documents and/or as required by other sections of these specifications.

B. If in the substantiated evaluation of the COR, the installation fails to meet the requirements of the construction documents with respect to function and maintainability, an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no additional cost or time to the Government.

3.2 FIELD TESTS

A. All tests shall be witnessed by the CxA or by the COR.

B. Perform an electric insulation resistance Test using a megohmmeter on all motors after installation, before startup. All shall test free from grounds.

C. Perform Load test in accordance with IEEE 112, Test Method B, to determine freedom from electrical or mechanical defects and compliance with performance data.

D. Insulation Resistance: Not less than one-half meg-ohm between stator conductors and frame, to be determined at the time of final inspection.

E. All test data shall be complied into a report form for each motor and provided to the contracting officer or their representative.

3.3 STARTUP AND TESTING

A. Perform tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove

full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.

B. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.

C. The CxA shall observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with COR and CxA. Provide a minimum notice of 10 working days prior to startup and testing.

3.4 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

B. Components provided under this section of the specification shall be tested as part of a greater system.

3.5 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer’s technical representative for 1 hours to instruct each VA personnel responsible in operation and maintenance of the system.

B. Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

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SECTION 23 05 41
NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the application of noise control measures, seismic restraints for equipment, tolerance and vibration isolation for HVAC work, and vibration control techniques to boiler plant rotating equipment and parts including chillers, cooling towers, boilers, pumps, fans, compressors, motors, and steam turbines.

B. A complete listing of common acronyms and abbreviations are included in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.

B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA and SAMPLES.

C. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

D. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

E. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

F. Section 23 31 00, HVAC DUCTS and CASINGS.

1.3 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Where conflicts occur these specifications and the VHA standards will govern.

B. American Society of Civil Engineers (ASCE):

ASCE 7-2016.....Minimum Design Loads for Buildings and Other Structures

C. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):

Handbook-2019.....ASHRAE Handbook – HVAC Applications

Handbook-2021.....ASHRAE Handbook - Fundamentals, Chapter 8, Sound and Vibration

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

A123/A123M-2017.....Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

A307-2021.....Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength

B117-2019.....Standard Practice for Operating Salt Spray (Fog) Apparatus

D2240-2015(R2021).....Standard Test Method for Rubber Property - Durometer Hardness

E. International Code Council (ICC):

IBC-2021.....International Building Code

F. Manufacturers Standardization Society (MSS):

SP-58-2018.....Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation

G. Occupational Safety and Health Administration (OSHA):

29 CFR 1910.95.....Occupational Noise Exposure

H. Sheet Metal and Air Conditioning Contractor’s National Association (SMACNA):

001-2008.....Seismic Restraint Manual: Guidelines for Mechanical Systems, 3rd Edition

I. Department of Veterans Affairs (VA):

H-18-8-2019(R2020).....Seismic Design Requirements

PG-18-10-2017(R2021)....HVAC Design Manual

1.4 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

B. Information and material submitted under this section shall be marked “SUBMITTED UNDER SECTION 23 XX XX, SECTION TITLE”, 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. Vibration isolators:

a. Floor mountings

b. Hangers

c. Snubbers

d. Thrust restraints

2. Bases.

3. Seismic restraint provisions and bolting.

4. Acoustical enclosures.

D. Isolator manufacturer shall furnish with submittal load calculations for selection of isolators, including supplemental bases, based on lowest operating speed of equipment supported.

E. Seismic Requirements: Submittals are required for all equipment anchors, supports and seismic restraints. Submittals shall include weights, dimensions, standard connections, and manufacturer's certification that all specified equipment will withstand seismic Lateral Force requirements as shown in the contract documents.

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.

B. Refer to Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS for additional sustainable design requirements.

C. Noise Criteria:

1. Perform an acoustic analysis to demonstrate that the specified room noise levels are achieved in all octave bands for all air-handling units, heating and ventilating units, fans, chillers, boilers, generators, and outdoor noise producing equipment, such as cooling towers and chillers. Refer to VA HVAC Design Manual Chapter 6 Room Data Sheets for the required Noise Criteria (NC) levels. If the necessary room type is not listed in Chapter 6 of VA HVAC Design Manual then consult the ASHRAE Handbook - HVAC Applications. The analysis shall consider both air duct borne noise and noise transmission through walls, floors and roofs and shall be completed for all duct systems and all HVAC equipment.

2. For equipment which has no sound power ratings scheduled on the plans, the contractor shall select equipment such that the foregoing

noise criteria, local ordinance noise levels, and OSHA 29 CFR 1910.95 requirements are not exceeded. Selection procedure shall be in accordance with ASHRAE Handbook - Fundamentals, Chapter 8, Sound and Vibration.

3. An allowance, not to exceed 5 db, may be added to the measured value to compensate for the variation of the room attenuating effect between room test condition prior to occupancy and design condition after occupancy which may include the addition of sound absorbing material, such as, furniture. This allowance may not be taken after occupancy. The room attenuating effect is defined as the difference between sound power level emitted to room and sound pressure level in room.
4. In absence of specified measurement requirements, measure equipment noise levels three feet from equipment and at an elevation of maximum noise generation.

D. Seismic Restraint Requirements:

1. Equipment:
   a. All mechanical equipment not supported with isolators external to the unit shall be securely anchored to the structure. Such mechanical equipment shall be properly supported to resist a horizontal force of 20 percent of the weight of the equipment furnished.
   b. All mechanical equipment mounted on vibration isolators shall be provided with seismic restraints capable of resisting a horizontal force of 50 percent of the weight of the equipment furnished.
2. Piping: Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
3. Ductwork: Refer to Section 23 31 00, HVAC DUCTS AND CASINGS.

E. Allowable Vibration Tolerances for Rotating, Non-reciprocating Equipment: Not to exceed a self-excited vibration maximum velocity of 5 mm per second (0.20 inch per second) RMS, filter in, when measured with a vibration meter on bearing caps of machine in vertical, horizontal, and axial directions or measured at equipment mounting feet if bearings are concealed. Measurements for internally isolated fans and motors may be made at the mounting feet.

1.6 AS-BUILT DOCUMENTATION

A. Comply with requirements in paragraph AS-BUILT DOCUMENTATION of Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Type of isolator, base, and minimum static deflection shall be as required for each specific equipment application as recommended by isolator or equipment manufacturer. Refer to ASHRAE Handbook - HVAC Applications Chapter 49, Noise and Vibration Control, Table 47 for selection guide for Vibration Isolation.

B. Elastomeric isolators shall comply with ASTM D2240 and be oil resistant neoprene with a maximum stiffness of 60 durometer and have a straight-line deflection curve.

C. Exposure to Weather: Isolator housings to be either hot dipped galvanized or powder coated to ASTM B117 salt spray testing standards. Springs to be powder coated or electro galvanized. All hardware to be electro galvanized. In addition, provide limit stops to resist wind velocity. Velocity pressure established by wind shall be calculated in accordance with Section 1609 of the International Building Code. A minimum wind velocity of 75 mph shall be employed.

D. Uniform Loading: Select and locate isolators to produce uniform loading and deflection even when equipment weight is not evenly distributed.

E. Color code isolators by type and size for easy identification of capacity.

2.2 SEISMIC RESTRAINT REQUIREMENTS FOR EQUIPMENT

A. Bolt pad mounted equipment, without vibration isolators, to the floor or other support using ASTM A307 standard bolting material.

B. Provide floor mounted equipment with Type SS vibration Isolators. Where Type N isolators are used provide channel frame base horizontal restraints bolted to the floor, or other support, on all sides of the equipment. Size and material required for the base shall be as recommended by the isolator manufacturer.

C. On all sides of suspended equipment, provide bracing for rigid supports and provide restraints for resiliently supported equipment.

2.3 VIBRATION ISOLATORS

A. Floor Mountings:

1. Double Deflection Neoprene (Type N): Shall include neoprene covered steel support plated (top and bottom), friction pads, and necessary bolt holes.
2. Spring Isolators (Type S): Shall be free-standing, laterally stable and include acoustical friction pads and leveling bolts. Isolators shall have a minimum ratio of spring diameter-to-operating spring height of 1.0 and an additional travel to solid equal to 50 percent of rated deflection.
3. Captive Spring Mount for Seismic Restraint (Type SS):
   a. Design mounts to resiliently resist seismic forces in all directions. Snubbing shall take place in all modes with adjustment to limit upward, downward, and horizontal travel to a maximum of 6 mm (1/4 inch) before contacting snubbers. Mountings shall have a minimum rating of one G coefficient of gravity as calculated and certified by a registered structural engineer.
   b. All mountings shall have leveling bolts that are rigidly bolted to the equipment. Spring diameters shall be no less than 0.8 of the compressed height of the spring at rated load. Springs shall have a minimum additional travel to solid equal to 50 percent of the rated deflection. Mountings shall have ports for spring inspection. Provide an all directional neoprene cushion collar around the equipment bolt.
4. Spring Isolators with Vertical Limit Stops (Type SP): Similar to spring isolators noted above, except include a vertical limit stop to limit upward travel if weight is removed and also to reduce movement and spring extension due to wind loads. Provide clearance around restraining bolts to prevent mechanical short circuiting.
5. Pads (Type D), Washers (Type W), and Bushings (Type L): Pads shall be natural rubber or neoprene waffle, neoprene and steel waffle, or reinforced duck and neoprene. Washers and bushings shall be reinforced duck and neoprene. Size pads for a maximum load of 345 kPa (50 pounds per square inch).

B. Hangers: Shall be combination neoprene and springs unless otherwise noted and shall allow for expansion of pipe.
   1. Combination Neoprene and Spring (Type H): Vibration hanger shall contain a spring and double deflection neoprene element in series.

Spring shall have a diameter not less than 0.8 of compressed operating spring height. Spring shall have a minimum additional travel of 50 percent between design height and solid height. Spring shall permit a 15 degree angular misalignment without rubbing on hanger box.

2. Hanger supports for piping 50 mm (2 inches) and greater shall have a pointer and scale deflection indicator.

C. Snubbers: Each spring mounted base shall have a minimum of four all-directional or eight two directional (two per side) seismic snubbers that are double acting. Elastomeric materials shall be shock absorbent neoprene bridge quality bearing pads, maximum 60 durometer, replaceable and have a minimum thickness of 6 mm (1/4 inch). Air gap between hard and resilient material shall be not less than 3.2 mm (1/8 inch) nor greater than 6 mm (1/4 inch). Restraints shall be capable of withstanding design load without permanent deformation.

D. Thrust Restraints (Type THR): Restraints shall provide a spring element contained in a steel frame with neoprene pads at each end attachment. Restraints shall have factory preset thrust and be field adjustable to allow a maximum movement of 6 mm (1/4 inch) when the fan starts and stops. Restraint assemblies shall include rods, angle brackets and other hardware for field installation.

2.4 BASES

A. Rails (Type R): Design rails with isolator brackets to reduce mounting height of equipment and cradle machines having legs or bases that do not require a complete supplementary base. To assure adequate stiffness, height of members shall be a minimum of 1/12 of longest base dimension but not less than 100 mm (4 inches). Where rails are used with neoprene mounts for small fans or close coupled pumps, extend rails to compensate overhang of housing.

B. Inertia Base (Type I): Base shall be a reinforced concrete inertia base. Pour concrete into a welded steel channel frame, incorporating prelocated equipment anchor bolts and pipe sleeves. Level the concrete to provide a smooth uniform bearing surface for equipment mounting. Provide grout under uneven supports. Channel depth shall be a minimum of 1/12 of longest dimension of base but not less than 152 mm (6 inches). Form shall include 13 mm (1/2 inch) reinforcing bars welded in

place on minimum of 203 mm (8 inch) centers running both ways in a layer 38 mm (1-1/2 inches) above bottom. Use height saving brackets in all mounting locations. Weight of inertia base shall be equal to or greater than weight of equipment supported to provide a maximum peak-to-peak displacement of 1.6 mm (1/16 inch).

C. Curb Mounted Isolation Base (Type CB): Fabricate from aluminum to fit on top of standard curb with overlap to allow water run-off and have wind and water seals which shall not interfere with spring action. Provide resilient snubbers with 6 mm (1/4 inch) clearance for wind resistance. Top and bottom bearing surfaces shall have sponge type weather seals. Integral spring isolators shall comply with Spring Isolator (Type S) requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

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

B. Vibration Isolation:

1. No metal-to-metal contact will be permitted between fixed and floating parts.
2. Connections to Equipment: Allow for deflections equal to or greater than equipment deflections. Electrical, drain, piping connections, and other items made to rotating or reciprocating equipment (pumps, compressors, etc.) which rests on vibration isolators, shall be isolated from building structure for first three hangers or supports with a deflection equal to that used on the corresponding equipment.
3. Common Foundation: Mount each electric motor on same foundation as driven machine. Hold driving motor and driven machine in positive rigid alignment with provision for adjusting motor alignment and belt tension. Bases shall be level throughout length and width. Provide shims to facilitate pipe connections, leveling, and bolting.
4. Provide heat shields where elastomers are subject to temperatures over 38 degrees C (100 degrees F).
5. Extend bases for pipe elbow supports at discharge and suction connections at pumps. Pipe elbow supports shall not short circuit pump vibration to structure.

6. Non-rotating equipment such as heat exchangers and convertors shall be mounted on isolation units having the same static deflection as the isolation hangers or support of the pipe connected to the equipment.

C. Inspection and Adjustments: Check for vibration and noise transmission through connections, piping, ductwork, foundations, and walls. Adjust, repair, or replace isolators as required to reduce vibration and noise transmissions to specified levels.

3.2 ADJUSTING

A. Adjust vibration isolators after piping systems are filled and equipment is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Attach thrust limits at centerline of thrust and adjust to a maximum of 6 mm (1/4 inch) movement during start and stop.

D. Adjust active height of spring isolators.

E. Adjust snubbers according to manufacturer's recommendations.

F. Adjust seismic restraints to permit free movement of equipment within normal mode of operation.

G. Torque anchor bolts according to equipment manufacturer's recommendations to resist seismic forces.

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SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 DESCRIPTION

A. A complete listing of common acronyms and abbreviations are included in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. Testing, adjusting, and balancing (TAB) of heating, ventilating and air conditioning (HVAC) systems. TAB includes the following:

1. Planning systematic TAB procedures.
2. Design Review Report.
3. Systems Inspection Report.
4. Duct Air Leakage Test Report.
5. Systems Readiness Report.
6. Balancing air and water distribution systems; adjustment of total system to provide design performance; and testing performance of equipment and automatic controls.
7. Vibration and sound measurements.
8. Recording and reporting results.
9. Document critical paths of flow on reports.

C. Definitions:

1. Basic TAB used in this Section: Chapter 39, "Testing, Adjusting and Balancing" of ASHRAE Handbook "HVAC Applications".
2. TAB: Testing, Adjusting and Balancing; the process of checking and adjusting HVAC systems to meet design objectives.
3. AABC: Associated Air Balance Council.
4. NEBB: National Environmental Balancing Bureau.
5. TABB: Testing Adjusting and Balancing Bureau.
6. SMACNA: Sheet Metal and Air Conditioning Contractors’ National Association.
7. Hydronic Systems: Includes chilled water and heating hot water.
8. Air Systems: Includes all outside air, supply air, return air, exhaust air and relief air systems.

9. Flow Rate Tolerance: The allowable percentage variation, minus to plus, of actual flow rate from values (design) in the contract documents.

1.2 RELATED WORK

A. Section 01 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 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.
E. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
F. Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.
G. Section 23 07 11, HVAC AND BOILER PLANT INSULATION.
H. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.
I. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.
J. Section 23 31 00, HVAC DUCTS AND CASINGS.
K. Section 23 36 00, AIR TERMINAL UNITS.

1.3 APPLICABLE PUBLICATIONS

A. The following publications form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Where conflicts occur these specifications and the VHA standards will govern.
B. American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE):
2019.....ASHRAE Handbook – HVAC Applications, Chapter 39, Testing, Adjusting, and Balancing and Chapter 49, Noise and Vibration Control
C. Associated Air Balance Council (AABC):
2016.....National Standards for Total System Balance, 7th Edition
D. National Environmental Balancing Bureau (NEBB):
2019.....Procedural Standard for Testing, Adjusting, and Balancing of Environmental Systems, 9th Edition
2015.....Procedural Standard for the Measurement of Sound and Vibration, 2nd Edition

S110-2019.....Whole Building Technical Commissioning of New Construction, 2nd Edition

E. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):

2002.....HVAC Systems Testing, Adjusting and Balancing, 3rd Edition

2003.....TAB Procedural Guide 1st Edition

1.4 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 23 05 93", with applicable paragraph identification.

C. Submit names and qualifications of TAB agency and TAB Specialists within 60 days after the notice to proceed. Submit information on three recently completed projects and a list of proposed test equipment.

D. For use by the COR staff, submit one complete set of applicable AABC, NEBB or TABB publications that will be the basis of TAB work.

E. Submit the following for review and approval:

1. Design Review Report within 90 days for conventional design projects within 60 days for design-build projects after the system layout on air and water side is completed by the Contractor.
2. Systems inspection report on equipment and installation for conformance with design.
3. Duct Air Leakage Test Report.
4. Systems Readiness Report.
5. Intermediate and Final TAB reports covering flow balance and adjustments, performance tests, vibration tests and sound tests.
6. Include in final reports uncorrected installation deficiencies noted during TAB and applicable explanatory comments on test results that differ from design requirements.
7. Include in each report the critical path for each balanced branch (air and hydronic). Every branch shall have at least one terminal device damper 100 percent open.

F. Prior to request for Final or Partial Final inspection, submit completed Test and Balance report for the area with noted critical paths.

1.5 QUALITY ASSURANCE

A. Refer to paragraphs QUALITY ASSURANCE and SUBMITTALS, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC, and Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

B. Qualifications:

1. TAB Agency: The TAB agency shall be a subcontractor of the General Contractor and shall report to and be paid by the General Contractor.
2. The TAB agency shall be either a certified member of AABC, NEBB, or TABB to perform TAB service for HVAC, water balancing and vibrations and sound testing of equipment. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the agency loses subject certification during this period, the General Contractor shall immediately notify the COR and submit another qualified TAB firm for approval. Any agency that has been the subject of disciplinary action by either the AABC, TABB or NEBB within the five (5) years preceding Contract Award shall not be eligible to perform any work related to the TAB. All work performed in this Section and in other related Sections by the TAB agency shall be considered invalid if the TAB agency loses its certification prior to Contract completion, and the successor agency’s review shows unsatisfactory work performed by the predecessor agency.
3. TAB Specialist: The TAB Specialist shall be either a member of AABC or TABB or an experienced technician of the Agency certified by NEBB. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the Specialist loses subject certification during this period, the General Contractor shall immediately notify the COR and submit another TAB Specialist for approval. Any individual that has been the subject of disciplinary action by either the AABC or the NEBB within the five (5) years preceding Contract Award shall not be eligible to perform any duties related to the HVAC systems, including TAB. All work

specified in this Section and in other related Sections performed by the TAB Specialist shall be considered invalid if the TAB Specialist loses its certification prior to Contract completion and shall be performed by an approved successor.

4. TAB Specialist shall be identified by the General Contractor within sixty (60) days after the Notice to Proceed. The TAB Specialist will be coordinating, scheduling, and reporting all TAB work and related activities and will provide necessary information as required by the COR. The responsibilities shall specifically include:
   a. Directly supervising all TAB work.
   b. Sign the TAB reports that bear the seal of the TAB standard. The reports shall be accompanied by report forms and schematic drawings required by the TAB standard, AABC, TABB or NEBB.
   c. Following all TAB work through its satisfactory completion.
   d. Providing final markings of settings of all HVAC adjustment devices.
   e. Permanently mark location of duct test ports.
   f. Documenting critical paths from the fan or pump. These critical paths are ones in which are 100 percent open from the fan or pump to the terminal device. This will show the least amount of restriction is being imposed on the system by the TAB firm.
5. All TAB technicians performing actual TAB work shall be experienced and shall have done satisfactory work on a minimum of three (3) projects comparable in size and complexity to this project. Qualifications shall be certified by the TAB agency in writing. The lead technician shall be certified by AABC, TABB or NEBB.

C. Test Equipment Criteria: The instrumentation shall meet the accuracy/calibration requirements established by AABC National Standards, TABB/SMACNA International Standards, or by NEBB Procedural Standard for Testing, Adjusting and Balancing of Environmental Systems and instrument manufacturer. Provide calibration history of the instruments to be used for test and balance purpose. All equipment shall remain in calibration, or be re-calibrated if certification expires, during the TAB procedures.

D. TAB Criteria:

1. One or more of the applicable AABC, NEBB, TABB or SMACNA publications, supplemented by Chapter 39, "Testing, Adjusting and Balancing" of ASHRAE Handbook "HVAC Applications" and requirements stated herein shall be the basis for planning, procedures, and reports.
2. Flow Rate Tolerance: Following tolerances are allowed. For tolerances not mentioned herein follow Chapter 39, "Testing, Adjusting and Balancing" of ASHRAE Handbook "HVAC Applications" as a guideline. Air Filter resistance during tests, artificially imposed, if necessary, shall be at least 100 percent of manufacturer recommended change over pressure drop values for pre-filters and after-filters.
   a. Air handling unit and all other fans, cubic meters/min (cubic feet per minute): Minus 5 percent to plus 10 percent.
   b. Air Terminal Units (maximum values): Minus 5 percent to plus 10 percent
   c. Exhaust Hoods/Cabinets: 0 percent to plus 10 percent.
   d. Minimum Outside Air: 0 percent to plus 10 percent.
   e. Individual room air outlets and inlets, and air flow rates not mentioned above: Minus 5 percent to plus 10 percent except if the air to air space is 100 CFM or less the tolerance will be minus 5 to plus 5 percent.
   f. Heating Hot Water Pumps and Hot Water Coils: Minus 5 percent to plus 5 percent.
   g. Chilled Water and Condenser Water Pumps: Minus 5 percent to plus 5 percent.
   h. Chilled Water Coils: Minus 5 percent to plus 5 percent.
3. Systems shall be adjusted for energy efficient operation as described in PART 3.
4. Typical TAB procedures and critical path results shall be demonstrated to the COR for one air distribution system (including all fans, 3 terminal units, 3 rooms randomly selected by the COR, one of which shall be a critical path) and 1 hydronic system (pumps and 3 coils) as follows:
   a. When field TAB work begins.

b. During each partial final inspection and the final inspection for the project if requested by VA.

PART 2 - PRODUCTS

2.1 PLUGS

A. Provide plastic plugs to seal holes drilled in ductwork for test purposes.

2.2 INSULATION REPAIR MATERIAL

A. See Section 23 07 11, HVAC and BOILER PLANT INSULATION. Provide for repair of insulation removed or damaged for TAB work.

PART 3 - EXECUTION

3.1 GENERAL

A. Refer to TAB Criteria in Paragraph QUALITY ASSURANCE.

B. Obtain applicable contract documents and copies of approved submittals for HVAC equipment and automatic control systems.

3.2 DESIGN REVIEW REPORT

A. The TAB Specialist shall review the contract documents and advise the COR of any design deficiencies that would prevent the HVAC systems from effectively operating in accordance with the sequence of operation specified or prevent the effective and accurate TAB of the system. The TAB Specialist shall provide a report individually listing each deficiency and the corresponding proposed corrective action necessary for proper system operation.

3.3 SYSTEMS INSPECTION REPORT

A. Inspect equipment and installation for conformance with design.

B. The inspection and report shall be done after air distribution and hydronic equipment is onsite and duct and piping installation has begun, but well in advance of performance testing and balancing work. The purpose of the inspection is to identify and report deviations from design and ensure that systems will be ready for TAB at the appropriate time.

C. Reports: Follow checklist format developed by AABC, NEBB or SMACNA (TABB), supplemented by narrative comments, with emphasis on air-handling units and fans. Check for conformance with submittals. Verify that diffuser and register sizes are correct. Check air terminal unit installation including their duct sizes and routing.

3.4 DUCT AIR LEAKAGE TEST REPORT

A. TAB Agency shall perform the leakage test as outlined in "Duct Leakage Tests and Repairs" in Section 23 31 00, HVAC DUCTS and CASINGS for TAB agency's role and responsibilities in witnessing, recording and reporting of deficiencies.

3.5 SYSTEM READINESS REPORT

A. The TAB Contractor shall measure existing air and water flow rates associated with existing systems utilized to serve renovated areas as indicated in the contract documents. Submit report of findings to COR.

B. Inspect each system to ensure that it is complete including installation and operation of controls. Submit report to COR in standard format and forms prepared and/or approved by the CxA.

C. Verify that all items such as ductwork piping, dampers, valves, ports, terminals, connectors, etc., that are required for TAB are installed. Provide a report to the COR.

3.6 TAB REPORTS

A. Submit an intermediate report for 25 percent 50 percent of systems and equipment tested and balanced to establish satisfactory test results.

B. The TAB Contractor shall provide raw data immediately in writing to the COR if there is a problem in achieving intended results before submitting a formal report.

C. If over 20 percent of readings in the intermediate report fall outside the acceptable range, the TAB report shall be considered invalid and all contract TAB work shall be repeated after engineering and construction have been evaluated and re-submitted for approval at no additional cost to the owner.

D. Do not proceed with the remaining systems until intermediate report is approved by the COR.

3.7 TAB PROCEDURES

A. TAB shall be performed in accordance with the requirement of the Standard under which TAB agency is certified by either AABC, TABB or NEBB. Balancing shall be done proportionally to all applicable systems.

1. At least 1 trunk damper shall be 100 percent open.
2. At least 1 branch damper shall be 100 percent open per trunk.
3. At least 1 terminal device duct be 100 percent open per branch.

4. At least one hydronic balancing valve shall be 100 percent open per hydronic system.

B. General: During TAB all related system components shall be in full operation. Fan and pump rotation, motor loads and equipment vibration shall be checked and corrected as necessary before proceeding with TAB. Set controls and/or block off parts of distribution systems to simulate design operation of variable volume air or water systems for test and balance work.

C. Coordinate TAB procedures with existing systems and any phased construction completion requirements for the project. Provide TAB reports for pre-construction air and water flow rate and for each phase of the project prior to partial final inspections of each phase of the project. Return existing areas outside the work area to pre-constructed conditions.

D. Allow 7 days' time in construction schedule for TAB and submission of all reports for an organized and timely correction of deficiencies.

E. Air Balance and Equipment Test: Include air-handling units, fans, terminal units, room diffusers/outlets/inlets, and fume hoods.

1. Artificially load air filters by partial blanking to produce static air pressure drop of manufacturer's recommended pressure drop.
2. Adjust fan speeds to provide design air flow. V-belt drives, including fixed pitch pulley requirements, are specified in Section 23 05 11, COMMON WORK RESULTS FOR HVAC. Provide new drive sets as required to adjust fan speeds.
3. Test and balance systems in all specified modes of operation, including variable volume, economizer, and fire emergency modes. Verify that dampers and other HVAC controls function properly.
4. Variable Air Volume (VAV) Systems:
   a. Coordinate TAB, including system volumetric controls, with Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.
   b. Section 23 36 00, AIR TERMINAL UNITS, specifies that maximum and minimum flow rates for air terminal units (ATU) be factory set. Check and readjust ATU flow rates if necessary to meet design criteria. Balance air distribution from ATU on full cooling maximum scheduled cubic meters per minute (cubic feet per minute). Reset room thermostats and check ATU operation from

maximum to minimum cooling, to the heating mode, and back to cooling. Record and report the heating coil leaving air temperature when the ATU is in the maximum heating mode. Record and report outdoor air flow rates under all operating conditions (The test shall demonstrate that the minimum outdoor air ventilation rate shall remain constant under all operating conditions).

c. Adjust operating pressure control setpoint to maintain the design flow to each space with the lowest setpoint. Confirm static pressure reset is operational and functioning properly.

5. Record final measurements for air handling equipment performance data sheets.

6. Record final damper settings for all manual volume dampers.

F. Rooms with Specific Pressure Relationships Including SPS

1. For rooms that require specific pressure relationships as noted in the contract documents report the following information:

a. Room differential pressure at minimum and maximum flows.

b. Room air changes per hour (ACH).

c. Adjust airflows to achieve the required air pressure relationships. Increase/decrease the supply/exhaust airflow as needed. For positively pressurized rooms the supply airflow shall be set per the contract documents and return/exhaust airflow shall be adjusted to achieve the required pressure relationship. For negatively pressurized rooms the exhaust airflow per the contract documents and the supply airflow adjusted to achieve the required pressure relationship.

G. Water Balance and Equipment Test: Include circulating pumps and coils.

1. Adjust flow rates for equipment. Set coils and evaporator to values on equipment submittals, if different from values in the contract documents.

3. Primary-Secondary (variable volume) Systems: Coordinate TAB with Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC. Balance systems at design water flow and then verify that variable flow controls function as designed.

4. Record final measurements for hydronic equipment on performance data sheets. Include entering and leaving water temperatures for heating

and cooling coils, and for convertors. Include entering and leaving air temperatures (DB/WB for cooling coils) for air-handling units and reheat coils. Make air and water temperature measurements at the same time.

5. On coils with automatic flow limiting valves (automatic balancing valves) measure and report Delta P across valve and measure Delta P across 100 percent open temperature control valve and using control valve CV calculate and report gpm.
6. Record final valve setting for all balancing valves.

3.8 VIBRATION TESTING

A. Furnish instruments and perform vibration measurements as specified in Section 23 05 41, NOISE and VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT. Field vibration balancing is specified in Section 23 05 11, COMMON WORK RESULTS FOR HVAC. Provide measurements for all rotating HVAC equipment of 373 watts (1/2 horsepower) and larger, including centrifugal/screw compressors, cooling towers, pumps, fans and motors.

B. Record initial measurements for each unit of equipment on test forms and submit a report to the COR. Where vibration readings exceed the allowable tolerance Contractor shall be directed to correct the problem. The TAB agency shall verify that the corrections are done and submit a final report to the COR.

3.10 MARKING OF SETTINGS

A. Following approval of TAB Final Report, the setting of all HVAC adjustment devices including valves, splitters and dampers shall be permanently marked by the TAB Specialist so that adjustment can be restored if disturbed at any time. Style and colors used for markings shall be coordinated with the COR.

3.11 IDENTIFICATION OF TEST PORTS

A. The TAB Specialist shall permanently and legibly identify the location points of duct test ports. If the ductwork has exterior insulation, the identification shall be made on the exterior side of the insulation. All penetrations through ductwork and ductwork insulation shall be sealed to prevent air leaks and maintain integrity of vapor barrier.

3.12 PHASING

A. Phased Projects: Testing and Balancing Work to follow project with areas shall be completed per the project phasing. Upon completion of

the project all areas shall have been tested and balanced per the contract documents.

B. Existing Areas: Systems that serve areas outside of the project scope shall not be adversely affected. Measure existing parameters where shown to document system capacity.

3.13 CRITICAL FLOW PATH

A. Provide a documented critical path for all fluid flows. There shall be at least one (1) terminal device that can be traced back to the fan or pump where there is no damper or valves that are less than 100 percent open.

3.14 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

B. Components provided under this section of the specification will be tested as part of a larger system.

- - E N D - -

SECTION 23 07 11
HVAC AND BOILER PLANT INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Field applied insulation for thermal efficiency and condensation control for
   1. HVAC piping, ductwork and equipment.

B. Definitions
   1. ASJ: All service jacket, white finish facing or jacket.
   2. Air conditioned space: Space having air temperature and/or humidity controlled by mechanical equipment.
   3. Cold: Equipment, ductwork or piping handling media at design temperature of 16 degrees C (60 degrees F) or below.
   4. Concealed: Ductwork and piping above ceilings and in chases, and pipe spaces.
   5. Exposed: Piping, ductwork, and equipment exposed to view in finished areas including mechanical and electrical equipment rooms or exposed to outdoor weather. Attics and crawl spaces where air handling units are located are considered to be mechanical rooms. Shafts, chases, crawl spaces and pipe basements are not considered finished areas.
   6. FSK: Foil-scrim-kraft facing.
   7. Hot: HVAC Ductwork handling air at design temperature above 16 degrees C (60 degrees F);HVAC equipment or piping handling media above 41 degrees C (105 degrees F); and piping media and equipment 32 to 230 degrees C(90 to 450 degrees F).
   8. Density: kg/m^3 - kilograms per cubic meter (Pcf - pounds per cubic foot).
   9. Runouts: Branch pipe connections up to 25-mm (one-inch) nominal size to fan coil units or reheat coils for terminal units.
   10. Thermal conductance: Heat flow rate through materials.
      a. Flat surface: Watt per square meter (BTU per hour per square foot).
      b. Pipe or Cylinder: Watt per square meter (BTU per hour per linear foot).

11. Thermal Conductivity (k): Watt per meter, per degree C (BTU per inch thickness, per hour, per square foot, per degree F temperature difference).
12. 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 shall have a maximum published permeance of 0.1 perms and vapor barriers shall have a maximum published permeance of 0.001 perms.
13. HPS: High pressure steam (415 kPa [60 psig] and above).
14. HPR: High pressure steam condensate return.
15. MPS: Medium pressure steam (110 kPa [16 psig] thru 414 kPa [59 psig].
16. MPR: Medium pressure steam condensate return.
17. LPS: Low pressure steam (103 kPa [15 psig] and below).
18. LPR: Low pressure steam condensate gravity return.
19. PC: Pumped condensate.
20. HWH: Hot water heating supply.
21. HWHR: Hot water heating return.
28. VR: Vacuum condensate return.
29. CPD: Condensate pump discharge.
30. R: Pump recirculation.
31. FOS: Fuel oil supply.
32. FOR: Fuel oil return.
33. CW: Cold water.
34. SW: Soft water.
35. HW: Hot water.
36. CH: Chilled water supply.
37. CHR: Chilled water return.
41. PVDC: Polyvinylidene chloride vapor retarder jacketing, white.

1.2 RELATED WORK

A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
B. Section 07 84 00, FIRESTOPPING.
C. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
D. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.
E. Section 23 21 13, HYDRONIC PIPING.

F. Section 23 22 13, STEAM and CONDENSATE HEATING PIPING

1.3 QUALITY ASSURANCE

A. Refer to article QUALITY ASSURANCE, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. Criteria:

1. Comply with NFPA 90A, particularly paragraphs 4.3.3.1 through 4.3.3.6, 4.3.10.2.6, and 5.4.6.4, parts of which are quoted as follows:

4.3.3.1 Pipe insulation and coverings, duct coverings, duct linings, vapor retarder facings, adhesives, fasteners, tapes, and supplementary materials added to air ducts, plenums, panels, and duct silencers used in duct systems, unless otherwise provided for in 4.3.3.1.1 or 4.3.3.1.2., shall have, in the form in which they are used, a maximum flame spread index of 25 without evidence of continued progressive combustion and a maximum smoke developed index of 50 when tested in accordance with NFPA 255, *Standard Method of Test of Surface Burning Characteristics of Building Materials*.

4.3.3.1.1 Where these products are to be applied with adhesives, they shall be tested with such adhesives applied, or the adhesives used shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when in the final dry state. *(See 4.2.4.2.)*

4.3.3.1.2 The flame spread and smoke developed index requirements of 4.3.3.1.1 shall not apply to air duct weatherproof coverings where they are located entirely outside of a building, do not penetrate a wall or roof, and do not create an exposure hazard.

4.3.3.2 Closure systems for use with rigid and flexible air ducts tested in accordance with UL 181, Standard for Safety Factory-Made Air Ducts and Air Connectors, shall have been tested, listed, and used in accordance with the conditions of their listings, in accordance with one of the following:

(1) UL 181A, Standard for Safety Closure Systems for Use with Rigid Air Ducts and Air Connectors

(2) UL 181B, Standard for Safety Closure Systems for Use with Flexible Air Ducts and Air Connectors

4.3.3.3 Air duct, panel, and plenum coverings and linings, and pipe insulation and coverings shall not flame, glow, smolder, or smoke when tested in accordance with a similar test for pipe covering, ASTM C 411, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation, at the temperature to which they are exposed in service.

4.3.3.3.1 In no case shall the test temperature be below 121°C (250°F).

4.3.3.4 Air duct coverings shall not extend through walls or floors that are required to be fire stopped or required to have a

fire resistance rating, unless such coverings meet the requirements of 5.4.6.4.

4.3.3.5* Air duct linings shall be interrupted at fire dampers to prevent interference with the operation of devices.

4.3.3.6 Air duct coverings shall not be installed so as to conceal or prevent the use of any service opening.

4.3.10.2.6 Materials exposed to the airflow shall be noncombustible or limited combustible and have a maximum smoke developed index of 50 or comply with the following.

4.3.10.2.6.1 Electrical wires and cables and optical fiber cables shall be listed as noncombustible or limited combustible and have a maximum smoke developed index of 50 or shall be listed as having a maximum peak optical density of 0.5 or less, an average optical density of 0.15 or less, and a maximum flame spread distance of 1.5 m (5 ft) or less when tested in accordance with NFPA 262, Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

4.3.10.2.6.2 Pneumatic tubing for control systems shall be listed as having a maximum peak optical density of 0.5 or less, an average optical density of 0.15 or less, and a maximum flame spread distance of 1.5 m (5 ft) or less when tested in accordance with UL 1820, Standard for Safety Fire Test of Pneumatic Tubing for Flame and Smoke Characteristics.

4.3.10.2.6.4 Optical-fiber and communication raceways shall be listed as having a maximum peak optical density of 0.5 or less, an average optical density of 0.15 or less, and a maximum flame spread distance of 1.5 m (5 ft) or less when tested in accordance with UL 2024, Standard for Safety Optical-Fiber Cable Raceway.

4.3.10.2.6.6 Supplementary materials for air distribution systems shall be permitted when complying with the provisions of 4.3.3.

5.4.6.4 Where air ducts pass through walls, floors, or partitions that are required to have a fire resistance rating and where fire dampers are not required, the opening in the construction around the air duct shall be as follows:

(1) Not exceeding a 25.4 mm (1 in.) average clearance on all sides

(2) Filled solid with an approved material capable of preventing the passage of flame and hot gases sufficient to ignite cotton waste when subjected to the time-temperature fire conditions required for fire barrier penetration as specified in NFPA 251, *Standard Methods of Tests of Fire Endurance of Building Construction and Materials*

2. Test methods: ASTM E84, UL 723, or NFPA 255.
3. Specified k factors are at 24 degrees C (75 degrees F) mean temperature unless stated otherwise. Where optional thermal insulation material is used, select thickness to provide thermal

conductance no greater than that for the specified material. For pipe, use insulation manufacturer's published heat flow tables. For domestic hot water supply and return, run out insulation and condensation control insulation, no thickness adjustment need be made.

4. All materials shall be compatible and suitable for service temperature, and shall not contribute to corrosion or otherwise attack surface to which applied in either the wet or dry state.

C. Every package or standard container of insulation or accessories delivered to the job site for use must have a manufacturer's stamp or label giving the name of the manufacturer and description of the material.

1.4 SUBMITTALS

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

B. Shop Drawings:

1. All information, clearly presented, shall be included to determine compliance with drawings and specifications and ASTM, federal and military specifications.
   a. Insulation materials: Specify each type used and state surface burning characteristics.
   b. Insulation facings and jackets: Each type used. Make it clear that white finish will be furnished for exposed ductwork, casings and equipment.
   c. Insulation accessory materials: Each type used.
   d. Manufacturer's installation and fitting fabrication instructions for flexible unicellular insulation.
   e. Make reference to applicable specification paragraph numbers for coordination.

C. Samples:

1. Each type of insulation: Minimum size 100 mm (4 inches) square for board/block/ blanket; 150 mm (6 inches) long, full diameter for round types.
2. Each type of facing and jacket: Minimum size 100 mm (4 inches square).

3. Each accessory material: Minimum 120 ML (4 ounce) liquid container or 120 gram (4 ounce) dry weight for adhesives / cement / mastic.

1.5 STORAGE AND HANDLING OF MATERIAL

A. Store materials in clean and dry environment, pipe covering jackets shall be clean and unmarred. Place adhesives in original containers. Maintain ambient temperatures and conditions as required by printed instructions of manufacturers of adhesives, mastics and finishing cements.

1.6 APPLICABLE PUBLICATIONS

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

B. Federal Specifications (Fed. Spec.):

L-P-535E (2)- 1999.....Plastic Sheet (Sheeting): Plastic Strip; Poly (Vinyl Chloride) and Poly (Vinyl Chloride - Vinyl Acetate), Rigid.

C. Military Specifications (Mil. Spec.):

MIL-A-3316C -1987 Adhesives, Fire-Resistant, Thermal Insulation

MIL-A-24179A (1)-2016 Adhesive, Flexible Unicellular-Plastic Thermal Insulation

MIL-C-19565C (1)- 2016 Coating Compounds, Thermal Insulation, Fire-and Water-Resistant, Vapor-Barrier

MIL-C-20079H-1987 .....Cloth, Glass; Tape, Textile Glass; and Thread, Glass and Wire-Reinforced Glass

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

A167-99 2014.....Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

B209-2014.....Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

C411-2019.....Standard test method for Hot-Surface Performance of High-Temperature Thermal Insulation

C449-2019.....Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement

C533-2017.....Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation

C534-2017.....Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form

C547-2017.....Standard Specification for Mineral Fiber pipe Insulation

C552-07 .....Standard Specification for Cellular Glass Thermal Insulation

C553-2015.....Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications

C585-2016.....Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System) R (1998)

C612-2014.....Standard Specification for Mineral Fiber Block and Board Thermal Insulation

C1126- 2019.....Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation

C1136- 2017.....Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation

D1668-97a 2017 .....Standard Specification for Glass Fabrics (Woven and Treated) for Roofing and Waterproofing

E84-2014.....Standard Test Method for Surface Burning Characteristics of Building Materials

E119-2007.....Standard Test Method for Fire Tests of Building Construction and Materials

E136-2019.....Standard Test Methods for Behavior of Materials in a Vertical Tube Furnace at 750 degrees C (1380 F)

E. National Fire Protection Association (NFPA):

90A-2018.....Standard for the Installation of Air Conditioning and Ventilating Systems

96-2018.....Standard~~s~~ for Ventilation Control and Fire Protection of Commercial Cooking Operations

101-2018.....Life Safety Code

251-2014 .....Standard methods of Tests of Fire Endurance of Building Construction Materials

255-2006.....Standard Method of tests of Surface Burning Characteristics of Building Materials

F. Underwriters Laboratories, Inc (UL):

723-2018.....UL Standard for Safety Test for Surface Burning Characteristics of Building Materials with Revision of 09/08

G. Manufacturer's Standardization Society of the Valve and Fitting Industry (MSS):

SP58-2018.....Pipe Hangers and Supports Materials, Design, and Manufacture

PART 2 - PRODUCTS

2.1 MINERAL FIBER OR FIBER GLASS

A. ASTM C612 (Board, Block), Class 1 or 2, density 48 kg/m^3 (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) with foil scrim (FSK) facing.

B. ASTM C553 (Blanket, Flexible) Type I, Class B-5, Density 32 kg/m^3 (2 pcf), k = 0.04 (0.27) at 24 degrees C (75 degrees F), for use at temperatures up to 204 degrees C (400 degrees F) with foil scrim (FSK) facing.

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 (450 degrees F) with an all service vapor retarder jacket with polyvinyl chloride premolded fitting covering.

2.2 MINERAL WOOL OR REFRACTORY FIBER

A. Comply with Standard ASTM C612, Class 3, 450 degrees C (850 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 all service vapor retarder jacket with polyvinyl chloride premolded fitting covering.

B. Equipment and Duct Insulation, ASTM C 1126, 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.

2.4 CELLULAR GLASS CLOSED-CELL

A. Comply with Standard ASTM C177, C518, density 120 kg/m^3 (7.5 pcf) nominal, k = 0.033 (0.29) at 24~~0~~ degrees C (75 degrees F).

B. Pipe insulation for use at temperatures up to 200 degrees C (400 degrees F) with all service vapor retarder jacket.

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 polyvinyl chloride premolded fitting covers.

B. Equipment and duct insulation, ASTM C 591,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 C177, C518, 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 (200 degrees F). No jacket required.

2.8 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**

Temperature, maximum degrees C (degrees F)	649 (1200)	927 (1700)
Density (dry), Kg/m^3 (lb/ ft3)	232 (14.5)	288 (18)
Thermal conductivity: Min W/ m K (Btu in/h ft^2 degrees F)@ mean temperature of 93 degrees C (200 degrees F)	0.059 (0.41)	0.078 (0.540)
Surface burning characteristics: Flame spread Index, Maximum	0	0
Smoke Density index, Maximum	0	0

2.9 INSULATION FACINGS AND JACKETS

A. Vapor Retarder, higher strength with low water permeance $\underline{=}$ 0.02 or less perm rating, Beach puncture 50 units for insulation facing on exposed ductwork, casings and equipment, and for pipe insulation jackets. Facings and jackets shall be all service type (ASJ) or PVDC Vapor Retarder jacketing.

B. ASJ jacket shall be white kraft bonded to 0.025 mm (1 mil) thick aluminum foil, fiberglass reinforced, with pressure sensitive adhesive closure. Comply with ASTM C1136. Beach puncture 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: Foil-Scrim-Kraft (FSK) or PVDC vapor retarder jacketing type for concealed ductwork and equipment.

D. Field applied vapor barrier jackets shall be provided, in addition to the specified facings and jackets, on all exterior piping and ductwork as well as on interior piping and ductwork exposed to outdoor air (i.e.; in ventilated attics, piping in ventilated (not air conditioned) spaces, etc.)in high humidity areas 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. Glass Cloth Jackets: Presized, minimum 0.18 kg per square meter (7.8 ounces per square yard), 2000 kPa (300 psig) bursting strength with integral vapor retarder where required or specified. Weather proof if utilized for outside service.

F. Factory composite materials may be used provided that they have been tested and certified by the manufacturer.

G. Pipe fitting insulation covering (jackets): Fitting covering shall be premolded to match shape of fitting and shall be polyvinyl chloride (PVC) conforming to Fed Spec L-P-335, 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.

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 to match shape of fitting and of 0.6 mm (0.024) inch minimum thickness aluminum. Fittings shall be of same construction as straight run jackets but need not be of the same alloy. Factory-fabricated stainless steel bands shall be installed on all circumferential joints. Bands shall be 13 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.

2.10 REMOVABLE INSULATION JACKETS

A. Insulation and Jacket:

1. Non-Asbestos Glass mat, type E needled fiber.
2. Temperature maximum of 450°F, Maximum water vapor transmission of 0.00 perm, and maximum moisture absorption of 0.2 percent by volume.
3. Jacket Material: Silicon/fiberglass and LFP 2109 pure PTFE.

4. Construction: One piece jacket body with three-ply braided pure Teflon or Kevlar thread and insulation sewn as part of jacket. Belt fastened.

2.11 PIPE COVERING PROTECTION SADDLES

A. Cold pipe support: Premolded pipe insulation 180 degrees (half-shells) on bottom half of pipe at supports. Material shall be cellular glass or high density Polyisocyanurate insulation of the same thickness as adjacent insulation. Density of Polyisocyanurate insulation shall be a minimum of 48 kg/m^3 (3.0 pcf).

Nominal Pipe Size and Accessories Material (Insert Blocks)	
Nominal Pipe Size mm (inches)	Insert Blocks mm (inches)
Up through 125 (5)	150 (6) long
150 (6)	150 (6) long
200 (8), 250 (10), 300 (12)	225 (9) long
350 (14), 400 (16)	300 (12) long
450 through 600 (18 through 24)	350 (14) long

B. Warm or hot pipe supports: Premolded pipe insulation (180 degree half-shells) on bottom half of pipe at supports. Material shall be high density Polyisocyanurate (for temperatures up to 149 degrees C [300 degrees F]), cellular glass or calcium silicate. Insulation at supports shall have same thickness as adjacent insulation. Density of Polyisocyanurate insulation shall be a minimum of 48 kg/m^3 (3.0 pcf).

C. Boiler Plant Pipe supports: MSS SP58, Type 39. Apply at all pipe support points, except where MSS SP58, Type 3 pipe clamps provided as part of the support system.

2.12 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-24179, Type II Class 1: Adhesive for installing flexible unicellular insulation and for laps and general use.

D. Mil. Spec. MIL-C-19565, Type I: Protective finish for outdoor use.

E. Mil. Spec. MIL-C-19565, 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.

2.13 MECHANICAL FASTENERS

A. Pins, anchors: Welded pins, or metal or nylon anchors with galvanized steel-coated or fiber washer, or clips. Pin diameter shall be as recommended by the insulation manufacturer.

B. Staples: Outward clinching monel or galvanized steel.

C. Wire: 1.3 mm thick (18 gage) soft annealed galvanized or 1.9 mm (14 gage) copper clad steel or nickel copper alloy.

D. Bands: 13 mm (0.5 inch) nominal width, brass, galvanized steel, aluminum or stainless steel.

2.14 REINFORCEMENT AND FINISHES

A. Glass fabric, open weave: ASTM D1668, Type III (resin treated) and Type I (asphalt treated).

B. Glass fiber fitting tape: Mil. Spec MIL-C-20079, Type II, Class 1.

C. Tape for Flexible Elastomeric Cellular Insulation: As recommended by the insulation manufacturer.

D. Hexagonal wire netting: 25 mm (one inch) mesh, 0.85 mm thick (22 gage) galvanized steel.

E. Corner beads: 50 mm (2 inch) by 50 mm (2 inch), 0.55 mm thick (26 gage) galvanized steel; or, 25 mm (1 inch) by 25 mm (1 inch), 0.47 mm thick (28 gage) aluminum angle adhered to 50 mm (2 inch) by 50 mm (2 inch) Kraft paper.

F. PVC fitting cover: Fed. Spec L-P-535, Composition A, 11-86 Type II, Grade GU, with Form B Mineral Fiber insert, for media temperature 4 degrees C (40 degrees F) to 121 degrees C (250 degrees F). Below 4 degrees C (40 degrees F) and above 121 degrees C (250 degrees F). Provide double layer insert. Provide color matching vapor barrier pressure sensitive tape.

2.15 FIRESTOPPING MATERIAL

A. Other than pipe and duct insulation, refer to Section 07 84 00 FIRESTOPPING.

2.16 FLAME AND SMOKE

A. Unless shown otherwise all assembled systems shall meet flame spread 25 and smoke developed 50 rating as developed under ASTM, NFPA and UL standards and specifications. See paragraph 1.3 "Quality Assurance".

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. Required pressure tests of duct and piping joints and connections shall be completed and the work approved by the 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, insulate entire specified equipment, piping (pipe, fittings, valves, accessories), and duct systems. Insulate each pipe and duct individually. Do not use scrap pieces of insulation where a full length section will fit.

C. Insulation materials shall be installed in a first class manner with smooth and even surfaces, with jackets and facings drawn tight and smoothly cemented down at all laps. Insulation shall be continuous through all sleeves and openings, except at fire dampers and duct heaters (NFPA 90A). Vapor retarders shall be continuous and uninterrupted throughout systems with operating temperature 16 degrees C (60 degrees F) and below. Lap and seal vapor retarder over ends and exposed edges of insulation. Anchors, supports and other metal projections through insulation on cold surfaces shall be insulated and vapor sealed for a minimum length of 150 mm (6 inches).

D. Install vapor stops at all insulation terminations on either side of valves, pumps and equipment and particularly in straight lengths of pipe insulation.

E. Construct insulation on parts of equipment such as chilled water pumps and heads of chillers, convertors and heat exchangers that must be opened periodically for maintenance or repair, so insulation can be removed and replaced without damage. Install insulation with bolted 1 mm thick (20 gage) galvanized steel or aluminum covers as complete units, or in sections, with all necessary supports, and split to coincide with flange/split of the equipment.

F. Insulation on hot piping and equipment shall be terminated square at items not to be insulated, access openings and nameplates. Cover all exposed raw insulation with white sealer or jacket material.

G. Protect all 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.

H. Insulate PRVs, flow meters, and steam traps.

I. HVAC work not to be insulated:

1. Internally insulated ductwork and air handling units.
2. Relief air ducts (Economizer cycle exhaust air).
3. Exhaust air ducts and plenums, and ventilation exhaust air shafts.
4. Equipment: Expansion tanks, flash tanks, hot water pumps, steam condensate pumps.
5. In hot piping: Unions, flexible connectors, control valves, PRVs, safety valves and discharge vent piping, vacuum breakers, thermostatic vent valves, steam traps 20 mm (3/4 inch) and smaller, exposed piping through floor for convectors and radiators. Insulate piping to within approximately 75 mm (3 inches) of uninsulated items.

   h. Ball joints except piping between joints(NI)

J. Apply insulation materials subject to the manufacturer's recommended temperature limits. Apply adhesives, mastic and coatings at the manufacturer's recommended minimum coverage.

K. Elbows, flanges and other fittings shall be insulated with the same material as is used on the pipe straights. The elbow/ fitting insulation shall be field-fabricated, mitered or factory prefabricated to the necessary size and shape to fit on the elbow/ fitting. Use of polyurethane spray-foam to fill a PVC elbow jacket is prohibited on cold applications.

L. Firestop Pipe and Duct insulation:

1. Provide firestopping insulation at fire and smoke barriers through penetrations. Fire stopping insulation shall be UL listed as defines in Section 07 84 00, FIRESTOPPING.
2. Pipe and duct penetrations requiring fire stop insulation including, but not limited to the following:

a. Pipe risers through floors
b. Pipe or duct chase walls and floors
c. Smoke partitions
d. Fire partitions

M. Freeze protection of above grade outdoor piping (over heat tracing tape): 26 mm (10 inch) thick insulation, for all pipe sizes 75 mm(3 inches) and smaller and 25 mm(1inch) thick insulation for larger pipes. Provide metal jackets for all pipes. Provide for cold water make-up to cooling towers and condenser water piping and chilled water piping as described in Section 23 21 13, HYDRONIC PIPING (electrical heat tracing systems).

N. Provide vapor barrier jackets over insulation as follows:
1. All piping and ductwork exposed to outdoor weather.
2. All interior piping and ducts conveying fluids exposed to outdoor air (i.e. in attics, ventilated (not air conditioned) spaces, etc.) below ambient air temperature in high humidity areas.

O. Provide metal jackets over insulation as follows:
1. All piping and ducts exposed to outdoor weather.
2. Piping exposed in building, within 1800 mm (6 feet) of the floor, that connects to sterilizers, kitchen and laundry equipment. Jackets may be applied with pop rivets. Provide aluminum angle ring escutcheons at wall, ceiling or floor penetrations.
3. A 50 mm (2 inch) overlap is required at longitudinal and circumferential joints.

3.2 INSULATION INSTALLATION

A. Mineral Fiber Board:
1. Faced board: Apply board on pins spaced not more than 300 mm (12 inches) on center each way, and not less than 75 mm (3 inches) from each edge of board. In addition to pins, apply insulation bonding adhesive to entire underside of horizontal metal surfaces. Butt insulation edges tightly and seal all joints with laps and butt strips. After applying speed clips cut pins off flush and apply vapor seal patches over clips.
2. Plain board:
a. Insulation shall be scored, beveled or mitered to provide tight joints and be secured to equipment with bands spaced 225 mm (9

inches) on center for irregular surfaces or with pins and clips on flat surfaces. Use corner beads to protect edges of insulation.

b. For hot equipment: Stretch 25 mm (1 inch) mesh wire, with edges wire laced together, over insulation and finish with insulating and finishing cement applied in one coat, 6 mm (1/4 inch) thick, trowel led to a smooth finish.

c. For cold equipment: Apply meshed glass fabric in a tack coat 1.5 to 1.7 square meter per liter (60 to 70 square feet per gallon) of vapor mastic and finish with mastic at 0.3 to 0.4 square meter per liter (12 to 15 square feet per gallon) over the entire fabric surface.

d. Chilled water pumps: Insulate with removable and replaceable 1 mm thick (20 gage) aluminum or galvanized steel covers lined with insulation. Seal closure joints/flanges of covers with gasket material. Fill void space in enclosure with flexible mineral fiber insulation.

3. Exposed, unlined ductwork and equipment in unfinished areas, mechanical and electrical equipment rooms and attics, interstitial spaces and duct work exposed to outdoor weather:

a. 40 mm (1-1/2 inch) 50 mm (2 inch) thick insulation faced with ASJ (white all service jacket): Supply air duct unlined air handling units and after filter housing.

b. 40 mm (1-1/2 inch) 50 mm (2 inch) thick insulation faced with ASJ: Return air duct, mixed air plenums and prefilter housing.

c. Outside air intake ducts: no insulation required 25 mm (one inch) thick insulation faced with ASJ.

d. Exposed, unlined supply and return ductwork exposed to outdoor weather: 50 mm (2 inch) thick insulation faced with a reinforcing membrane and two coats of vapor barrier mastic or multi-layer vapor barrier with a maximum water vapor permeability of 0.001 perms.

4. Supply air duct in the warehouse and in the laundry: 25 mm (one inch) thick insulation faced with ASJ.

5. Cold equipment: 40 mm (1-1/2inch) thick insulation faced with ASJ.

a. Chilled water pumps, water filter, chemical feeder pot or tank.

b. Pneumatic, cold storage water and surge tanks.

6. Hot equipment: 40 mm (1-1/2 inch) thick insulation faced with ASJ.
   a. Reheat coil casing and separation chambers on steam humidifiers located above ceilings.

B. Flexible Mineral Fiber Blanket:

1. Adhere insulation to metal with 75 mm (3 inch) wide strips of insulation bonding adhesive at 200 mm (8 inches) on center all around duct. Additionally secure insulation to bottom of ducts exceeding 600 mm (24 inches) in width with pins welded or adhered on 450 mm (18 inch) centers. Secure washers on pins. Butt insulation edges and seal joints with laps and butt strips. Staples may be used to assist in securing insulation. Seal all vapor retarder penetrations with mastic. Sagging duct insulation will not be acceptable. Install firestop duct insulation where required.
2. Supply air ductwork to be insulated includes main and branch ducts from AHU discharge to room supply outlets, and the bodies of ceiling outlets to prevent condensation. Insulate sound attenuator units, coil casings and damper frames. To prevent condensation insulate trapeze type supports and angle iron hangers for flat oval ducts that are in direct contact with metal duct.
3. Concealed supply air ductwork.
   a. Above ceilings at a roof level, in attics, and duct work exposed to outdoor weather: 50 mm (2 inch) thick insulation faced with FSK.
   b. Above ceilings for other than roof level: 40 mm (1 ½ inch) thick insulation faced with FSK.
4. Concealed return air duct:
   a. In attics (where not subject to damage) and where exposed to outdoor weather: 50mmm (2 inch)thick insulation faced with FSK,
   b. Above ceilings at a roof level, unconditioned areas, and in chases with external wall or containing steam piping; 40 mm (1-1/2 inch) thick, insulation faced with FSK.
   c. In interstitial spaces (where not subject to damage): 40 mm (1-1/2 inch thick insulation faced with FSK.
   d. Concealed return air ductwork in other locations need not be insulated.

5. Concealed outside air duct: 40 mm (1-1/2 inch) thick insulation faced with FSK.
6. Exhaust air branch duct from autopsy refrigerator to main duct: 40 mm (1-1/2 inch) thick insulation faced with FSK.

C. Molded Mineral Fiber Pipe and Tubing Covering:

1. Fit insulation to pipe or duct, aligning longitudinal joints. Seal longitudinal joint laps and circumferential butt strips by rubbing hard with a nylon sealing tool to assure a positive seal. Staples may be used to assist in securing insulation. Seal all vapor retarder penetrations on cold piping with a generous application of vapor barrier mastic. Provide inserts and install with metal insulation shields at outside pipe supports. Install freeze protection insulation over heating cable.
2. Contractor's options for fitting, flange and valve insulation:
   a. Insulating and finishing cement for sizes less than 100 mm (4 inches) operating at surface temperature of 16 degrees C (61 degrees F) or more.
   b. Factory premolded, one piece PVC covers with mineral fiber, (Form B), inserts. Provide two insert layers for pipe temperatures below 4 degrees C (40 degrees F), or above 121 degrees C (250 degrees F). Secure first layer of insulation with twine. Seal seam edges with vapor barrier mastic and secure with fitting tape.
   c. Factory molded, ASTM C547 or field mitered sections, joined with adhesive or wired in place. For hot piping finish with a smoothing coat of finishing cement. For cold fittings, 16 degrees C (60 degrees F) or less, vapor seal with a layer of glass fitting tape imbedded between two 2 mm (1/16 inch) coats of vapor barrier mastic.
   d. Fitting tape shall extend over the adjacent pipe insulation and overlap on itself at least 50 mm (2 inches).
3. Nominal thickness in millimeters and inches specified in the schedule at the end of this section.

D. Rigid Cellular Phenolic Foam:

1. Rigid closed cell phenolic insulation may be provided for piping, ductwork and equipment for temperatures up to 121 degrees C (250 degrees F).
2. Note the NFPA 90A burning characteristics requirements of 25/50 in paragraph 1.3.B
3. Provide secure attachment facilities such as welding pins.
4. Apply insulation with joints tightly drawn together
5. Apply adhesives, coverings, neatly finished at fittings, and valves.
6. Final installation shall be smooth, tight, neatly finished at all edges.
7. Minimum thickness in millimeters (inches) specified in the schedule at the end of this section.
8. Exposed, unlined supply and return ductwork exposed to outdoor weather: 50 mm (2 inch) thick insulation faced with a multi-layer vapor barrier with a maximum water vapor permeance of 0.00 perms.
9. Condensation control insulation: Minimum 25 mm (1.0 inch) thick for all pipe sizes.
   a. HVAC: Cooling coil condensation piping to waste piping fixture or drain inlet. Omit insulation on plastic piping in mechanical rooms.

E. 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 23 21 13: 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.

3. Cold equipment: 50 mm (2 inch) thick insulation faced with ASJ for chilled water pumps, water filters, chemical feeder pots or tanks, expansion tanks, air separators and air purgers.

4. Exposed, unlined supply and return ductwork exposed to outdoor weather: 50 mm (2 inch) thick insulation faced with a reinforcing membrane and two coats of vapor barrier mastic or multi-layer vapor barrier with a water vapor permeability of 0.00 perms.

F. Polyisocyanurate Closed-Cell Rigid Insulation:

1. Polyisocyanurate closed-cell rigid insulation (PIR) may be provided for exterior piping, equipment and ductwork for temperature up to 149 degree C (300 degree F).

2. Install insulation, vapor barrier 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 barrier integrity.

3. Install insulation with all joints tightly butted (except expansion) joints in hot applications).

4. If insulation thickness exceeds 63 mm (2.5 inches), install as a double layer system with longitudinal (lap) and butt joint staggering as recommended by manufacturer.

5. For cold applications, vapor barrier shall be installed in a continuous manner. No staples, rivets, screws or any other attachment device capable of penetrating the vapor barrier shall be used to attach the vapor barrier or jacketing. No wire ties capable of penetrating the vapor barrier shall be used to hold the insulation in place. Banding shall be used to attach PVC or metal jacketing.

6. Elbows, flanges and other fittings shall be insulated with the same material as is used on the pipe straights. The elbow/ fitting insulation shall be field-fabricated, mitered or factory prefabricated to the necessary size and shape to fit on the elbow/ fitting. Use of polyurethane spray-foam to fill PVC elbow jacket is prohibited on cold applications.
7. For cold applications, the vapor barrier on elbows/fittings shall be either mastic-fabric-mastic or 2 mil thick PVDC vapor barrier adhesive tape.
8. All PVC and metal jacketing shall be installed so as to naturally shed water. Joints shall point down and shall be sealed with either adhesive or caulking (except for periodic slip joints).
9. Underground piping: Follow instructions for above ground piping but the vapor retarder jacketing shall be 6 mil thick PVDC or minimum 30 mil thick rubberized bituminous membrane. Sand bed and backfill shall be a minimum of 150 mm (6 inches) all around insulated pipe.
10. Exposed, unlined supply and return ductwork exposed to outdoor weather: 50 mm (2 inch) thick insulation faced with a multi-layer vapor barrier with a water vapor permeance of 0.00 perms.
11. Note the NFPA 90A burning characteristic requirements of 25/50 in paragraph 1.3B. Refer to paragraph 3.1 for items not to be insulated.
12. Minimum thickness in millimeter (inches) specified in the schedule at the end of this section.

G. Flexible Elastomeric Cellular Thermal Insulation:
1. Apply insulation and fabricate fittings in accordance with the manufacturer's installation instructions and finish with two coats of weather resistant finish as recommended by the insulation manufacturer.
2. Pipe and tubing insulation:
   a. Use proper size material. Do not stretch or strain insulation.
   b. To avoid undue compression of insulation, provide cork stoppers or wood inserts at supports as recommended by the insulation manufacturer. Insulation shields are specified under Section 23 05 11.

c. Where possible, slip insulation over the pipe or tubing prior to connection, and seal the butt joints with adhesive. Where the slip-on technique is not possible, slit the insulation and apply it to the pipe sealing the seam and joints with contact adhesive. Optional tape sealing, as recommended by the manufacturer, may be employed. Make changes from mineral fiber insulation in a straight run of pipe, not at a fitting. Seal joint with tape.

3. Apply sheet insulation to flat or large curved surfaces with 100 percent adhesive coverage. For fittings and large pipe, apply adhesive to seams only.
4. Pipe insulation: nominal thickness in millimeters (inches as specified in the schedule at the end of this section.
5. Minimum 20 mm (0.75 inch) thick insulation for pneumatic control lines for a minimum distance of 6 m (20 feet) from discharge side of the refrigerated dryer.
6. Use Class S (Sheet), 20 mm (3/4 inch) thick for the following:
   a. Chilled water pumps
   b. Bottom and sides of metal basins for winterized cooling towers (where basin water is heated).
   c. Chillers, insulate any cold chiller surfaces subject to condensation which has not been factory insulated.
   d. Piping inside refrigerators and freezers: Provide heat tape under insulation.
7. Exposed, unlined supply and return ductwork exposed to outdoor weather: 50 mm (2 inch) thick insulation faced with a multi-layer vapor barrier with a water vapor permeance of 0.00 perms.

H. Duct Wrap for Kitchen Hood Grease Ducts:
1. The insulation thickness, layers and installation method shall be as per recommendations of the manufacturer to maintain the fire integrity and performance rating.
2. Provide stainless steel jacket for all exterior and exposed interior ductwork.

I. Calcium Silicate:
1. Minimum thickness in millimeter (inches) specified in the schedule at the end of this section for piping other than in boiler plant. See paragraphs 3.3 through 3.7 for Boiler Plant Applications.

2. Engine Exhaust Insulation for Emergency Generator and Diesel Driven Fire Pump: Type II, Class D, 65 mm (2 1/2 inch) nominal thickness. Cover exhaust completely from engine through roof or wall construction, including muffler. Secure with 16 AWG galvanized annealed wire or 0.38 x 12 mm 0.015 x 1/2 IN wide galvanized bands on 300 mm 12 IN maximum centers. Anchor wire and bands to welded pins, clips or angles. Apply 25 mm 1 IN hex galvanized wire over insulation. Fill voids with 6 mm 1/4 IN insulating cement.
3. ETO Exhaust (High Temperature): Type II, class D, 65 mm (2.5 inches) nominal thickness. Cover duct for entire length. Provide sheet aluminum jacket for all exterior ductwork.
4. Kitchen Exhaust Duct work: Type II, class D, 65 mm (2.5 inches) nominal thickness. Wire insulation in place with 12 gauge galvanized wire.
5. MRI Quench Vent Insulation: Type I, class D, 150 mm (6 inch) nominal thickness.

3.3 APPLICATION –BOILER PLANT, PIPE, VALVES, STRAINERS AND FITTINGS:

A. Temperature range 120 to 230 degrees C (251 to 450 degrees F);
1. Application; Steam service 110 kpa (16 psig nominal) and higher, high pressure condensate to trap assembly, boiler bottom blowoff from boiler to blowoff valve closest to boiler.
2. Insulation and Jacket:
   a. Calcium silicate for piping from zero to 1800 mm (6 feet) above boiler room floor, feedwater heater mezzanine floor or access platform and any floors or platforms on which tanks or pumps are located.
   b. Mineral fiber for remaining locations.
   c. ASJ with PVC premolded fitting coverings.
   d. Aluminum jacket from zero to 1800 mm (6 feet) above floor on atomizing steam and condensate lines at boilers and burners.
3. Thickness:

Nominal Thickness Of Calcium Silicate Insulation (Boiler Plant)	
Pipe Diameter mm (in)	Insulation Thickness mm (in)
25 (1 and below)	125 (5)
25 to 38 (1-1/4 to 1-1/2)	125 (5)
38 (1-1/2) and above	150 (6)

B. Temperature range 100 to 121 degrees C (211 to 250 degrees F):
   1. Application: Steam service 103 kpa (15 psig) and below, trap assembly discharge piping, boiler feedwater from feedwater heater to boiler feed pump recirculation, feedwater heater overflow, heated oil from oil heater to burners.
   2. Insulation and Jacket:
      a. Calcium silicate for piping from zero to 1800 mm (0 to 6 feet) above boiler room floor, feedwater heater mezzanine floor and access platform, and any floors or access platforms on which tanks or pumps are located.
      b. Mineral Fiber or rigid closed cell phenolic foam for remaining locations.
      c. ASJ with PVC premolded fitting coverings.
      d. Aluminum jacket from zero to 1800 mm (6 feet) above floor on condensate lines at boilers and burners.
   3. Thickness-calcium silicate and mineral fiber insulation:

Nominal Thickness Of Insulation	
Pipe Diameter mm (in)	Insulation Thickness mm (in)
25 (1 and below)	50 (2)
25 to 38 (1-1/4 to 1-1/2)	50 (2)
38 (1-1/2) and above	75 (3)

   4. Thickness-rigid closed-cell phenolic foam insulation:

Nominal Thickness Of Insulation	
Pipe Diameter mm (in)	Insulation Thickness mm (in)
25 (1 and below)	38 (1.5)
25 to 38 (1-1/4 to 1-1/2)	38 (1.5)
38 (1-1/2) and above	75(3)

C. Temperature range 32 to 99 degrees C (90 to 211 degrees F):

1. Application: Pumped condensate, vacuum heating return, gravity and pumped heating returns, condensate transfer, condensate transfer pump recirculation, heated oil system to heaters and returns from burners, condensate return from convertors and heated water storage tanks.
2. Insulation Jacket:
   a. Calcium silicate for piping from zero to 1800 mm (six feet above boiler room floor, feedwater heater mezzanine floor and access platform and any floor or access platform on which tanks or pumps are located.
   b. Mineral fiber or rigid closed-cell phenolic foam for remaining locations.
   c. ASJ with PVC premolded fitting coverings.
3. Thickness-calcium silicate and mineral fiber insulation:

Nominal Thickness Of Insulation	
Pipe Diameter mm (in)	Insulation Thickness mm (in)
25 (1 and below)	38 (1.5)
25 to 38 (1-1/4 to 1-1/2)	50(2)
38 (1-1/2) and above	75 (3)

4. Thickness-rigid closed-cell phenolic foam insulation:

Nominal Thickness Of Insulation	
Pipe Diameter mm (in)	Insulation Thickness mm (in)
25 (1 and below)	19 (0.75)
25 to 38 (1-1/4 to 1-1/2)	19 (0.75)
38 (1-1/2) and above	25 (1)

D. Protective insulation to prevent personnel injury:
   1. Application: Piping from zero to 1800 mm (6 feet) above all floors and access platforms including continuous blowoff, feedwater and boiler water sample, blowoff tank vent, flash tank vents and condensater tank vent, shot-type chemical feed, fire tube boiler bottom blowoff after valves, valve by-passes.
   2. Insulation thickness: 25 mm (1 inch).
   3. Insulation and jacket: Calcium silicate with ASJ except provide aluminum jacket on piping at boilers within 1800 mm (6 feet) of floor. Use PVC premolded fitting coverings when all service jacket is utilized.

E. Installation:
   1. At pipe supports, weld pipe covering protection saddles to pipe, except where MS-SP58, type 3 pipe clamps are utilized.
   2. Insulation shall be firmly applied, joints butted tightly, mechanically fastened by stainless steel wires on 300 mm (12 inch) centers.
   3. At support points, fill and thoroughly pack space between pipe covering protective saddle bearing area.
   4. Terminate insulation and jacket hard and tight at anchor points.
   5. Terminate insulation at piping facilities not insulated with a 45 degree chamfered section of insulating and finishing cement covered with jacket.
   6. On calcium silicate, mineral fiber and rigid closed-cell phenolic foam systems, insulated flanged fittings, strainers and valves with sections of pipe insulation cut, fitted and arranged neatly and firmly wired in place. Fill all cracks, voids and coat outer surface with insulating cement. Install jacket. Provide similar construction on welded and threaded fittings on calcium silicate systems or use premolded fitting insulation.
   7. On mineral fiber systems, insulate welded and threaded fittings more than 50 mm (2 inches) in diameter with compressed blanket insulation (minimum 2/1) and finish with jacket or PVC cover.
   8. Insulate fittings 50 mm (2 inches) and smaller with mastic finishing material and cover with jacket.

9. Insulate valve bonnet up to valve side of bonnet flange to permit bonnet flange removal without disturbing insulation.
10. Install jacket smooth, tight and neatly finish all edges. Over wrap ASJ butt strips by 50 percent. Secure aluminum jacket with stainless steel bands 300 mm (12 inches) on center or aluminum screws on 200 mm (4 inch) centers.
11. Do not insulate basket removal flanges on strainers.

3.4 APPLICATION-BOILER FLUE GAS SYSTEMS

A. Temperature range 150 to 370 degrees C (300 to 700 degrees F):
   1. Application: Transitions, stacks and breechings from boiler outlet to stack outlet; induced draft fans (if provided); flue gas recirculation fans and ductwork (if provided).
   2. Thickness:
      a. Single-wall duct systems: 50 mm (2 inches).
      b. Double-wall factory-fabricated duct systems with air space between walls: None.
   3. Insulation and jacket: Calcium Silicate with aluminum sheet metal jacket.

B. Protective Insulation to Prevent Personnel Injury:
   1. Application: Double wall factory-fabricated duct system with uninsulated air space between walls within 900 mm (3 feet) horizontally and 1800 mm (6 feet) vertically of platform or floor.
   2. Insulation thickness; 25 mm (1 inch).
   3. Insulation and jacket: Calcium Silicate with aluminum sheet metal jacket.

C. Insulating:
   1. Provide attachment facilities such as angles, welded studs, clip angles.
   2. Apply insulation with joints tightly butted and staggered. Seal joints with high temperature cement.
   3. Provide metal corner beads.
   4. Band insulation firmly in place to provide a smooth surface. Maximum band spacing shall not be more than 300 mm (12 inches).
   5. Install jacket. All surfaces outside of building must be weather tight. At termination of stub stacks, provide metal closure system

which is connected and sealed to perimeter of stack to prevent water penetration of insulation.

3.5 APPLICATION-BOILER DEAERATING FEEDWATER HEATER, TANKS

A. Temperature range 38 to 120 degrees C (100 to 250 degrees F)
   1. Application: Deaerating feedwater heater and storage tank, condensate storage tanks, heat exchangers, blowoff tank.
   2. Insulation Thickness:
      a. Feedwater heater and storage tanks: 75 mm (3 inches)
      b. Condensate storage tanks: 50 mm (2 inches)
      c. Blowoff tank, heat exchangers: 25 mm (1 inch).
   3. Insulation and covering: Calcium silicate with glass cloth jacket.

B. Insulating:
   1. Insulate tanks with an assembly of chamfered block to fit curvature. Secure with 1.6 mm diameter (16 gage) wire or stainless steel bands 300 mm (12 inches) on centers, fill all voids and interstices with finishing cement coat, imbed hexagonal wire mesh in first finish coat. Provide a second finish coat and a glass cloth covering.
   2. Apply glass cloth with adhesive, smooth, tight and neatly finished at all cloth edges; prime to receive paint.
   3. Do not insulate over nameplates and data plates. Nameplates and data plates must be legible.

3.6 APPLICATION ON HEATED OR TRACED OIL FACILITIES OUTSIDE OF BUILDING

A. Temperature range 30 to 120 degrees C (85 to 250 degrees F).
   1. Application: Aboveground oil storage tank, oil and steam or hot water underground and aboveground piping systems.
   2. Insulation thickness:
      a. Tanks; 38 mm (1-1/2 inches) plus finish.
      b. Oil suction and return piping: 38 mm (1-1/2 inches plus finish).
      c. Steam or hot water piping: 38 mm (1-1/2 inches) plus finish.

B. Insulation and jacket (aboveground tanks and piping): Calcium silicate with glass cloth or aluminum jacket, weatherproof jacket when used outside of building.

C. Insulation and Jacket (underground piping); Calcium silicate with fiberglass scrim jacket located within secondary containment. Allow space for heating cable (if provided) along bottom line of piping.

3.7 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.

B. Components provided under this section of the specification will be tested as part of a larger system. Refer to section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS and related sections for contractor responsibilities for system commissioning.

3.8 PIPE INSULATION SCHEDULE

A. Provide insulation for piping systems as scheduled below:

Insulation Wall 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 Above
	Insulation Wall Thickness Millimeters (Inches)				
122-177 degrees C (251-350 degrees F) (HPS, MPS)	Mineral Fiber (Above ground piping only)	75 (3)	100 (4)	113 (4.5)	113 (4.5)
93-260 degrees C (200-500 degrees F) (HPS, HPR)	Calcium Silicate	100 (4)	125 (5)	150 (6)	150 (6)
100-121 degrees C (212-250 degrees F) (HPR, MPR, LPS, vent piping from PRV Safety Valves, Condensate receivers and flash tanks)	Mineral Fiber (Above ground piping only)	62 (2.5)	62 (2.5)	75 (3.0)	75 (3.0)
100-121 degrees C (212-250 degrees F) (HPR, MPR, LPS, vent piping from PRV Safety Valves, Condensate receivers and flash tanks)	Rigid Cellular Phenolic Foam	50 (2.0)	50 (2.0)	75 (3.0)	75 (3.0)
38-94 degrees C (100-200 degrees F)	Mineral Fiber (Above ground piping only)	38 (1.5)	38 (1.5)	50 (2.0)	50 (2.0)

(LPR, PC, HWH, HWHR, GH and GHR)					
38-99 degrees C (100-211 degrees F) (LPR, PC, HWH, HWHR, GH and GHR)	Rigid Cellular Phenolic Foam	38 (1.5)	38 (1.5)	50 (2.0)	50 (2.0)
39-99 degrees C (100-211 degrees F) (LPR, PC, HWH, HWHR, GH and GHR)	Polyiso-cyanurate Closed-Cell Rigid (Exterior Locations only)	38 (1.5)	38 (1.5)	----	----
38-94 degrees C (100-200 degrees F) (LPR, PC, HWH, HWHR, GH and GHR)	Flexible Elastomeric Cellular Thermal (Above ground piping only)	38 (1.5)	38 (1.5)	----	----
4-16 degrees C (40-60 degrees F) (CH, CHR, GC, GCR and RS for DX refrigeration)	Rigid Cellular Phenolic Foam	38 (1.5)	38 (1.5)	38 (1.5)	38 (1.5)
4-16 degrees C (40-60 degrees F) (CH and CHR within chiller room and pipe chase and underground)	Cellular Glass Closed-Cell	50 (2.0)	50 (2.0)	75 (3.0)	75 (3.0)
4-16 degrees C (40-60 degrees F) (CH, CHR, GC, GCR and RS for DX refrigeration)	Cellular Glass Closed-Cell	38 (1.5)	38 (1.5)	38 (1.5)	38 (1.5)
4-16 degrees C (40-60 degrees F) (CH, CHR, GC and GCR (where underground)	Polyiso-cyanurate Closed-Cell Rigid	38 (1.5)	38 (1.5)	50 (2.0)	50 (2.0)

4-16 degrees C (40-60 degrees F) (CH, CHR, GC, GCR and RS for DX refrigeration)	Polyiso-cyanurate Closed-Cell Rigid (Exterior Locations only)	38 (1.5)	38 (1.5)	38 (1.5)	38 (1.5)
(40-60 degrees F) (CH, CHR, GC, GCR and RS for DX refrigeration)	Flexible Elastomeric Cellular Thermal (Above ground piping only)	38 (1.5)	38 (1.5)	38 (1.5)	38 (1.5)

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03-01-23

SECTION 23 08 00
COMMISSIONING OF HVAC SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. The requirements of this Section apply to all sections of Division 23.

B. This project will have selected building systems commissioned. The complete list of equipment and systems to be commissioned is specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. The commissioning process, which the Contractor is responsible to execute, is defined in Section 01 91 00 GENERAL COMMISSIONING REQUIRMENTS. A Commissioning Agent (CxA) appointed by the VA will manage the commissioning process.

1.2 RELATED WORK

A. Section 01 00 00 GENERAL REQUIREMENTS.

B. Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

D. Section 23 05 41 NOISE AND VIBRATION CONTROL for HVAC PIPING AND EQUIPMENT.

E. Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC.

F. Section 23 09 23 DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

1.3 SUMMARY

A. This Section includes requirements for commissioning the HVAC systems of the related subsystems and equipment. This Section supplements the general requirements specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

B. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for more details regarding processes and procedures as well as roles and responsibilities for all Commissioning Team members.

1.4 DEFINITIONS

A. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for definitions.

1.5 COMMISSIONED SYSTEMS

A. Commissioning of a system or systems specified in Division 23 is part of the construction process. Documentation and testing of these systems, as well as training of the VA’s Operation and Maintenance personnel in accordance with the requirements of Section 01 91 00

GENERAL COMMISSIONING REQUIREMENTS and of Division 23, is required in cooperation with the VA and the Commissioning Agent.

B. The Facility HVAC systems commissioning will include the systems listed in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

1.6 SUBMITTALS

A. The commissioning process requires review of selected Submittals that pertain to the systems to be commissioned. The Commissioning Agent will provide a list of submittals that will be reviewed by the Commissioning Agent. This list will be reviewed and approved by the VA prior to forwarding to the Contractor. Refer to Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, and SAMPLES for further details.

B. The commissioning process requires Submittal review simultaneously with engineering review. Specific submittal requirements related to the commissioning process are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

1.7 APPLICABLE PUBLICATIONS

A. The following publications form a part of this specification to the extent indicated by the reference thereto. In text the publications are referenced to by the acronym of the organization.

B. Department of Veterans Affairs (VA):
PG 18-10 2007.....Mission Critical Facilities - DRAFT
PG 18-10 2007.....Life-Safety Protected Facilities - DRAFT

C. American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE):
HANDBOOK 2019.....HVAC Applications ASHRAE Handbook, Chapter 39, Testing, Adjusting, and Balancing, Chapter 44, HVAC Commissioning and Chapter 49, Sound and Vibration Control
HANDBOOK 2017.....HVAC Fundamentals ASHRAE Handbook, Chapter 8, Sound and Vibration

D. Associated Air Balance Council (AABC):
7th Edition 2016.....AABC National Standards for Total System Balance

E. National Environmental Balancing Bureau (NEBB):
9th Edition 2019.....Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems

3rd Edition 2015 .....Procedural Standards for the Measurement of Sound and Vibration

2nd Edition 2019 ... Standard for Whole Building Technical Commissioning of New Construction

F. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):

0062006.....HVAC Duct Construction Standard - Metal and Flexible Duct

3rd Edition 2005 ... HVAC Systems Testing, Adjusting and Balancing

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 CONSTRUCTION INSPECTIONS

A. Commissioning of HVAC systems will require inspection of individual elements of the HVAC systems construction throughout the construction period. The Contractor shall coordinate with the Commissioning Agent in accordance with Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS and the Commissioning plan to schedule HVAC systems inspections as required to support the Commissioning Process.

3.2 PRE-FUNCTIONAL CHECKLISTS

A. The Contractor shall complete Pre-Functional Checklists to verify systems, subsystems, and equipment installation is complete and systems are ready for Systems Functional Performance Testing. The Commissioning Agent will prepare Pre-Functional Checklists to be used to document equipment installation. Refer to Sections 23 05 41 NOISE AND VIBRATION CONTROL for HVAC PIPING AND EQUIPMENT, Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC and Section 23 09 23 DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC requirements. The Contractor shall complete the checklists. Completed checklists shall be submitted to the VA and to the Commissioning Agent for review. The Commissioning Agent may spot check a sample of completed checklists. If the Commissioning Agent determines that the information provided on the checklist is not accurate, the Commissioning Agent will return the marked-up checklist to the Contractor for correction and resubmission. If the Commissioning Agent determines that a significant number of completed checklists for similar equipment are not accurate, the Commissioning Agent will select a broader sample of checklists for

review. If the Commissioning Agent determines that a significant number of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and resubmission. Refer to SECTION 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for Pre-Functional Checklists, Equipment Startup Reports, and other commissioning documents.

3.3 CONTRACTORS TESTS

A. Contractor tests as required by other sections of Division 23 shall be scheduled and documented in accordance with Section 01 00 00 GENERAL REQUIREMENTS. All testing shall be incorporated into the project schedule. Contractor shall provide no less than 7 calendar days' notice of testing. The Commissioning Agent will witness selected Contractor tests at the sole discretion of the Commissioning Agent. Contractor tests shall be completed prior to scheduling Systems Functional Performance Testing.

3.4 SYSTEMS FUNCTIONAL PERFORMANCE TESTING:

A. The Commissioning Process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions. The Commissioning Agent will prepare detailed Systems Functional Performance Test procedures for review and approval by the 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 requirements.

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 GENERAL COMMISSIONING REQUIREMENTS. The instruction shall be scheduled in coordination with the VA COR after submission and approval of formal training plans. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS and Division 23 Sections for additional Contractor training requirements.

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SECTION 23 09 23

DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 - GENERAL

1.1 DESCRIPTION

A. General Contractor shall provide direct-digital control system(s) as indicated on the project documents, point list, interoperability tables, drawings and as described in these specifications. Include a complete and working direct-digital control system. Include all engineering, programming, configuration/setup hardware and software, controls and installation materials, installation labor, commissioning and startup, training, final project documentation and warranty. A System Integrator and Direct Digital Controls Contractor shall be two separate direct subcontractors of General Contractor.

1. All new building controllers shall be native BACnet. All new BACnet workstations, controllers, devices and components shall be listed by BACnet Testing Laboratories. All new BACnet workstations, controllers, devices and components shall be accessible using a HTML5 Web browser interface. Browsers shall not require the use of an extension or add on software in order to access aforementioned workstations, controllers, devices, and components.
2. The work administered by this Section of the technical specifications shall include all labor, materials, special tools, equipment, enclosures, power supplies, software, software licenses, Project specific software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, submittals, testing, verification, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, Warranty, specified services and any other items required for a complete and fully functional Controls System.

B. Some products are furnished but not installed by the contractor administered by this Section of the technical specifications. The contractor administered by this Section of the technical specifications shall formally coordinate in writing and receive from other contractors formal acknowledgements in writing prior to submission the installation

of the products. These products include but are not limited to the following:

1. Control valves.
2. Flow switches.
3. Flow meters.
4. Sensor wells and sockets in piping.
5. Terminal unit controllers.

C. Some products are installed but not furnished by the contractor administered by this Section of the technical specifications. The contractor administered by this Section of the technical specifications shall formally coordinate in writing and receive from other contractors formal acknowledgements in writing prior to submission the procurement of the products. These products include but are not limited to the following:

1. Factory-furnished accessory thermostats and sensors furnished with unitary equipment.

D. Some products are not provided by, but are nevertheless integrated with the work executed by, the contractor administered by this Section of the technical specifications. These products include but are not limited to the following:

1. Fire alarm systems. If zoned fire alarm is required by the project-specific requirements, this interface shall require multiple relays, which are provided and installed by the fire alarm system contractor, to be monitored.
2. Terminal units’ velocity sensors
3. Condenser water quality systems: condenser water high- and low-parts hydrogen (pH) alarms.
4. Steam trap monitoring system: Monitoring and alarms shall be connected to the ECC via BACnet.
5. Variable frequency drives. These controls, if not native BACnet, will require a BACnet Gateway.
6. The following systems have limited control (as individually noted below) from the ECC:
   a. Constant temperature rooms: temperature out of acceptable range and status alarms.

b. Medical gas systems (if not bottled at point of use): low pressure and status alarms.

E. Responsibility Table:

Work/Item/System	Furnish	Install	Low Voltage Wiring	Line Power
Control system low voltage and communication wiring	23 09 23	23 09 23	23 09 23	N/A
Terminal units	23	23	N/A	26
Controllers for terminal units	23 09 23	23	23 09 23	16
LAN conduits and raceway	23 09 23	23 09 23	N/A	N/A
Automatic dampers (not furnished with equipment)	23 09 23	23	N/A	N/A
Automatic damper actuators	23 09 23	23 09 23	23 09 23	23 09 23
Manual valves	23	23	N/A	N/A
Automatic valves	23 09 23	23	23 09 23	23 09 23
Pipe insertion devices and taps, flow and pressure stations.	23	23	N/A	N/A
Thermowells	23 09 23	23	N/A	N/A
Current Switches	23 09 23	23 09 23	23 09 23	N/A
Control Relays	23 09 23	23 09 23	23 09 23	N/A
Power distribution system monitoring interfaces	23 09 23	23 09 23	23 09 23	26
All control system nodes, equipment, housings, enclosures and panels.	23 09 23	23 09 23	23 09 23	26
Smoke detectors	28 31 00	28 31 00	28 31 00	28 31 00
Fire/Smoke Dampers	23	23	28 31 00	28 31 00
Smoke Dampers	23	23	28 31 00	28 31 00
Fire Dampers	23	23	N/A	N/A
VFDs	23	26	23 09 23	26
Medical gas panels	23	23	26	26
Laboratory Air Valves	23	23	23 09 23	N/A

Work/Item/System	Furnish	Install	Low Voltage Wiring	Line Power
Control system interface with CRU A/C controls	23 09 23	23 09 23	23 09 23	26
Fire Alarm shutdown relay interlock wiring	28	28	28	26
Control system monitoring of fire alarm smoke control relay	28	28	23 09 23	28
Fire-fighter's smoke control station (FSCS	28	28	28	28
Unit Heater controls (not furnished with equipment)	23 09 23	23 09 23	23 09 23	26
Starters, HOA switches	23	23	N/A	26
Steam Trap Monitoring not in Boiler Plant	23 22 13	23 22 13	26	26

F. This facility's existing direct-digital control (DDC) system is manufactured by Siemens Apogee and its ECC is in the Engineering Office of the Existing Powerhouse. The existing system's top-end communications is via BACnet. The existing system's ECC and controllers were installed in the year of 2015. The contractor administered by this Section of the technical specifications shall observe the capabilities, communication network, services, spare capacity of the existing control system and its ECC prior to beginning work. Existing control services are currently provided by Control Management, Inc. Columbia, SC.

G. The direct-digital control system shall start and stop equipment, move (position) damper actuators and valve actuators, and vary speed of equipment to execute the mission of the control system. Use electricity as the motive force for all damper and valve actuators, unless use of pneumatics as motive force is specifically granted in writing by the VA.

1.2 RELATED WORK

A. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

B. Section 23 21 13, Hydronic Piping.

C. Section 23 22 13, Steam and Condensate Heating Piping.

D. Section 23 31 00, HVAC Ducts and Casings.

E. Section 23 36 00, Air Terminal Units.

F. Section 26 05 11, Requirements for Electrical Installations.

G. Section 26 05 26, Grounding and Bonding for Electrical Systems.

H. Section 26 05 33, Raceway and Boxes for Electrical Systems.

I. Section 26 09 23, Lighting Controls.

J. Section 26 27 26, Wiring Devices.

K. Section 28 31 00, Fire Detection and Alarm.

1.3 DEFINITION

A. Algorithm: A logical procedure for solving a recurrent mathematical problem; A prescribed set of well-defined rules or processes for the solution of a problem in a finite number of steps.

B. Analog: A continuously varying signal value (e.g., temperature, current, velocity etc.

C. BACnet: A Data Communication Protocol for Building Automation and Control Networks -as defined by ANSI/ASHRAE Standard 135. This communications protocol allows diverse building automation devices to communicate data and services over a network.

D. BACnet/IP: Annex J of Standard 135. It defines and allows for using a reserved UDP socket to transmit BACnet messages over IP networks. A BACnet/IP network is a collection of one or more IP sub-networks that share the same BACnet network number.

E. BACnet Internetwork: Two or more BACnet networks connected with routers. The two networks may use different LAN technologies.

F. BACnet Network: One or more BACnet segments that have the same network address and are interconnected by bridges at the physical and data link layers.

G. BACnet Segment: One or more physical segments of BACnet devices on a BACnet network, connected at the physical layer by repeaters.

H. BACnet Broadcast Management Device (BBMD): A communications device which broadcasts BACnet messages to all BACnet/IP devices and other BBMDs connected to the same BACnet/IP network.

I. BACnet Interoperability Building Blocks (BIBBs): BACnet Interoperability Building Blocks (BIBBs) are collections of one or more

BACnet services. These are prescribed in terms of an "A" and a "B" device. Both of these devices are nodes on a BACnet internetwork.

J. BACnet Testing Laboratories (BTL). The organization responsible for testing products for compliance with the BACnet standard, operated under the direction of BACnet International.

K. Baud: It is a signal change in a communication link. One signal change can represent one or more bits of information depending on type of transmission scheme. Simple peripheral communication is normally one bit per Baud. (e.g., Baud rate = 78,000 Baud/sec is 78,000 bits/sec, if one signal change = 1 bit).

L. Binary: A two-state system where a high signal level represents an "ON" condition and an "OFF" condition is represented by a low signal level.

M. BMP or bmp: Suffix, computerized image file, used after the period in a DOS-based computer file to show that the file is an image stored as a series of pixels.

N. Bus Topology: A network topology that physically interconnects workstations and network devices in parallel on a network segment.

O. Control Unit (CU): Generic term for any controlling unit, stand-alone, microprocessor based, digital controller residing on secondary LAN or Primary LAN, used for local controls or global controls

P. Deadband: A temperature range over which no heating or cooling is supplied, i.e., 22-25 degrees C (72-78 degrees F), as opposed to a single point change over or overlap).

Q. Device: a control system component that contains a BACnet Device Object and uses BACnet to communicate with other devices.

R. Device Object: Every BACnet device requires one Device Object, whose properties represent the network visible properties of that device. Every Device Object requires a unique Object Identifier number on the BACnet internetwork. This number is often referred to as the device instance.

S. Device Profile: A specific group of services describing BACnet capabilities of a device, as defined in ASHRAE Standard 135, Annex L. Standard device profiles include BACnet Operator Workstations (B-OWS), BACnet Building Controllers (B-BC), BACnet Advanced Application Controllers (B-AAC), BACnet Application Specific Controllers (B-ASC), BACnet Smart Actuator (B-SA), and BACnet Smart Sensor (B-SS). Each

device used in new construction is required to have a PICS statement listing which service and BIBBs are supported by the device.

T. Diagnostic Program: A software test program, which is used to detect and report system or peripheral malfunctions and failures. Generally, this system is performed at the initial startup of the system.

U. Direct Digital Control (DDC): Microprocessor based control including Analog/Digital conversion and program logic. A control loop or subsystem in which digital and analog information is received and processed by a microprocessor, and digital control signals are generated based on control algorithms and transmitted to field devices in order to achieve a set of predefined conditions.

V. Distributed Control System: A system in which the processing of system data is decentralized and control decisions can and are made at the subsystem level. System operational programs and information are provided to the remote subsystems and status is reported back to the Engineering Control Center. Upon the loss of communication with the Engineering Control center, the subsystems shall be capable of operating in a stand-alone mode using the last best available data.

W. Download: The electronic transfer of programs and data files from a central computer or operation workstation with secondary memory devices to remote computers in a network (distributed) system.

X. DXF: An AutoCAD 2-D graphics file format. Many CAD systems import and export the DXF format for graphics interchange.

Y. Electrical Control: A control circuit that operates on line or low voltage and uses a mechanical means, such as a temperature sensitive bimetal or bellows, to perform control functions, such as actuating a switch or positioning a potentiometer.

Z. Electronic Control: A control circuit that operates on low voltage and uses a solid-state components to amplify input signals and perform control functions, such as operating a relay or providing an output signal to position an actuator.

AA. Engineering Control Center (ECC): The centralized control point for the intelligent control network. The ECC comprises of personal computer and connected devices to form a single workstation.

BB. Ethernet: A trademark for a system for exchanging messages between computers on a local area network using coaxial, fiber optic, or twisted-pair cables.

CC. Firmware: Firmware is software programmed into read only memory (ROM) chips. Software may not be changed without physically altering the chip.

DD. Gateway: Communication hardware connecting two or more different protocols. It translates one protocol into equivalent concepts for the other protocol. In BACnet applications, a gateway has BACnet on one side and non-BACnet (usually proprietary) protocols on the other side.

EE. GIF: Abbreviation of Graphic interchange format.

FF. Graphic Program (GP): Program used to produce images of air handler systems, fans, pumps, and building spaces. These images can be animated and/or color-coded to indicate operation of the equipment.

GG. Graphic Sequence of Operation: It is a graphical representation of the sequence of operation, showing all inputs and output logical blocks.

HH. I/O Unit: The section of a digital control system through which information is received and transmitted. I/O refers to analog input (AI, digital input (DI), analog output (AO) and digital output (DO). Analog signals are continuous and represent temperature, pressure, flow rate etc., whereas digital signals convert electronic signals to digital pulses (values), represent motor status, filter status, on-off equipment etc.

II. I/P: a method for conveying and routing packets of information over LAN paths. User Datagram Protocol (UDP) conveys information to “sockets” without confirmation of receipt. Transmission Control Protocol (TCP) establishes "sessions", which have end-to-end confirmation and guaranteed sequence of delivery.

JJ. JPEG: A standardized image compression mechanism stands for Joint Photographic Experts Group, the original name of the committee that wrote the standard.

KK. Local Area Network (LAN): A communication bus that interconnects operator workstation and digital controllers for peer-to-peer communications, sharing resources and exchanging information.

LL. Network Repeater: A device that receives data packet from one network and rebroadcasts to another network. No routing information is added to the protocol.

MM. MS/TP: Master-slave/token-passing (ISO/IEC 8802, Part 3). It uses twisted-pair wiring for relatively low speed and low cost communication.

NN. Native BACnet Device: A device that uses BACnet as its primary method of communication with other BACnet devices without intermediary gateways. A system that uses native BACnet devices at all levels is a native BACnet system.

OO. Network Number: A site-specific number assigned to each network segment to identify for routing. This network number must be unique throughout the BACnet internetwork.

PP. Object: The concept of organizing BACnet information into standard components with various associated properties. Examples include analog input objects and binary output objects.

QQ. Object Identifier: An object property used to identify the object, including object type and instance. Object Identifiers must be unique within a device.

RR. Object Properties: Attributes of an object. Examples include present value and high limit properties of an analog input object. Properties are defined in ASHRAE 135; some are optional and some are required. Objects are controlled by reading from and writing to object properties.

SS. Operating system (OS): Software, which controls the execution of computer application programs.

TT. PCX: File type for an image file. When photographs are scanned onto a personal computer they can be saved as PCX files and viewed or changed by a special application program as Photo Shop.

UU. Peripheral: Different components that make the control system function as one unit. Peripherals include monitor, printer, and I/O unit.

VV. Peer-to-Peer: A networking architecture that treats all network stations as equal partners- any device can initiate and respond to communication with other devices.

WW. PICS: Protocol Implementation Conformance Statement, describing the BACnet capabilities of a device. All BACnet devices have published PICS.

XX. PID: Proportional, integral, and derivative control, used to control modulating equipment to maintain a setpoint.

YY. Repeater: A network component that connects two or more physical segments at the physical layer.

ZZ. Router: a component that joins together two or more networks using different LAN technologies. Examples include joining a BACnet Ethernet LAN to a BACnet MS/TP LAN.

AAA. Sensors: devices measuring state points or flows, which are then transmitted back to the DDC system.

BBB. Thermostats : devices measuring temperatures, which are used in control of standalone or unitary systems and equipment not attached to the DDC system.

1.4 QUALITY ASSURANCE

A. Criteria:

1. Single Source Responsibility of subcontractor: Either the DDC Contractor or the System Integrator shall obtain hardware and software supplied under this Section and delegate the responsibility to a single source controls installation subcontractor. The Integration subcontractor shall be responsible for the complete design, installation, integration, and commissioning of the system. The controls subcontractor shall be in the business of design, installation and service of such building automation control systems similar in size and complexity.
2. Equipment and Materials: Equipment and materials shall be cataloged products of manufacturers regularly engaged in production and installation of HVAC control systems. Products shall be manufacturer’s latest standard design and have been tested and proven in actual use.
3. The controls subcontractor shall provide a list of no less than five similar projects which have building control systems as specified in this Section. These projects must be on-line and functional such that the Department of Veterans Affairs (VA) representative could observe the control systems in full operation.

4. The controls subcontractor shall have an in-place facility within 50 100 miles with technical staff, spare parts inventory for the next five (5) years, and necessary test and diagnostic equipment to support the control systems.
5. The controls subcontractor shall have minimum of three years of experience in design and installation of building automation systems similar in performance to those specified in this Section. Provide evidence of experience by submitting resumes of the project manager, the local branch manager, project engineer, the application engineering staff, and the electronic technicians who would be involved with the supervision, the engineering, and the installation of the control systems. Training and experience of these personnel shall not be less than three years. Failure to disclose this information will be a ground for disqualification of the supplier.
6. Provide a competent and experienced Project Manager employed by the Controls Contractor. The Project Manager shall be supported as necessary by other Contractor employees in order to provide professional engineering, technical and management service for the work. The Project Manager shall attend scheduled Project Meetings as required and shall be empowered to make technical, scheduling and related decisions on behalf of the Controls Contractor.

B. Codes and Standards:
1. All work shall conform to the applicable Codes and Standards.
2. Electronic equipment shall conform to the requirements of FCC Regulation, Part 15, Governing Radio Frequency Electromagnetic Interference, and be so labeled.

1.5 PERFORMANCE

A. The system shall conform to the following:
1. Graphic Display: The system shall display up to four (4) graphics on a single screen with a minimum of twenty (20) dynamic points per graphic. All current data shall be displayed within ten (10) seconds of the request.
2. Graphic Refresh: The system shall update all dynamic points with current data within eight (8) seconds. Data refresh shall be automatic, without operator intervention.

3. Object Command: The maximum time between the command of a binary object by the operator and the reaction by the device shall be two(2) seconds. Analog objects shall start to adjust within two (2) seconds.
4. Object Scan: All changes of state and change of analog values shall be transmitted over the high-speed network such that any data used or displayed at a controller or work-station will be current, within the prior six (6) seconds.
5. Alarm Response Time: The maximum time from when an object goes into alarm to when it is annunciated at the workstation shall not exceed (10) seconds.
6. Program Execution Frequency: Custom and standard applications shall be capable of running as often as once every (5) seconds. The Contractor shall be responsible for selecting execution times consistent with the mechanical process under control.
7. Multiple Alarm Annunciations: All workstations on the network shall receive alarms within five (5) seconds of each other.
8. Performance: Programmable Controllers shall be able to execute DDC PID control loops at a selectable frequency from at least once every one (1) second. The controller shall scan and update the process value and output generated by this calculation at this same frequency.
9. Reporting Accuracy: Listed below are minimum acceptable reporting end-to-end accuracies for all values reported by the specified system:

Measured Variable	Reported Accuracy
Space temperature	±0.5 degrees C (±1 degrees F)
Ducted air temperature	±0.5 degrees C [±1 degrees F]
Outdoor air temperature	±1.0 degrees C [±2 degrees F]
Dew Point	±1.5 degrees C [±3 degrees F]
Water temperature	±0.5 degrees C [±1 degrees F]
Relative humidity	±2 percent RH
Water flow	±1 percent of reading
Air flow (terminal)	±10 percent of reading
Air flow (measuring stations)	±5 percent of reading

Carbon Monoxide (CO)	±5 percent of reading
Carbon Dioxide (CO_2)	±50 ppm
Air pressure (ducts)	±25 Pa [±0.1 inch wg]
Air pressure (space)	±0.3 Pa [±0.001 inch wg]
Water pressure	±2 percent of full scale *Note 1
Electrical Power	±0.5 percent of reading

Note 1: for both absolute and differential pressure

10. Control stability and accuracy: Control sequences shall maintain measured variable at setpoint within the following tolerances:

Controlled Variable	Control Accuracy	Range of Medium
Air Pressure	±50 Pa (±0.2 inch wg)	0-1.5 kPa (0-6 inch wg)
Air Pressure	±3 Pa (±0.01 inch wg)	-25 to 25 Pa (-0.1 to 0.1 inch wg)
Airflow	±10 percent of full scale	
Space Temperature	±1.0°C (±2.0 degrees F)	
Duct Temperature	±1.5°C (±3 degrees F)	
Humidity	±5 percent RH	MRI, SPS, PHARMACY
Fluid Pressure	±10 kPa (±1.5 psig)	0-1 MPa (1-150 psig)
Fluid Pressure	±250 Pa (±1.0 inch wg)	0-12.5 kPa (0-50 inch wg) differential

11. Extent of direct digital control: control design shall allow for at least the points indicated on the points lists on the drawings.

1.6 WARRANTY

A. Labor and materials for control systems shall be warranted for a period as specified under Warranty in FAR clause 52.246-21.

B. Control system failures during the warranty period shall be adjusted, repaired, or replaced at no cost or reduction in service to the owner. The system includes all computer equipment, transmission equipment, and all sensors and control devices.

C. The on-line support service shall allow the Controls supplier to dial out over telephone lines to or connect via (through password-limited access) VPN through the internet to monitor and control the facility's building automation system. This remote connection to the facility shall be within two (2) hours of the time that the problem is reported. This coverage shall include normal business hours, after business hours, weekend and holidays. If the problem cannot be resolved with on-line support services, the Controls supplier shall dispatch the qualified personnel to the job site to resolve the problem within 8 24 hours after the problem is reported.

D. Controls subcontractor shall be responsible for temporary operations and maintenance of the control systems during the construction period until final commissioning, training of facility operators and acceptance of the project by VA.

1.7 SUBMITTALS

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

B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC", with applicable paragraph identification.

C. Manufacturer's Literature and Data Including:

1. A wiring diagram for each type of input device and output device including DDC controllers, modems, repeaters, etc. Diagram shall show how the device is wired and powered, showing typical connections at the digital controllers and each power supply, as well as the device itself. Show for all field connected devices, including but not limited to, control relays, motor starters, electric or electronic actuators, and temperature pressure, flow and humidity sensors and transmitters.
2. A diagram of each terminal strip, including digital controller terminal strips, terminal strip location, termination numbers and the associated point names.
3. Control dampers and control valves schedule, including the size and pressure drop.

4. Control air-supply components, and computations for sizing compressors, receivers and main air-piping, if pneumatic controls are furnished.
5. Catalog cut sheets of all equipment used. This includes, but is not limited to software (by manufacturer and by third parties), DDC controllers, panels, peripherals, airflow measuring stations and associated components, and auxiliary control devices such as sensors, actuators, and control dampers. When manufacturer's cut sheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted. Each submitted piece of literature and drawings should clearly reference the specification and/or drawings that it supposed to represent.
6. Sequence of operations for each system and the associated control diagrams. Equipment and control labels shall correspond to those shown on the drawings.
7. Color prints of proposed graphics with a list of points for display.
8. Furnish a BACnet Protocol Implementation Conformance Statement (PICS) for each BACnet-compliant device.
9. Schematic wiring diagrams for all control, communication and power wiring. Provide a schematic drawing of the central system installation. Label all cables and ports with computer manufacturers' model numbers and functions. Show all interface wiring to the control system.
10. An instrumentation list for each controlled system. Each element of the controlled system shall be listed in table format. The table shall show element name, type of device, manufacturer, model number, and product data sheet number.
11. Riser diagrams of wiring between central control unit (CCU) and all control panels.
12. Plan drawings showing routing of LAN and locations of control panels, controllers, routers, gateways, ECC, and larger controlled devices.
13. Construction details for all installed conduit, cabling, raceway, cabinets, and similar. Construction details of all penetrations and their protection.

14. Quantities of submitted items may be reviewed but it is the responsibility of the contractor administered by this Section of the technical specifications to provide sufficient quantities for a complete and working system.

D. Product Certificates: Compliance with Article, QUALITY ASSURANCE.

E. Validation Test Plan: Along with manufacturer's literature, product certificates, wiring and functional diagrams, and sequence of operations, submit for review and approval a Validation Test Plan which is specific to the work of this project and which references the specific controls component nomenclatures found in the control contractor's wiring and functional diagrams and the specific sequences of controls for this project and which describes how the contractor will implement the controls system validation and demonstration as specified in paragraph 3.2 SYSTEM VALIDATION AND DEMONSTRATION found in this section.

F. Licenses: Provide licenses for all software residing on and used by the Controls Systems, ECC, and portable OWS and transfer these licenses to the Owner prior to completion.

G. As Built Control Drawings:

1. Furnish three (3) copies of as-built drawings for each control system. The documents shall be submitted for approval prior to final completion.
2. Furnish one (1) set of applicable control system prints for each mechanical system for wall mounting. The documents shall be submitted for approval prior to final completion.
3. Furnish one (1) CD-ROM in CAD DWG and/or .DXF format for the drawings noted in subparagraphs above.

H. Operation and Maintenance (O/M) Manuals):

1. Submit in accordance with Article, INSTRUCTIONS, in Specification Section 01 00 00, GENERAL REQUIREMENTS.
2. Include the following documentation:
   a. General description and specifications for all components, including logging on/off, alarm handling, producing trend reports, overriding computer control, and changing set points and other variables.

b. Detailed illustrations of all the control systems specified for ease of maintenance and repair/replacement procedures, and complete calibration procedures.
c. One copy of the final version of all software provided including operating systems, programming language, operator workstation software, and graphics software.
d. Complete troubleshooting procedures and guidelines for all systems.
e. Complete operating instructions for all systems.
f. Recommended preventive maintenance procedures for all system components including a schedule of tasks for inspection, cleaning and calibration. Provide a list of recommended spare parts needed to minimize downtime.
g. Training Manuals: Submit the course outline and training material to the Owner for approval three (3) weeks prior to the training to VA facility personnel. These persons will be responsible for maintaining and the operation of the control systems, including programming. The Owner reserves the right to modify any or all of the course outline and training material.
h. Licenses, guaranty, and other pertaining documents for all equipment and systems.

I. Submit Performance Report to COR prior to final inspection.

1.8 INSTRUCTIONS

A. Instructions to VA operations personnel: Perform in accordance with Article, INSTRUCTIONS, in Specification Section 01 00 00, GENERAL REQUIREMENTS, and as noted below. Contractor shall also video tape instruction sessions noted below.
1. First Phase: Formal instructions to the VA facilities personnel for a total of 16 32 48 hours, given in multiple training sessions (each no longer than four hours in length), conducted sometime between the completed installation and prior to the performance test period of the control system, at a time mutually agreeable to the Contractor and the VA.
2. Second Phase: This phase of training shall comprise of on the job training during startup, checkout period, and performance test period. VA facilities personnel will work with the Contractor’s

installation and test personnel on a daily basis during startup and checkout period. During the performance test period, controls subcontractor will provide 8 16 32 48 hours of instructions, given in multiple training sessions (each no longer than four hours in length), to the VA facilities personnel.

3. The O/M Manuals shall contain approved submittals as outlined in Article 1.7, SUBMITTALS. The Controls subcontractor will review the manual contents with VA facilities personnel during second phase of training.
4. Training shall be given by direct employees of THE CONTROLS system subcontractor.

1.9 PROJECT CONDITIONS (ENVIRONMENTAL CONDITIONS OF OPERATION)

A. The ECC and peripheral devices and system support equipment shall be designed to operate in ambient condition of 20 to 35 degrees C (65 to 90 degrees F) at a relative humidity of 20 to 80 percent non-condensing.

B. The Controllers used outdoors shall be mounted in NEMA 4 waterproof enclosures, and shall be rated for operation at -40 to 65 degrees C (-40 to 150 degrees F).

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

D. Sensors and controlling devices shall be designed to operate in the environment, which they are sensing or controlling.

1.10 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Where conflicts occur these specifications and the VHA standards will govern.

B. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE):

135-2020.....BACnet A Data Communication Protocol for Building Automation and Control Networks

147-2019.....Reducing the Release of Halogenated Refrigerants from Refrigerating and Air-Conditioning Equipment and Systems

C. Federal Communication Commission (FCC):

Rules and Regulations Title 47 Chapter 1-2014 Part 15: Radio Frequency Devices

D. Institute of Electrical and Electronic Engineers (IEEE):
802.3-2018.....Standard for Ethernet

E. National Fire Protection Association (NFPA):
70-2020.....National Electric Code

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 CONTROLS SYSTEM ARCHITECTURE

A. General

1. The Controls Systems shall consist of multiple Nodes and associated equipment connected by industry standard digital and communication network arrangements.
2. The ECC, building controllers and principal communications network equipment shall be standard products of recognized major manufacturers available through normal PC and computer vendor channels – not "Clones" assembled by a third-party subcontractor.
3. The networks shall, at minimum, comprise, as necessary, the following:
   a. A fixed ECC and a portable operator’s terminal.
   b. Network computer processing, data storage and BACnet-compliant communication equipment including Servers and digital data processors.
   c. BACnet-compliant routers, bridges, switches, hubs, modems, gateways, interfaces and similar communication equipment.
   d. Active processing BACnet-compliant building controllers connected to other BACnet-compliant controllers together with their power supplies and associated equipment.
   e. Addressable elements, sensors, transducers and end devices.
   f. Third-party equipment interfaces and gateways as described and required by the Contract Documents.

g. Other components required for a complete and working Control Systems as specified.

B. The Specifications for the individual elements and component subsystems shall be minimum requirements and shall be augmented as necessary by the Contractor to achieve both compliance with all applicable codes, standards, and to meet all requirements of the Contract Documents.

C. Network Architecture

1. The Controls communication network shall utilize BACnet communications protocol operating over a standard Ethernet LAN and operate at a minimum speed of 100 Mb/sec.
2. The networks shall utilize only copper and optical fiber communication media as appropriate and shall comply with applicable codes, ordinances and regulations. They may also utilize digital wireless technologies as appropriate to the application and if approved by the VA.
3. All necessary telephone lines, ISDN lines and internet Service Provider services and connections will be provided by the VA.

D. Third Party Interfaces:

1. The contractor administered by this Section of the technical specifications shall include necessary hardware, equipment, software and programming to allow data communications between the controls systems and building systems supplied by other trades.
2. Other manufacturers and contractors supplying other associated systems and equipment shall provide their necessary hardware, software and startup at their cost and shall cooperate fully with the contractor administered by this Section of the technical specifications in a timely manner and at their cost to ensure complete functional integration.

E. Servers:

1. Provide data storage server(s) to archive historical data including trends, alarm and event histories and transaction logs.
2. Equip these server(s) with the same software tool set that is located in the BACnet building controllers for system configuration and custom logic definition and color graphic configuration.
3. Access to all information on the data storage server(s) shall be through the same browser functionality used to access individual

nodes. When logged onto a server the operator will be able to also interact with any other controller on the control system as required for the functional operation of the controls systems. The contractor administered by this Section of the technical specifications shall provide all necessary digital processor programmable data storage server(s).

4. These server(s) shall be utilized for controls systems application configuration, for archiving, reporting and trending of data, for operator transaction archiving and reporting, for network information management, for alarm annunciation, for operator interface tasks, for controls application management and similar.

2.3 COMMUNICATION

A. Control products, communication media, connectors, repeaters, hubs, and routers shall comprise a BACnet internetwork. Controller and operator interface communication shall conform to ANSI/ASHRAE Standard 135, BACnet.

1. The Data link / physical layer protocol between the ECC and all B-BC’s (for communication) acceptable to the VA throughout its facilities is Ethernet (ISO 8802-3) and BACnet/IP.
2. The MS/TP data link / physical layer protocol is prohibited to the VA in any new BACnet network or sub-network in its healthcare or lab facilities.

B. Each controller shall have a communication port for connection to an operator interface.

C. Project drawings indicate remote buildings or sites to be connected by a nominal 56,000 baud modem over voice-grade telephone lines. In each remote location a modem and field device connection shall allow communication with each controller on the internetwork as specified in Paragraph D.

D. Internetwork operator interface and value passing shall be transparent to internetwork architecture.

1. An operator interface connected to a controller shall allow the operator to interface with each internetwork controller as if directly connected. Controller information such as data, status, reports, system software, and custom programs shall be viewable and editable from each internet controller.

2. Inputs, outputs, and control variables used to integrate control strategies across multiple controllers shall be readable by each controller on the internetwork. Program and test all cross-controller links required to execute specified control system operation. An authorized operator shall be able to edit cross-controller links by typing a standard object address.

E. System shall be expandable to at least twice the required input and output objects with additional controllers, associated devices, and wiring. Expansion shall not require operator interface hardware additions or software revisions.

F. ECCs and Controllers with real-time clocks shall use the BACnet Time Synchronization service. The system shall automatically synchronize system clocks daily from an operator-designated device via the internetwork. The system shall automatically adjust for daylight savings and standard time as applicable.

2.4 NETWORK AND DEVICE NAMING CONVENTION

A. Network Numbers

1. BACnet network numbers shall be based on a "facility code, network" concept. The "facility code" is the VAMC’s or VA campus’ assigned numeric value assigned to a specific facility or building. The "network" typically corresponds to a "floor" or other logical configuration within the building. BACnet allows 65535 network numbers per BACnet internet work.
2. The network numbers are thus formed as follows: "Net #" = "FFFNN" where:
   a. FFF = Facility code (see below)
   b. NN = 00-99 This allows up to 100 networks per facility or building

B. Device Instances

1. BACnet allows 4194305 unique device instances per BACnet internet work. Using Agency's unique device instances are formed as follows: "Dev #" = "FFFNNDD" where
   a. FFF and N are as above and
   b. DD = 00-99, this allows up to 100 devices per network.
2. Note Special cases, where the network architecture of limiting device numbering to DD causes excessive subnet works. The device

number can be expanded to DDD and the network number N can become a single digit. In NO case shall the network number N and the device number D exceed 4 digits.

3. Facility code assignments:
4. 000-400 Building/facility number
5. Note that some facilities have a facility code with an alphabetic suffix to denote wings, related structures, etc. The suffix will be ignored. Network numbers for facility codes greater than 400 will be assigned in the range 000-399.

C. Device Names

1. Name the control devices based on facility name, location within a facility, the system or systems that the device monitors and/or controls, or the area served. The intent of the device naming is to be easily recognized. Names can be up to 254 characters in length, without embedded spaces. Provide the shortest descriptive, but unambiguous, name. For example, in building #123 prefix the number with a “B” followed by the building number, if there is only one chilled water pump "CHWP-1", a valid name would be "B123.CHWP. 1.STARTSTOP". If there are two pumps designated "CHWP-1", one in a basement mechanical room (Room 0001) and one in a penthouse mechanical room (Room PH01), the names could be "B123.R0001.CHWP.1. STARTSTOP" or "B123.RPH01.CHWP.1.STARTSTOP". In the case of unitary controllers, for example a VAV box controller, a name might be "B123.R101.VAV". These names should be used for the value of the "Object_Name" property of the BACnet Device objects of the controllers involved so that the BACnet name and the EMCS name are the same.

2.5 BACnet DEVICES

A. All BACnet Devices – controllers, gateways, routers, actuators, Operator Displays, and sensors shall conform to BACnet Device Profiles and shall be BACnet Testing Laboratories (BTL) -Listed as conforming to those Device Profiles. Protocol Implementation Conformance Statements (PICSs), describing the BACnet capabilities of the Devices shall be published and available for the Devices through links in the BTL website.

1. BACnet Building Controllers, shall conform to the BACnet B-BC Device Profile, and shall be BTL-Listed as conforming to the B-BC Device Profile. The Device's PICS shall be submitted.
2. BACnet Advanced Application Controllers shall conform to the BACnet B-AAC Device Profile and shall be BTL-Listed as conforming to the B-AAC Device Profile. The Device's PICS shall be submitted.
3. BACnet Application Specific Controllers shall conform to the BACnet B-ASC Device Profile and shall be BTL-Listed as conforming to the B-ASC Device Profile. The Device's PICS shall be submitted.
4. BACnet Smart Actuators shall conform to the BACnet B-SA Device Profile and shall be BTL-Listed as conforming to the B-SA Device Profile. The Device's PICS shall be submitted.
5. BACnet Smart Sensors shall conform to the BACnet B-SS Device Profile and shall be BTL-Listed as conforming to the B-SS Device Profile. The Device's PICS shall be submitted.
6. BACnet routers and gateways shall conform to the BACnet B-OTH Device Profile, and shall be BTL-Listed as conforming to the B-OTH Device Profile. The Device's PICS shall be submitted.

2.6 CONTROLLERS

A. General. Provide an adequate number of BTL listed B-BC building controllers, BTL listed B-AAC, BTL listed B-ASC, BTL listed B-SA, and BTL listed B-SS's to achieve the performance specified in the Part 1 Article on "System Performance." Each of these controllers shall meet the following requirements.

1. Communication.
   a. Each B-BC controller shall reside on a BACnet network using the ISO 8802-3 (Ethernet) Data Link/Physical layer protocol for its communications.
   b. Each B-BC controller shall provide a service communication port using BACnet Data Link/Physical layer protocol for connection to a portable operator's terminal. If this port is not available built into the controller, contractor is to install a 4 port unmanaged switch inside the B-BC control cabinet.
2. Keypad. A local keypad and display shall be provided for each controller. The keypad shall be provided for interrogating and

editing data. Provide a system security password to prevent unauthorized use of the keypad and display.

3. Serviceability. Provide diagnostic LEDs for power, communication, and processor. All wiring connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
4. Memory. The controller shall maintain all BIOS and programming information in the event of a power loss for at least 72 hours.
5. The controller shall be able to operate at 90 percent to 110 percent of nominal voltage rating and shall perform an orderly shutdown less than 80 percent nominal voltage. Controller operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 watt at 1 meter (3 feet).
6. Transformer. Power supply for the ASC must be rated at a minimum of 125 percent of B-ASC power consumption and shall be of the fused or current limiting type.

B. Provide BTL-Listed B-ASC application specific controllers for each piece of equipment for which they are constructed. Application specific controllers shall communicate with other BACnet devices on the internetwork using the BACnet Read (Execute) Property service.

1. Each B-ASC shall be capable of stand-alone operation and shall continue to provide control functions without being connected to the network.
2. Each B-ASC will contain sufficient I/O capacity to control the target system.
3. Communication.
   a. Each controller shall reside on a BACnet network using the ISO 8802-3 (Ethernet) Data Link/Physical layer protocol for its communications. Each building controller also shall perform BACnet routing if connected to a network of custom application and application specific controllers.
   b. Each controller shall have a BACnet Data Link/Physical layer compatible connection for a laptop computer or a portable operator’s tool. This connection shall be extended to a space temperature sensor port where shown.

4. Serviceability. Provide diagnostic LEDs for power, communication, and processor. All wiring connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
5. Memory. The application specific controller shall use nonvolatile memory and maintain all BIOS and programming information in the event of a power loss.
6. Immunity to power and noise. Controllers shall be able to operate at 90 percent to 110 percent of nominal voltage rating and shall perform an orderly shutdown below 80 percent. Operation shall be protected against electrical noise of 5-120 Hz and from keyed radios up to 5 watts at 1 meter (3 feet).

C. Direct Digital Controller Software

1. The software programs specified in this section shall be commercially available, concurrent, multi-tasking operating system and support the use of software application that operates under DOS Linuxor Microsoft Windows.
2. All points shall be identified by up to 30-character point name and 16-character point descriptor. The same names shall be used at the ECC.
3. All control functions shall execute within the stand-alone control units. All new controllers installed will also include all software and/or hardware required to program, commission, or alter the sequence of operation of said controller(s). Controllers requiring software or hardware that is not commercially available will not be allowed. Installation of software and/or hardware for controller configuration will be the responsibility of the DDC contractor. COR will direct to install said hardware and/or software on either the B-AWS or portable operator terminal. The VA shall be able to customize control strategies and sequences of operations defining the appropriate control loop algorithms and choosing the optimum loop parameters without requiring the services of a DDC contractor.
4. All controllers shall be capable of being programmed to utilize stored default values for assured fail-safe operation of critical processes. Default values shall be invoked upon sensor failure or, if the primary value is normally provided by the central or another

CU, or by loss of bus communication. Individual application software packages shall be structured to assume a fail-safe condition upon loss of input sensors. Loss of an input sensor shall result in output of a sensor-failed message at the ECC. Each ACU and RCU shall have capability for local readouts of all functions. The UCUs shall be read remotely.

5. All DDC control loops shall be able to utilize any of the following control modes:
   a. Two position (on-off, slow-fast) control.
   b. Proportional control.
   c. Proportional plus integral (PI) control.
   d. Proportional plus integral plus derivative (PID) control. All PID programs shall automatically invoke integral wind up prevention routines whenever the controlled unit is off, under manual control of an automation system or time-initiated program.
   e. Automatic tuning of control loops.
6. System Security: Operator access shall be secured using individual password and operator’s name. Passwords shall restrict the operator to the level of object, applications, and system functions assigned to him. A minimum of three (3)or a maximum of six (6) levels of security for operator access shall be provided.
7. Application Software: The controllers shall provide the following programs as a minimum for the purpose of optimizing energy consumption while maintaining comfortable environment for occupants. All application software shall reside and run in the system digital controllers. Editing of the application shall occur at the ECC or via a portable operator’s terminal, when it is necessary, to access directly the programmable unit.
   a. Power Demand Limiting (PDL): Power demand limiting program shall monitor the building power consumption and limit the consumption of electricity to prevent peak demand charges. PDL shall continuously track the electricity consumption from a pulse input generated at the kilowatt-hour/demand electric meter. PDL shall sample the meter data to continuously forecast the electric demand likely to be used during successive time intervals. If the forecast demand indicates that electricity usage will likely to

exceed a user preset maximum allowable level, then PDL shall automatically shed electrical loads. Once the demand load has met, loads that have been shed shall be restored and returned to normal mode. Control system shall be capable of demand limiting by resetting the HVAC system set points to reduce load while maintaining indoor air quality.

b. Economizer: An economizer program shall be provided for VAV systems. This program shall control the position of air handler relief, return, and outdoor dampers. If the outdoor air dry bulb temperature falls outdoor air dry bulb temperature and humidity fall below changeover set point the energy control center will modulate the dampers to provide 100 percent outdoor air. The operator shall be able to override the economizer cycle and return to minimum outdoor air operation at any time.

c. Night Setback/Morning Warm up Control: The system shall provide the ability to automatically adjust set points for this mode of operation.

d. Optimum Start/Stop (OSS): Optimum start/stop program shall automatically be coordinated with event scheduling. The OSS program shall start HVAC equipment at the latest possible time that will allow the equipment to achieve the desired zone condition by the time of occupancy, and it shall also shut down HVAC equipment at the earliest possible time before the end of the occupancy period and still maintain desired comfort conditions. The OSS program shall consider both outside weather conditions and inside zone conditions. The program shall automatically assign longer lead times for weekend and holiday shutdowns. The program shall poll all zones served by the associated AHU and shall select the warmest and coolest zones. These shall be used in the start time calculation. It shall be possible to assign occupancy start times on a per air handler unit basis. The program shall meet the local code requirements for minimum outdoor air while the building is occupied. Modification of assigned occupancy start/stop times shall be possible via the ECC.

e. Event Scheduling: Provide a comprehensive menu driven program to automatically start and stop designated points or a group of points according to a stored time. This program shall provide the capability to individually command a point or group of points. When points are assigned to one common load group it shall be possible to assign variable time advances/delays between each successive start or stop within that group. Scheduling shall be calendar based and advance schedules may be defined up to one year in advance. Advance schedule shall override the day-to-day schedule. The operator shall be able to define the following information:
   1) Time, day.
   2) Commands such as on, off, auto.
   3) Time delays between successive commands.
   4) Manual overriding of each schedule.
   5) Allow operator intervention.
f. Alarm Reporting: The operator shall be able to determine the action to be taken in the event of an alarm. Alarms shall be routed to the ECC based on time and events. An alarm shall be able to start programs, login the event, print and display the messages. The system shall allow the operator to prioritize the alarms to minimize nuisance reporting and to speed operator’s response to critical alarms. A minimum of six (6) priority levels of alarms shall be provided for each point.
g. Remote Communications: The system shall have the ability to dial out in the event of an alarm to the ECC and alpha-numeric pagers. The alarm message shall include the name of the calling location, the device that generated the alarm, and the alarm message itself. The operator shall be able to remotely access and operate the system using dial up communications. Remote access shall allow the operator to function the same as local access.
h. Maintenance Management (PM): The program shall monitor equipment status and generate maintenance messages based upon the operators defined equipment run time, starts, and/or calendar date limits. A preventative maintenance alarm shall be printed indicating maintenance requirements based on pre-defined run time. Each

preventive message shall include point description, limit criteria and preventative maintenance instruction assigned to that limit. A minimum of 480-character PM shall be provided for each component of units such as air handling units.

2.7 SPECIAL CONTROLLERS

A. Laboratory rooms and the fume hoods in those rooms shall be controlled to allow for a variable flow of conditioned air into the room, general exhaust from the room, and exhaust through the fume hood while maintaining a safe face velocity at the hood sash opening and proper space pressurization.

B. Fume Hood Exhaust Air Controller: The air flow through the open face of the hood, regardless of sash position, shall be controlled at a face velocity between 30 to 36 meter per minute (100 fpm and 120 fpm). A velocity sensor controller located in a sampling tube in the side wall of the hood shall control a damper in the hood discharge to maintain the face velocity.

C. Room Differential Pressure Controller: The differential pressure in laboratory rooms, operating rooms, in the SPS area, Chemo compounding rooms, and isolation rooms shall be maintained by controlling the quantity of air exhausted from or supplied to the room. A sensor-controller shall measure and control the velocity of air flowing into or out of the room through a sampling tube installed in the wall separating the room from the adjacent space and display the value on its monitor. The sensor-controller shall meet the following as a minimum:

1. Operating range: -0.25 to +0.25 inches of water column
2. Resolution: 5 percent of reading
3. Accuracy: +/- 10 percent of reading +/- 0.005 inches of water column
4. Analog output: 4-20 ma or 0-10 VDC
5. Operating temperature range: 32 degrees F - 120 degrees F

2.8 SENSORS (AIR, WATER AND STEAM)

A. Sensors’ measurements shall be read back to the DDC system, and shall be visible by the ECC.

B. Temperature and Humidity Sensors shall be electronic, vibration and corrosion resistant for wall, immersion, and/or duct mounting. Provide all remote sensors as required for the systems.

1. Temperature Sensors: thermistor type for terminal units and Resistance Temperature Device (RTD) with an integral 4-20 mA or 0-10 VDC transmitter type for all other sensors.
   a. Duct sensors shall be rigid or averaging type as shown on drawings. Averaging sensor shall be a minimum of 1 linear foot of sensing element for each square feet of cooling/heating coil face area.
   b. Immersion sensors shall be provided with a separable well made of stainless steel, bronze or monel material. Pressure rating of well is to be consistent with the system pressure in which it is to be installed. Temperature well shall be filled with a thermal compound compatible with installed sensor.
   c. All space sensors shall be equipped with in-space User set-point adjustment, override switch, numerical temperature display on sensor cover, and BACnet communication port. Match room thermostats. Provide a tooled-access cover.
      1) Public space sensor: setpoint adjustment shall be only through the ECC or through the DDC system’s diagnostic device/laptop. Do not provide in-space User set-point adjustment. Provide an opaque keyed-entry cover if needed to restrict in-space User set-point adjustment.
      2) Psychiatric patient room sensor: sensor shall be flush with wall or on the return duct, shall not include an override switch, numerical temperature display on sensor cover, shall not include a communication port and shall not allow in-space User set-point adjustment. Setpoint adjustment shall be only through the ECC or through the DDC system’s diagnostic device/laptop. Provide a stainless-steel cover plate with an insulated back and security screws.
   d. Outdoor air temperature sensors shall have watertight inlet fittings and be shielded from direct sunlight.
   e. Room security sensors shall have stainless steel cover plate with insulated back and security screws.
   f. Wire: Twisted, shielded-pair cable.
   g. Output Signal: 4-20 mA or 0-10 VDC.
2. Humidity Sensors: Bulk polymer sensing element type.

a. Duct and room sensors shall have a sensing range of 20 to 80 percent with accuracy of ± 2 to ± 5 percent RH, including hysteresis, linearity, and repeatability.
b. Outdoor humidity sensors shall be furnished with element guard and mounting plate and have a sensing range of 0 to 100 percent RH.
c. Continuous Output Signal: 4-20 mA or 0-10 VDC.

C. Static Pressure Sensors: Non-directional, temperature compensated.
1. 4-20 mA or 0-10 VDC output signal.
2. 0 to 5 inches wg for duct static pressure range.
3. 0 to 0.25 inch wg for Building static pressure range.

D. Vortex Water flow sensors:
1. Type: Insertion vortex type with retractable probe assembly and 2 inch full port gate valve.
a. Pipe size: up to 24 inches.
b. Retractor: ASME threaded, non-rising stem type with hand wheel.
c. Mounting connection: 2 inch 150 PSI flange.
d. Sensor assembly: Design for expected water flow and pipe size.
e. Seal: Teflon (PTFE).
2. Controller:
a. Integral to unit.
b. Locally display flow rate and total.
c. Output flow signal to BAS/EMS/BES/BMCS: Digital pulse or BACnet type.
3. Performance:
a. Turndown: 20:1
b. Response time: Adjustable from 1 to 100 seconds.
c. Power: 24 volt AC or -- VDC
4. Install flow meters according to manufacturer’s recommendations. Where recommended by manufacturer because of mounting conditions, provide flow rectifier.

E. Turbine Water Flow Sensors: shall be insertion turbine type with turbine element, retractor and preamplifier/transmitter mounted on a two-inch full port isolation valve; assembly easily removed or installed as a single unit under line pressure through the isolation valve without interference with process flow; calibrated scale shall

allow precise positioning of the flow element to the required insertion depth within plus or minus minute 1 mm (0.05 inch); wetted parts shall be constructed of stainless steel. Operating power shall be nominal 24 VDC or 24 Volt AC. Local instantaneous flow indicator shall be LED type in NEMA 4 enclosure with 3-1/2 digital display, for wall or panel mounting.

1. Performance characteristics:
   a. Ambient conditions: -40 degrees C to 60 degrees C (-40 degrees F to 140 degrees F), 5 to 100 percent humidity.
   b. Operating conditions: 850 kPa (125 psig), 0 degree C to 120 degrees C (30 degrees F to 250 degrees F), 0.15 to 12 meters per second (0.5 to 40 feet per second) velocity.
   c. Nominal range (turn down ratio): 10 to 1.
   d. Preamplifier mounted on meter shall provide 4-20 mA or 0-10 VDC, a divided pulse output or switch closure signal for units of volume or mass per a time base. Signal transmission distance shall be a minimum of 1,800 meters (6,000 feet). Preamplifier for bi-directional flow measurement shall provide a directional contact closure from a relay mounted in the preamplifier .
   e. Pressure Loss: Maximum 1 percent of the line pressure in line sizes above 100 mm (4 inches).
   f. Ambient temperature effects, less than 0.005 percent calibrated span per degrees C (degrees F) temperature change.
   g. RFI effect - flow meter shall not be affected by RFI.
   h. Power supply effect less than 0.02 percent of span for a variation of plus or minus 10 percent power supply.

F. Steam Flow Sensor/Transmitter:
   1. Sensor: Vortex shedder incorporating wing type sensor and amplification technology for high signal-to-noise ratio, carbon steel body with 316 stainless steel working parts, 24 VDC power, NEMA 4 enclosure.
      a. Ambient conditions, -40 degrees C to 80 degrees C (-40 degrees F to 175 degrees F).
      b. Process conditions, 900 kPa (125 psig) saturated steam.
      c. Turn down ratio, 20 to 1.
      d. Output signal, 4-20 ma or 0-10 VDC DC.

e. Processor/Transmitter, NEMA 4 enclosure with keypad program selector and six digit LCD output display of instantaneous flow rate or totalized flow, solid state switch closure signal shall be provided to the nearest DDC panel for totalization.
   1) Ambient conditions, -20 degrees C to 50 degrees C (0 degrees F to 120 degrees F), 0 to 95 percent non-condensing RH.
   2) Power supply, 120 VAC, 60 hertz or 24 VDC.
   3) Internal battery, provided for 24-month retention of RAM contents when all other power sources are removed.
f. Sensor on all steam lines shall be protected by pigtail siphons installed between the sensor and the line, and shall have an isolation valve installed between the sensor and pressure source.

G. Flow switches:
1. Shall be either paddle or differential pressure type.
   a. Paddle-type switches (liquid service only) shall be UL Listed, SPDT snap-acting, adjustable sensitivity with NEMA 4 enclosure.
   b. Differential pressure type switches (air or water service) shall be UL listed, SPDT snap acting, NEMA 4 enclosure, with scale range and differential suitable for specified application.

H. Current Switches: Current operated switches shall be self powered, solid state with adjustable trip current as well as status, power, and relay command status LED indication. The switches shall be selected to match the current of the application and output requirements of the DDC systems.

I. Water Overflow Indicators:
1. Float Switches: Float switch manufactured to close a normally open electrical contact when water level rises at the bottom of a drain pan or sump. All parts that come in contact with water shall be plastic, brass, or stainless steel. Select switch configuration for reliable operation in the specific location it is to be used (primary drain pan, primary humidifier drain pan, secondary pan, pump sump etc.) Contact rating 4A at 24 VAC maximum and 100 mA at 5 VDC minimum. For installation the switch shall be clamped to the side of the fan or sump. Switches that required drilling through the side of the pan or sump shall be prohibited.

2. Water Sensors: 24 VAC powered solid state single pole – double throw contacts that closes upon the sensor's detection of water at the bottom of pan, sump, floor etc. Sensor designed to be placed at the bottom of the pan, floor etc. where it will detect moisture. Sensor design shall incorporate water sensor array inside a hydrophilic pad designed to absorb and alarm with only a small amount of water. Contact rating 4A at 24 VAC maximum and 100 mA at 5 VDC minimum.

2.9 CONTROL CABLES

A. General:

1. Ground cable shields, drain conductors, and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments. Comply with Sections 27 05 26 and 26 05 26.
2. Cable conductors to provide protection against induction in circuits. Crosstalk attenuation within the System shall be in excess of -80 dB throughout the frequency ranges specified.
3. Minimize the radiation of RF noise generated by the System equipment so as not to interfere with any audio, video, data, computer main distribution frame (MDF), telephone customer service unit (CSU), and electronic private branch exchange (EPBX) equipment the System may service.
4. The as-installed drawings shall identify each cable as labeled, used cable, and bad cable pairs.
5. Label system's cables on each end. Test and certify cables in writing to the VA before conducting proof-of-performance testing. Minimum cable test requirements are for impedance compliance, inductance, capacitance, signal level compliance, opens, shorts, cross talk, noise, and distortion, and split pairs on all cables in the frequency ranges used. Make available all cable installation and test records at demonstration to the VA. All changes (used pair, failed pair, etc.) shall be posted in these records as the change occurs.
6. Power wiring shall not be run in conduit with communications trunk wiring or signal or control wiring operating at 100 volts or less.

B. Analogue control cabling shall be not less than No. 18 AWG solid or stranded, with thermoplastic insulated conductors.

C. Copper digital communication cable between the ECC and the B-BC and B-AAC controllers shall be 100BASE-TX Ethernet, Category 5e or 6, not less than minimum 24 American Wire Gauge (AWG) solid, Shielded Twisted Pair (STP) or Unshielded Twisted Pair (UTP), with thermoplastic insulated conductors, enclosed in a thermoplastic outer jacket.
   1. Other types of media commonly used within IEEE Std 802.3 LANs (e.g., 10Base-T and 10Base-2) shall be used only in cases to interconnect with existing media.

D. All MS/TP communications cables for devices utilizing the EIA-485 standard must be listed for use on EIA-485 networks by the manufacturer of the cable. This requirement overrides any cable recommendation by the controller manufacturer. The use of EIA-485 communication cables shall not affect the warranty from the installing DDC contractor. Cables shall have the following characteristic:
   1. Nominal Impedance: 100-130 Ohms
   2. Twisted/shielded construction of 1, 1.5, or 2 pairs depending on controller requirements.
   3. Be plenum rated when required
   4. Cables designated for use by the cable manufacturer for use in PA or Speaker systems shall not be allowed, regardless of recommendations by the controller manufacturer.

E. Optical digital communication fiber, if used, shall be Multimode or Single mode fiber, 62.5/125 micron for multimode or 10/125 micron for single mode 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. Fiber-optic cable shall be suitable for use with the 100Base-FX or the 100Base-SX standard (as applicable) as defined in IEEE Std 802.3.

2.10 THERMOSTATS AND HUMIDISTATS

A. Room thermostats controlling unitary standalone heating and cooling devices not connected to the DDC system shall have three modes of operation (heating - null or dead band - cooling). Thermostats for patient bedrooms shall have capability of being adjusted to eliminate null or dead band. Wall mounted thermostats shall have polished or brushed aluminum satin chrome manufacturer's recommendation finish, setpoint range and temperature display and external adjustment:

1. Electronic Thermostats: Solid-state, microprocessor based, BACnet enabled programmable to daily, weekend, and holiday schedules.
   a. Public Space Thermostat: Public space thermostat shall have a thermistor sensor and shall not have a visible means of set point adjustment. Adjustment shall be via the digital controller to which it is connected.
   b. Patient Room Thermostats: thermistor with in-space User set point adjustment and an on-casing room temperature numerical temperature display.
   c. Psychiatric Patient Room Sensors: Electronic duct sensor as noted under Article 2.4.
   d. Battery replacement without program loss.

B. Strap-on aquastat shall be enclosed in a dirt-and-moisture proof housing with adjustable temperature switching point and minimum single pole, double throw switch. Variable setpoint and variable differential ranges selected for the application. Manual Automatic reset.

C. Freeze stats shall have a minimum of 300 mm (one linear foot) of sensing element for each 0.093 square meter (one square foot) of coil area. A freezing condition at any increment of 300 mm (one foot) anywhere along the sensing element shall be sufficient to operate the thermostatic element. Freezestats shall be manually-reset.

D. Room Humidistats: Provide fully proportioning humidistat with adjustable throttling range for accuracy of settings and conservation. The humidistat shall have set point scales shown in percent of relative humidity located on the instrument. Systems showing moist/dry or high/low are prohibited.

E. Low Signal Selector High Limit Duct Humidistat: Duct mounted high limit humidistat mounted downstream of the humidifier steam injection grid to protect the ductwork and other components from moisture in the event of humidifier loop problems. Typically set at 70 percent to 80 percent RH the device provides proportional signal back to steam control equipment as duct humidity approaches high limit setpoint thus providing more accurate control. Duct mounted device with polymer sensor:
   1. Output 4 to 20 milliamp or 0-10 VDC.
   2. Setpoint range 60 percent RH to 95 percent RH.

3. Proportional Band range 5 percent to 30 percent.
4. Auxiliary contacts for alarms.
5. Accuracy 2 percent RH and drift less than 0.5 percent per year.

2.11 FINAL CONTROL ELEMENTS AND OPERATORS

A. Fail Safe Operation: Control valves and dampers shall provide "fail safe" operation in either the normally open or normally closed position as required for freeze, moisture, and smoke or fire protection.

B. Spring Ranges: Range as required for system sequencing and to provide tight shut-off.

C. Power Operated Control Dampers (other than VAV Boxes): Factory fabricated, balanced type dampers. All modulating dampers shall be opposed blade type and gasketed. Blades for two-position, duct-mounted dampers shall be parallel, airfoil (streamlined) type for minimum noise generation and pressure drop.

1. Leakage: Except as specified in subparagraph 2 below, maximum leakage in closed position shall not exceed 7 L/S (15 CFMs) differential pressure for outside air and exhaust dampers and 200 L/S/ square meter (40 CFM/square feet) at 50 mm (2 inches) differential pressure for other dampers.
2. Frame shall be galvanized steel channel with seals as required to meet leakage criteria.
3. Blades shall be galvanized steel or aluminum, 200 mm (8 inch) maximum width, with edges sealed as required.
4. Bearing shall be nylon, bronze sleeve or ball type.
5. Hardware shall be zinc-plated steel. Connected rods and linkage shall be non-slip. Working parts of joints shall be brass, bronze, nylon or stainless steel.
6. Maximum air velocity and pressure drop through free area of the dampers:
   a. Smoke damper in air handling unit: 305 meter per minute (1000 fpm).
   b. Duct mounted damper: 600 meter per minute (2000 fpm).
   c. Maximum static pressure loss: 50 Pascal (0.20 inches water gauge).

D. Smoke Dampers and Combination Fire/Smoke Dampers: Dampers and operators are specified in Section 23 31 00, HVAC DUCTS AND CASINGS. Control of these dampers is specified under this Section.

E. Control Valves:

1. Valves shall be rated for a minimum of 150 percent of system operating pressure at the valve location but not less than 900 kPa (125 psig).
2. Valves 50 mm (2 inches) and smaller shall be bronze body with threaded or flare connections.
3. Valves 60 mm (2 1/2 inches) and greater shall be bronze or iron body with flanged connections.
4. Brass or bronze seats except for valves controlling media greater than 100 degrees C (210 degrees F), which shall have stainless steel seats.
5. Flow characteristics:
   a. Three way modulating valves shall be globe pattern. Position versus flow relation shall be linear relation for steam or equal percentage for water flow control.
   b. Two-way modulating valves shall be globe pattern. Position versus flow relation shall be linear for steam and equal percentage for water flow control.
   c. Two-way 2-position valves shall be ball, gate or butterfly type.
6. Maximum pressure drop:
   a. Two position steam control: 20 percent of inlet gauge pressure.
   b. Modulating Steam Control: 80 percent of inlet gauge pressure (acoustic velocity limitation).
   c. Modulating water flow control, greater of 3 meters (10 feet) of water or the pressure drop through the apparatus.
7. Two position water valves shall be line size.

F. Damper and Valve Operators and Relays:

1. Pneumatic operators, spring return type with non-ferrous metal bellows or diaphragm of neoprene or other elastomer. Bellows or diaphragm shall be of right size so that a change in operating pressure of not more than two (2) percent of the total motor operating pressure range will be required to start the valve or damper moving. Provide positive positioning or sequencing relays

with adjustable operating range and starting point for operators sequenced with other operators to permit adjustment of control sequences, except for control valves in confined spaces in terminal units, which may use springs with range selected to provide necessary sequencing. Metal parts shall be aluminum, mill finish galvanized steel, or zinc plated steel or stainless steel.

2. Electric operator shall provide full modulating control of dampers and valves. For dampers a linkage and pushrod shall be furnished for mounting the actuator on the damper frame internally in the duct, externally in the duct, externally on the duct wall, or shall be furnished with a direct-coupled design. Metal parts shall be aluminum, mill finish galvanized steel, or zinc plated steel or stainless steel. Provide actuator heads which allow for electrical conduit attachment. The motor(s) shall have sufficient closure torque to allow for complete closure of valve or damper under pressure. Provide multiple motors as required to achieve sufficient close-off torque.
   a. Minimum valve close-off pressure shall be equal to the system pump’s dead-head pressure, minimum 50 psig for valves smaller than 4 inches.
3. Electronic damper operators: Metal parts shall be aluminum, mill finish galvanized steel, or zinc plated steel or stainless steel. Provide actuator heads which allow for electrical conduit attachment. The motors shall have sufficient closure torque to allow for complete closure of valve or damper under pressure. Provide multiple motors as required to achieve sufficient close-off torque.
   a. VAV Box actuator shall be mounted on the damper axle or shall be of the air valve design, and shall provide complete modulating control of the damper. The motor shall have a closure torque of 35-inch pounds minimum with full torque applied at close off to attain minimum leakage.
4. See and coordinate drawings for required control operation.

2.12 AIR FLOW CONTROL

A. Airflow and static pressure shall be controlled via digital controllers with inputs from airflow control measuring stations and static pressure inputs as specified. Controller outputs shall be analog or pulse width

modulating output signals. The controllers shall include the capability to control via simple proportional (P) control, proportional plus integral (PI), proportional plus integral plus derivative (PID), and on-off. The airflow control programs shall be factory-tested programs that are documented in the literature of the control manufacturer.

B. Air Flow Measuring Station -- Electronic Thermal Type:

1. Air Flow Sensor Probe:

a. Each air flow sensor shall contain two individual thermal sensing elements. One element shall determine the velocity of the air stream while the other element shall compensate for changes in temperature. Each thermal flow sensor and its associated control circuit and signal conditioning circuit shall be factory calibrated and be interchangeable to allow replacement of a sensor without recalibration of the entire flow station. The sensor in the array shall be located at the center of equal area segment of the duct or fan inlet and the number of sensors shall be adequate to accommodate the expected velocity profile and variation in flow and temperature. The airflow station shall be of the insertion type in which sensor support structures are inserted from the outside of the ducts to make up the complete electronic velocity array.

b. Thermal flow sensor shall be constructed of hermetically sealed thermistors or nickel chromium or reference grade platinum wire, wound over an epoxy, stainless steel or ceramic mandrel and coated with a material suitable for the conditions to be encountered. Each dual sensor shall be mounted in an extruded aluminum alloy strut.

2. Air Flow Sensor Grid Array:

a. Each sensor grid shall consist of a lattice network of temperature sensors and linear integral controllers (ICs) situated inside an aluminum casing suitable for mounting in a duct or fan inlet. Each sensor shall be mounted within a strut facing downstream of the airflow and located so that it is protected on the upstream side. All wiring shall be encased (out of the air stream) to protect against mechanical damage.

b. The casing shall be made of welded aluminum of sufficient strength to prevent structural bending and bowing. Steel or iron composite shall not be acceptable in the casing material.

c. Pressure drop through the flow station shall not exceed 4 Pascal (0.015 inch WG) at 1,000 meter per minute (3,000 FPM).

3. Electronics Panel:

a. Electronics Panel shall consist of a surface mounted enclosure complete with solid-state microprocessor and software.

b. Electronics Panel shall be A/C powered 120 VAC 24 VAC and shall have the capability to transmit signals of 4-20 ma or 0-10 VDC type or PWM type for use in control of the HVAC Systems. The electronic panel shall have the capability to accept user defined scaling parameters for all output signals.

c. Electronics Panel shall have the capability to digitally display airflow in CFM LPS and temperature in degrees F degrees C . The displays shall be provided as an integral part of the electronics panel. The electronic panel shall have the capability to totalize the output flow in CFM for two or more systems, as required. A single output signal shall be provided which will equal the sum of the systems totalized. Output signals shall be provided for temperature and airflow. Provide remote mounted air flow or temperature displays where indicated on the plans.

d. Electronics Panel shall have the following:

1) Minimum of 12-bit A/D conversion.

2) Field adjustable digital primary output offset and gain.

3) Airflow analog output scaling of 100 to 10,000 FPM.

4) Temperature analog output scaling from -45 degrees C to 70 degrees C (-50 degrees F to 160 degrees F).

5) Analog output resolution (full scale output) of 0.025 percent.

e. All readings shall be in I.P. S.I. units.

4. Thermal flow sensors and its electronics shall be installed as per manufacturer’s instructions. The required probe sensor density shall be as follows:

Probe Sensor Density

Area (square feet)	Qty. Sensors

<=1	2
>1 to <4	4
4 to <8	6
8 to <12	8
12 to <16	12
>=16	16

a. Complete installation shall not exhibit more than ± 2.0 percent error in airflow measurement output for variations in the angle of flow of up to 10 percent in any direction from its calibrated orientation. Repeatability of readings shall be within ± 0.25 percent.

C. Static Pressure Measuring Station: shall consist of one or more static pressure sensors and transmitters along with relays or auxiliary devices as required for a complete functional system. The span of the transmitter shall not exceed two times the design static pressure at the point of measurement. The output of the transmitter shall be true representation of the input pressure with plus or minus 25 Pascal (0.1 inch) W.G. of the design required input pressure:

1. Static pressure sensors shall have the same requirements as Airflow Measuring Devices except that total pressure sensors are optional, and only multiple static pressure sensors positioned on an equal area basis connected to a network of headers are required.
2. For systems with multiple major or main trunk supply ducts, furnish a static pressure transmitter for each trunk duct. The transmitter signal representing the lowest static pressure shall be selected and this shall be the input signal to the controller.
3. The controller shall receive the static pressure transmitter signal and Control Unit (CU) shall provide a control output signal to the supply fan capacity control device. The control mode shall be proportional plus integral (PI) (automatic reset) and where required shall also include derivative mode.
4. In systems with multiple static pressure transmitters, provide a switch located near the fan discharge to prevent excessive pressure during abnormal operating conditions. High-limit switches shall be manually reset.

D. Constant Volume Control Systems shall consist of an air flow measuring station along with such relays and auxiliary devices as required to produce a complete functional system. The transmitter shall receive its air flow signal or static differential pressure signal from the flow measuring station and shall have a span not exceeding three times the design flow rate. The CU shall receive the transmitter signal and shall provide an output to the fan volume control device to maintain a constant flow rate. The CU shall provide proportional plus integral (PI) (automatic reset) control mode and where required also inverse derivative mode. Overall system accuracy shall be plus or minus the equivalent of 2 Pascal (0.008 inch) velocity pressure as measured by the flow station.

E. Airflow Synchronization:

1. Systems shall consist of an air flow measuring station for each main supply and return duct, the CU and such relays, as required to provide a complete functional system that will maintain a constant flow rate difference between supply and return air to an accuracy of ±10 percent. In systems where there is no suitable location for a flow measuring station that will sense total supply or return flow, provide multiple flow stations with a differential pressure transmitter for each station. Signals from the multiple transmitters shall be added through the CU such that the resultant signal is a true representation of total flow.
2. The total flow signals from supply and return air shall be the input signals to the CU. This CU shall track the return air fan capacity in proportion to the supply air flow under all conditions.

2.13 SAFETY

A. Provide hard-wired interlocked connections for such all safety devices, such as freeze stats, smoke detectors, smoke dampers, and refrigerant leak detection devices. All safety devises shall be provided with additional dry contacts and shall be connected to the DDC system for monitoring and sequencing.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Examine project plans for control devices and equipment locations; and report any discrepancies, conflicts, or omissions to COR for resolution before proceeding for installation.
2. Install equipment, piping, wiring /conduit parallel to or at right angles to building lines.
3. Install all equipment and piping in readily accessible locations. Do not run tubing and conduit concealed under insulation or inside ducts.
4. Mount control devices, tubing and conduit located on ducts and apparatus with external insulation on standoff support to avoid interference with insulation.
5. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.
6. Run tubing and wire connecting devices on or in control cabinets parallel with the sides of the cabinet neatly racked to permit tracing.
7. Install equipment level and plumb.

B. Electrical Wiring Installation:

1. All wiring and cabling shall be installed in conduits. Install conduits and wiring in accordance with Specification Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS. Conduits carrying control wiring and cabling shall be dedicated to the control wiring and cabling: these conduits shall not carry power wiring. Provide plastic end sleeves at all conduit terminations to protect wiring from burrs.
2. Install analog signal and communication cables in conduit and in accordance with Specification Division 27 – COMMINICATIONS. Install digital communication cables in conduit.
3. Install conduit and wiring between operator workstation(s), digital controllers, electrical panels, indicating devices, instrumentation, miscellaneous alarm points, thermostats, and relays as shown on the drawings or as required under this section.
4. Install all electrical work required for a fully functional system and not shown on electrical plans or required by electrical specifications. Where low voltage (less than 50 volt) power is required, provide suitable Class B transformers.

5. Install all system components in accordance with local Building Code and National Electric Code.
   a. Splices: Splices in shielded and coaxial cables shall consist of terminations and the use of shielded cable couplers. Terminations shall be in accessible locations. Cables shall be harnessed with cable ties.
   b. Equipment: Fit all equipment contained in cabinets or panels with service loops, each loop being at least 300 mm (12 inches) long. Equipment for fiber optics system shall be rack mounted, as applicable, in ventilated, self-supporting, code gauge steel enclosure. Cables shall be supported for minimum sag.
   c. Cable Runs: Keep cable runs as short as possible. Allow extra length for connecting to the terminal board. Do not bend flexible coaxial cables in a radius less than ten times the cable outside diameter.
   d. Use vinyl tape, sleeves, or grommets to protect cables from vibration at points where they pass around sharp corners, through walls, panel cabinets, etc.
6. Conceal cables, except in mechanical rooms and areas where other conduits and piping are exposed.
7. Permanently label or code each point of all field terminal strips to show the instrument or item served. Color-coded cable with cable diagrams may be used to accomplish cable identification.
8. Grounding: ground electrical systems per manufacturer’s written requirements for proper and safe operation.

C. Install Sensors and Controls:
   1. Temperature Sensors:
      a. Install all sensors and instrumentation according to manufacturer’s written instructions. Temperature sensor locations shall be readily accessible, permitting quick replacement and servicing of them without special skills and tools.
      b. Calibrate sensors to accuracy specified, if not factory calibrated.
      c. Use of sensors shall be limited to its duty, e.g., duct sensor shall not be used in lieu of room sensor.

d. Install room sensors permanently supported on wall frame. They shall be mounted at 1.5 meter (5.0 feet) above the finished floor unless otherwise noted on the plans or drawings.
e. Mount sensors rigidly and adequately for the environment within which the sensor operates. Separate extended-bulb sensors form contact with metal casings and coils using insulated standoffs.
f. Sensors used in mixing plenum, and hot and cold decks shall be of the averaging of type. Averaging sensors shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip.
g. All pipe mounted temperature sensors shall be installed in wells.
h. All wires attached to sensors shall be air sealed in their conduits or in the wall to stop air transmitted from other areas affecting sensor reading.
i. Permanently mark terminal blocks for identification. Protect all circuits to avoid interruption of service due to short-circuiting or other conditions. Line-protect all wiring that comes from external sources to the site from lightning and static electricity.

2. Pressure Sensors:
   a. Install duct static pressure sensor tips facing directly downstream of airflow.
   b. Install high-pressure side of the differential switch between the pump discharge and the check valve.
   c. Install snubbers and isolation valves on steam pressure sensing devices.
3. Actuators:
   a. Mount and link damper and valve actuators according to manufacturer’s written instructions.
   b. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed position.
   c. Check operation of valve/actuator combination to confirm that actuator modulates valve smoothly in both open and closed position.
4. Flow Switches:

a. Install flow switch according to manufacturer's written instructions.
b. Mount flow switch a minimum of 5 10 pipe diameters up stream and 5 10 pipe diameters downstream or 600 mm (2 feet) whichever is greater, from fittings and other obstructions.
c. Assure correct flow direction and alignment.
d. Mount in horizontal piping-flow switch on top of the pipe.

D. Installation of network:
1. Ethernet:
a. The network shall employ Ethernet LAN architecture, as defined by IEEE 802.3. The Network Interface shall be fully Internet Protocol (IP) compliant allowing connection to currently installed IEEE 802.3, Compliant Ethernet Networks.
b. The network shall directly support connectivity to a variety of cabling types. As a minimum provide the following connectivity: 100 Base TX (Category 5e cabling) for the communications between the ECC and the B-BC and the B-AAC controllers.
2. Third party interfaces: Contractor shall integrate real-time data from building systems by other trades and databases originating from other manufacturers as specified and required to make the system work as one system.

E. Installation of digital controllers and programming:
1. Provide a separate digital control panel for each major piece of equipment, such as air handling unit, pumping unit etc. Points used for control loop reset such as outdoor air, outdoor humidity, or space temperature could be located on any of the remote control units.
2. Provide sufficient internal memory for the specified control sequences and trend logging. There shall be a minimum of 25 percent of available memory free for future use.
3. System point names shall be human readable, permitting easy operator interface without the use of a written point index.
4. Provide software programming for the applications intended for the systems specified, and adhere to the strategy algorithms provided.
5. Provide graphics for each piece of equipment and floor plan in the building. This includes each air handling unit, fan, terminal unit,

pumping unit etc. These graphics shall show all points dynamically as specified in the point list.

3.2 SYSTEM VALIDATION AND DEMONSTRATION

A. As part of final system acceptance, a system demonstration is required (see below). Prior to start of this demonstration, the contractor is to perform a complete validation of all aspects of the controls and instrumentation system. When formal commissioning is included in the project the system validation/test shall be part of the commissioning and shall be witnessed by the CxA.

B. Validation

1. Prepare and submit for approval a validation test plan including test procedures for the performance verification tests. Test Plan shall be submitted for review with the control system submittal as indicated in paragraph 1.7 Submittals. Test Plan address all specified functions of the ECC and all specified sequences of operation. Explain in detail actions and expected results used to demonstrate compliance with the requirements of this specification. Explain the method for simulating the necessary conditions of operation used to demonstrate performance of the system. Test plan shall include a test check list to be used by the Installer’s agent to check and initial that each test has been successfully completed. Deliver test plan documentation for the performance verification tests to the owner’s representative 30 days prior to start of performance verification tests. Provide draft copy of operation and maintenance manual with performance verification test.
2. After approval of the validation test plan, installer shall carry out all tests and procedures therein. Installer shall completely check out, calibrate, and test all connected hardware and software to ensure that system performs in accordance with approved specifications and sequences of operation submitted. Installer shall complete and submit Test Check List.

C. Demonstration

1. System operation and calibration to be demonstrated by the installer in the presence of the Architect, CxA or COR on random samples of equipment as dictated by the COR. Should random sampling indicate

improper work, the owner reserves the right to subsequently witness complete calibration of the system at no addition cost to the VA.

2. Make accessible, personnel to provide necessary adjustments and corrections to systems as directed by balancing agency.
3. The following witnessed demonstrations of field control equipment shall be included:
   a. Observe HVAC systems in shut down condition. Check dampers and valves for normal position.
   b. Test application software for its ability to communicate with digital controllers, operator workstation, and uploading and downloading of control programs.
   c. Demonstrate the software ability to edit the control program off-line.
   d. Demonstrate reporting of alarm conditions for each alarm and ensure that these alarms are received at the assigned location, including operator workstations.
   e. Demonstrate ability of software program to function for the intended applications-trend reports, change in status etc.
   f. Demonstrate via graphed trends to show the sequence of operation is executed in correct manner, and that the HVAC systems operate properly through the complete sequence of operation, e.g., seasonal change, occupied/unoccupied mode, and warm-up condition.
   g. Demonstrate hardware interlocks and safeties functions, and that the control systems perform the correct sequence of operation after power loss and resumption of power loss.
   h. Prepare and deliver to the VA graphed trends of all control loops to demonstrate that each control loop is stable and the set points are maintained.
   i. Demonstrate that each control loop responds to set point adjustment and stabilizes within one (1) (5) minute(s). Control loop trend data shall be instantaneous and the time between data points shall not be greater than one (1) minute.
4. Witnessed demonstration of ECC functions shall consist of:
   a. Running each specified report.
   b. Display and demonstrate each data entry to show site specific customizing capability. Demonstrate parameter changes.

c. Step through penetration tree, display all graphics, demonstrate dynamic update, and direct access to graphics.
d. Execute digital and analog commands in graphic mode.
e. Demonstrate DDC loop precision and stability via trend logs of inputs and outputs (6 loops minimum).
f. Demonstrate Energy Management System (EMS) performance via trend logs and command trace.
g. Demonstrate scan, update, and alarm responsiveness.
h. Demonstrate spreadsheet/curve plot software, and its integration with database.
i. Demonstrate on-line user guide, and help function and mail facility.
j. Demonstrate digital system configuration graphics with interactive upline and downline load, and demonstrate specified diagnostics.
k. Demonstrate multitasking by showing dynamic curve plot, and graphic construction operating simultaneously via split screen.
l. Demonstrate class programming with point options of beep duration, beep rate, alarm archiving, and color banding.

3.3 STARTUP AND TESTING

A. Perform tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.
B. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.
C. The CxA will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and CxA. Provide a minimum notice of 10 working days prior to startup and testing.

3.4 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.
B. Components provided under this section of the specification will be tested as part of a larger system.

3.5 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer's technical representative for 4 hours s to instruct each VA personnel responsible in the operation and maintenance of the system.

B. Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

3.6 CONSTRUCTION WASTE MANAGEMENT

A. General: Comply with Contractor's Waste Management Plan and Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT.

B. To the greatest extent possible, separate reusable and recyclable products from contaminated waste and debris in accordance with the Contractor's Waste Management Plan. Place recyclable and reusable products in designated containers and protect from moisture and contamination.

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SECTION 23 21 13
HYDRONIC PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Water piping to connect HVAC equipment, including the following:
   1. Chilled water, condenser water, heating hot water and drain piping.
   2. Extension of domestic water make-up piping for HVAC systems.
   3. Glycol-water piping.

B. A complete listing of common acronyms and abbreviations are included in Section 23 05 10, COMMON WORK RESULTS FOR BOILER PLANT AND STEAM GENERATION Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.

B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

D. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

E. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

F. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

G. Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.

H. Section 23 07 11, HVAC AND BOILER PLANT INSULATION.

I. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

J. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

K. Section 23 21 23, HYDRONIC PUMPS.

L. Section 23 22 13, STEAM AND CONDENSATE HEATING PIPING.

M. Section 23 25 00, HVAC WATER TREATMENT.

1.3 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Where conflicts occur these specifications and the VHA standard will govern.

B. American Society of Mechanical Engineers (ASME):
   B1.20.1-2013.....Pipe Threads, General Purpose, Inch

B16.3-2016.....Malleable Iron Threaded Fittings: Classes 150 and 300

B16.4-2016.....Gray Iron Threaded Fittings: (Classes 125 and 250)

B16.5-2020.....Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard

B16.9-2018.....Factory Made Wrought Buttwelding Fittings

B16.11-2016.....Forged Fittings, Socket-Welding and Threaded

B16.18-2018.....Cast Copper Alloy Solder Joint Pressure Fittings

B16.22-2018.....Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings

B16.24-2016.....Cast Copper Alloy Pipe Flanges, Flanged Fittings, and Valves: Classes 150, 300, 600, 900, 1500, and 2500

B16.39-2019.....Malleable Iron Threaded Pipe Unions: Classes 150, 250, and 300

B16.42-2016.....Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300

B31.9-2020.....Building Services Piping

B40.100-2013.....Pressure Gauges and Gauge Attachments

ASME Boiler and Pressure Vessel Code (BPVC):

BPVC Section VIII-2021..Rules for Construction of Pressure Vessels, Division 1

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

A47/A47M-1999(R2018)e1..Standard Specification for Ferritic Malleable Iron Castings

A53/A53M-2020.....Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

A106/A106M-2019a.....Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service

A126-2004(R2019).....Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings

A183-2014(R2020).....Standard Specification for Carbon Steel Track Bolts and Nuts

A216/A216M-2021.....Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service

A193/A193M-24a.....Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications

A536-1984(R2019e1).....Standard Specification for Ductile Iron Castings

B62-2017.....Standard Specification for Composition Bronze or Ounce Metal Castings

B88-2020.....Standard Specification for Seamless Copper Water Tube

F439-2019.....Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80

F441/F441M-2020.....Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80

D. American Welding Society (AWS):

B2.1/B2.1M-2014.....Specification for Welding Procedure and Performance Qualification

E. Expansion Joint Manufacturer’s Association, Inc. (EJMA):

EJMA 2017.....Standards of the Expansion Joint Manufacturers Association, Tenth Edition

F. Manufacturers Standardization Society (MSS) of the Valve and Fitting Industry, Inc.:

SP-67-2017.....Butterfly Valves

SP-71-2018.....Gray Iron Swing Check Valves, Flanged and Threaded Ends

SP-80-2019.....Bronze Globe, Angle, and Check Valves

SP-85-2011.....Gray Iron Globe and Angle Valves, Flanged and Threaded Ends

SP-110-2010.....Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

SP-125-2018.....Check Valves: Gray Iron and Ductile Iron, In-line, Spring-Loaded, Center-Guided

G. National Fire Protection Association (NFPA):

70-2020.....National Electrical Code (NEC)

H. Tubular Exchanger Manufacturers Association (TEMA):

TEMA Standards 2019.....10th Edition

1.4 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 23 21 13, HYDRONIC PIPING", with applicable paragraph identification.

C. Manufacturer's Literature and Data Including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.

1. Pipe and equipment supports. Submit calculations for variable spring and constant support hangers.
2. Pipe and tubing, with specification, class or type, and schedule.
3. Pipe fittings, including miscellaneous adapters and special fittings.
4. Flanges, gaskets and bolting.
5. Couplings and fittings.
6. Valves of all types.
7. Strainers.
8. Flexible connectors for water service.
9. Pipe alignment guides.
10. Expansion joints.
11. Expansion compensators.
12. All specified hydronic system components.
13. Water flow measuring devices.
14. Gauges.

15. Thermometers and test wells.
16. Seismic bracing details for piping.

D. Submit the welder's qualifications in the form of a current (less than 1-year old) and formal certificate.

E. Coordination Drawings: Refer to paragraph, SUBMITTALS of Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

F. As-Built Piping Diagrams: Provide drawings as follows for chilled water, and heating hot water system and other piping systems and equipment.
   1. 1 complete set of reproducible drawings.
   2. 1 complete set of drawings in electronic AutoCAD and pdf format.

G. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replacement parts, and troubleshooting guide:
   1. Include complete list indicating all components of the systems.
   2. Include complete diagrams of the internal wiring for each item of equipment.
   3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

H. Completed System Readiness Checklist provided by the 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 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

I. Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

1.5 QUALITY ASSURANCE

A. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC, which includes welding qualifications.

B. Submit prior to welding of steel piping a certificate of Welder's certification. The certificate shall be current and not more than 1-year old.

C. All couplings, fittings, valves, and specialties shall be the products of a single manufacturer.
   1. All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped for quality assurance and traceability.

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.

E. Refer to Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS for additional sustainable design requirements.

1.6 AS-BUILT DOCUMENTATION

A. Comply with requirements in paragraph AS-BUILT DOCUMENTATION of Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

1.7 SPARE PARTS

A. For mechanical pressed sealed fittings provide tools required for each pipe size used at the facility.

PART 2 - PRODUCTS

2.1 PIPE AND EQUIPMENT SUPPORTS, PIPE SLEEVES, AND WALL AND CEILING PLATES

A. Provide in accordance with Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

2.2 PIPE AND TUBING

A. Chilled Water, Heating Hot Water, and Vent Piping:

1. Steel: ASTM A53/A53M Grade B, seamless or ERW, Schedule 40.
2. Copper Water Tube Option: ASTM B88, Type K or L, hard drawn. Soft drawn tubing, 19 mm (3/4 inch) and larger, shall be used for runouts routed under slab to floor mounted fan coil units.

B. Extension of Domestic Water Make-up Piping: ASTM B88, Type K or L, hard drawn copper tubing.

C. Cooling Coil Condensate Drain Piping:

1. From Air Handling Units: Copper water tube, ASTM B88, Type M, or Schedule 40 PVC plastic piping. Use of PVC piping is prohibited in exterior applications.
2. From Terminal Units: Copper water tube, ASTM B88, Type M for runouts and Type L for mains.

D. Pipe supports, including insulation shields, for aboveground piping: Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

2.3 FITTINGS FOR STEEL PIPE

A. 50 mm (2 inches) and Smaller: Screwed or welded joints.

1. Butt Welding: ASME B16.9 with same wall thickness as connecting piping.
2. Forged Steel, Socket Welding or Threaded: ASME B16.11.
3. Screwed: 150-pound malleable iron, ASME B16.3. 125-pound cast-iron, ASME B16.4, may be used in lieu of malleable iron. Bushing reduction of a single pipe size, or use of close nipples, is prohibited.
4. Unions: ASME B16.39.
5. Water Hose Connection Adapter: Brass, pipe thread to 19 mm (3/4 inch) garden hose thread, with hose cap nut.

B. 63 mm (2-1/2 inches) and Larger: Welded or flanged joints.

1. Butt Welding Fittings: ASME B16.9 with same wall thickness as connecting piping. Elbows shall be long radius type, unless otherwise noted.
2. Welding Flanges and Bolting: ASME B16.5:
   a. Water Service: Weld neck or slip-on, plain face, with 3.2 mm (1/8 inch) thick full-face neoprene gasket suitable for 104 degrees C (220 degrees F).
      1) Contractor's Option: Convoluted, cold formed 150-pound steel flanges, with Teflon gaskets, may be used for water service.
   b. Flange Bolting: Alloy-Steel or Stainless Steel, ASTM A193.

C. Welded Branch and Tap Connections: Forged steel weldolets, or branchlets and threadolets shall be used for branch connections up to 1 pipe size smaller than the main. Forged steel half-couplings, ASME B16.11 shall be used for drain, vent, and gauge connections.

2.4 FITTINGS FOR COPPER TUBING

A. Joints:

Solder Joints: Joints shall be made up in accordance with recommended practices of the materials applied. Apply 95/5 tin and antimony on all copper piping.

B. Bronze Flanges and Flanged Fittings: ASME B16.24.

C. Fittings: ASME B16.18 cast copper or ASME B16.22 solder wrought copper.

2.5 FITTINGS FOR PLASTIC PIPING

A. Schedule 40, socket type for solvent welding.

B. Schedule 40 PVC Drain Piping: Drainage pattern.

2.6 DIELECTRIC FITTINGS

A. Provide where copper tubing and ferrous metal pipe are joined.

B. 50 mm (2 inches) and Smaller: Threaded dielectric union, ASME B16.39.

C. 63 mm (2-1/2 inches) and Larger: Flange union with dielectric gasket and bolt sleeves, ASME B16.42. Dielectric gasket material shall be compatible with hydronic medium.

D. Temperature Rating: 99 degrees C (210 degrees F).

E. Contractor’s Option: On pipe sizes 50 mm (2 inch) and smaller, screwed end brass ball valves or dielectric nipples may be used in lieu of dielectric unions.

2.7 SCREWED JOINTS

A. Pipe Thread: ASME B1.20.1.

B. Lubricant or Sealant: Oil and graphite or other compound approved for the intended service.

2.8 VALVES

A. Asbestos packing is prohibited.

B. All valves of the same type shall be products of a single manufacturer.

C. Provide chain operators for valves 152 mm (6 inches) and larger when the centerline is located 2.4 m (8 feet) or more above the floor or operating platform.

D. Shut-Off Valves:

1. Ball Valves (Pipe Sizes 50 mm (2 inch) and Smaller): MSS SP-110, screwed or solder connections, brass or bronze body with chrome-plated ball with full port and Teflon seat at 2758 kPa (400 psig) working pressure rating. Provide stem extension to allow operation without interfering with pipe insulation.

2. Butterfly Valves (Pipe Sizes 63 mm (2-1/2 inch) and Larger): Provide stem extension to allow 50 mm (2 inches) of pipe insulation without interfering with valve operation. MSS SP-67, flange lug type rated 1200 kPa (175 psig) working pressure at 93 degrees C (200 degrees F). Valves shall be ANSI Leakage Class VI and rated for bubble tight shut-off to full valve pressure rating. Valve shall be rated for dead end service and bi-directional flow capability to full rated

pressure. Butterfly valves are prohibited for direct buried pipe applications.

a. Body: Cast-iron, ASTM A126, Class B. Malleable iron, ASTM A47/A47M electro-plated, or ductile iron, ASTM A536, Grade 65-45-12 electro-plated.

b. Trim: Bronze, aluminum bronze, or 300 series stainless-steel disc, bronze bearings, 316 stainless-steel shaft and manufacturer's recommended resilient seat. Resilient seat shall be field replaceable, and fully line the body to completely isolate the body from the product. A phosphate coated steel shaft or stem is acceptable if the stem is completely isolated from the product.

3. Field Interchangeable Actuators: Valves for balancing service shall have adjustable memory stop to limit open position.

a. Valves 152 mm (6 inches) and Smaller: Lever actuator with minimum of seven locking positions, except where chain wheel is required.

b. Valves 203 mm (8 inches) and Larger: Enclosed worm gear with handwheel, and where required, chain-wheel operator.

E. Globe and Angle Valves:

1. Globe Valves:

a. 50 mm (2 inches) and Smaller: MSS SP-80, bronze, 1034 kPa (150 psig) Globe valves shall be union bonnet with metal plug type disc.

b. 63 mm (2-1/2 inches) and Larger: 860 kPa (125 psig), flanged, iron body, bronze trim, MSS SP-85 for globe valves.

2. Angle Valves:

a. 50 mm (2 inches) and Smaller: MSS SP-80, bronze, 1034 kPa (150 psig) Angle valves shall be union bonnet with metal plug type disc.

b. 63 mm (2-1/2 inches) and Larger: 860 kPa (125 psig), flanged, iron body, bronze trim, MSS SP-85 for angle.

F. Check Valves:

1. Swing Check Valves:

a. 50 mm (2 inches) and Smaller: MSS SP-80, bronze, 1034 kPa (150 psig), 45-degree swing disc.

b. 63 mm (2-1/2 inches) and Larger: 860 kPa (125 psig), flanged, iron body, bronze trim, MSS SP-71 for check valves.

2. Non-Slam or Silent Check Valve: Spring loaded double disc swing check or internally guided flat disc lift type check for bubble tight shut-off. Provide where check valves are shown in chilled water and hot water piping. Check valves incorporating a balancing feature may be used.

a. Body: MSS SP-125 cast-iron, ASTM A126, Class B, or steel, ASTM A216/A216M, Class WCB, or ductile iron, ASTM 536, flanged or wafer type.

b. Seat, Disc and Spring: 18-8 stainless-steel, or bronze, ASTM B62. Seats may be elastomer material.

G. Water Flow Balancing Valves: For flow regulation. Provide separate isolation valve. Valves shall be sized to provide the needed pressure drop in the middle of their throttling range.

1. Globe style valve.

2. A dual-purpose flow balancing valve and adjustable flow meter, with bronze or cast-iron body, calibrated position pointer, valved pressure taps or quick disconnects with integral check valves and preformed polyurethane insulating enclosure.

3. Provide a readout kit including flow meter, readout probes, hoses, flow charts or calculator, and carrying case.

H. Automatic Balancing Control Valves: Factory calibrated to maintain constant flow (plus or minus five percent) over system pressure fluctuations of 28 to 393 kPa (4 to 57 psig). Provide standard pressure taps and 4 sets of capacity charts. Valves shall be line size and be one of the following designs:

1. Gray iron ASTM A126 or brass body rated 1200 kPa (175 psig) at 93 degrees C (200 degrees F), with stainless-steel piston and spring.

2. Brass or ferrous body designed for 2070 kPa (300 psig) service at 121 degrees C (250 degrees F), with corrosion resistant, tamper proof, self-cleaning piston/spring assembly that is easily removable for inspection or replacement.

3. Combination assemblies containing ball type shut-off valves, unions, flow regulators, strainers with blowdown valves and pressure temperature ports shall be acceptable.

2.9 WATER FLOW MEASURING DEVICES

A. Minimum overall accuracy plus or minus 3 percent over a range of 70 to 110 percent of design flow. Select devices for not less than 110 percent of design flow rate.

B. Venturi Type: Bronze, steel, or cast-iron with bronze throat, with valved pressure sensing taps upstream and at the throat.

C. Wafer Type Circuit Sensor: Cast-iron wafer-type flow meter equipped with readout valves to facilitate the connecting of a differential pressure meter. Each readout valve shall be fitted with an integral check valve designed to minimize system fluid loss during the monitoring process.

D. Self-Averaging Annular Sensor Type: Brass or stainless-steel metering tube, shutoff valves and quick-coupling pressure connections. Metering tube shall be rotatable so all sensing ports may be pointed down-stream when unit is not in use.

E. Insertion Turbine Type Sensor: Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

F. Flow Measuring Device Identification:

1. Metal tag attached by chain to the device.
2. Include meter or equipment number, manufacturer's name, meter model, flow rate factor and design flow rate in gpm.

G. Permanently Mounted Water Flow Indicating Meters: Minimum 152 mm (6 inch) diameter, or 457 mm (18 inch) long scale, for 120 percent of design flow rate, direct reading in gpm, with 3 valve manifold and 2 shut-off valves.

2.10 STRAINERS

A. Y Type.

1. Screens: Bronze, Monel metal or 18-8 stainless-steel, free area not less than 2-1/2 times pipe area, with perforations as follows: 1.1 mm (0.045 inch) diameter perforations for 100 mm (4 inches) and larger: 3.2 mm (1/8 inch) diameter perforations.

B. Suction Diffusers: Specified in Section 23 21 23, HYDRONIC PUMPS.

2.11 EXPANSION JOINTS

A. Factory built devices, inserted in the pipe lines, designed to absorb axial cyclical pipe movement which results from thermal expansion and contraction. This includes factory-built or field-fabricated guides located along the pipe lines to restrain lateral pipe motion and direct the axial pipe movement into the expansion joints.

B. Manufacturing Quality Assurance: Conform to Expansion Joints Manufacturers Association (EJMA) Standards.

C. Bellows - Internally Pressurized Type:
   1. Multiple corrugations of Type 304 or Type A240-321 stainless-steel.
   2. Internal stainless-steel sleeve entire length of bellows.
   3. External cast-iron equalizing rings for services exceeding 345 kPa (50 psig).
   4. Welded ends.
   5. Design shall conform to standards of EJMA and ASME B31.9.
   6. External tie rods designed to withstand pressure thrust force upon anchor failure if one or both anchors for the joint are at change in direction of pipeline.
   7. Integral external cover.

D. Bellows - Externally Pressurized Type:
   1. Multiple corrugations of Type 304 stainless-steel.
   2. Internal and external guide integral with joint.
   3. Design for external pressurization of bellows to eliminate squirm.
   4. Welded ends.
   5. Conform to the standards of EJMA and ASME B31.9.
   6. Threaded connection at bottom, 25 mm (1 inch) minimum, for drain or drip point.
   7. Integral external cover and internal sleeve.

E. Expansion Compensators:
   1. Corrugated bellows, externally pressurized, stainless-steel or bronze.
   2. Internal guides and anti-torque devices.
   3. Threaded ends.
   4. External shroud.
   5. Conform to standards of EJMA.

F. Expansion Joint (Contractor's Option): 2413 kPa (350 psig) maximum working pressure, steel pipe fitting consisting of telescoping body and slip-pipe sections, PTFE modified polyphenylene sulfide coated slide section, with welded or flanged ends, suitable for axial end movement to 75 mm (3 inch).

G. Expansion Joint Identification: Provide stamped brass or stainless-steel nameplate on each expansion joint listing the manufacturer, the allowable movement, flow direction, design pressure and temperature, date of manufacture, and identifying the expansion joint by the identification number in the contract documents.

H. Guides: Provide factory-built guides along the pipe line to permit axial movement only and to restrain lateral and angular movement. Guides shall be designed to withstand a minimum of 15 percent of the axial force which will be imposed on the expansion joints and anchors. Field-built guides shall be used if detailed in the contract documents.

I. Supports: Provide saddle supports and frame or hangers for heat exchanger. Mounting height shall be adjusted to facilitate gravity return of steam condensate. Construct supports from steel, weld joints.

2.12 HYDRONIC SYSTEM COMPONENTS

A. Pressure Reducing Valve (Water): Diaphragm or bellows operated, spring loaded type, with minimum adjustable range of 28 kPa (4 psig) above and below set point. Bronze, brass or iron body and bronze, brass or stainless-steel trim, rated 861 kPa (125 psig) working pressure at 107 degrees C (225 degrees F).

B. Pressure Relief Valve: Bronze or iron body and bronze or stainless-steel trim, with testing lever. Comply with ASME BPVC Section VIII and bear ASME stamp.

2.13 GAUGES, PRESSURE AND COMPOUND

A. ASME B40.100, Accuracy Grade 1A, (pressure, vacuum, or compound for air, oil or water), initial mid-scale accuracy 1 percent of scale (Qualify grade), metal or phenolic case, 114 mm (4-1/2 inches) in diameter, 6 mm (1/4 inch) NPT bottom connection, white dial with black graduations and pointer, clear glass or acrylic plastic window, suitable for board mounting. Provide red "set hand" to indicate normal working pressure.

B. Provide brass lever handle union cock. Provide brass/bronze pressure snubber for gauges in water service.

C. Range of Gauges: Provide range equal to at least 130 percent of normal operating range.

1. For Condenser Water Suction (Compound): 101 kPa (29.5 inches Hg) to 689 kPa (100 psig).

2.14 PRESSURE/TEMPERATURE TEST PROVISIONS

A. Pete's Plug: 6 mm (1/4 inch) MPT by 75 mm (3 inches) long, brass body and cap, with retained safety cap, Nordel self-closing valve cores, permanently installed in piping where shown, or in lieu of pressure gauge test connections shown in the contract documents.

B. Provide one each of the following test items to the COR:

1. 6 mm (1/4 inch) FPT by 3.2 mm (1/8 inch) diameter stainless-steel pressure gauge adapter probe for extra-long test plug.
2. 89 mm (3-1/2 inch) diameter, one percent accuracy, compound gauge, 101 kPa (29.5 inches Hg) to 689 kPa (100 psig) range.
3. 0 to 104 degrees C (32 to 220 degrees F) pocket thermometer 1/2-degree accuracy, 25 mm (1 inch) dial, 127 mm (5 inch) long stainless-steel stem, plastic case.

2.15 THERMOMETERS

A. Mercury or organic liquid filled type, red or blue column, clear plastic window, with 152 mm (6 inch) brass stem, straight, fixed or adjustable angle as required for each in reading.

B. Case: Chrome plated brass or aluminum with enamel finish.

C. Scale: Not less than 228 mm (9 inches), range as described below, 2-degree graduations.

D. Separable Socket (Well): Brass, extension neck type to clear pipe insulation.

E. Scale Ranges:

1. Chilled Water: 0 to 38 degrees C (32 to 100 degrees F).
2. Hot Water: 38 to 93 degrees C (100 to 200 degrees F).

2.16 FIRESTOPPING MATERIAL

A. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

PART 3 - EXECUTION

3.1 INSTALLATION

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

B. The contract documents show the general arrangement of pipe and equipment but do not show all required fittings and offsets that may be necessary to connect pipes to equipment, fan-coils, coils, radiators, etc., and to coordinate with other trades. Provide all necessary fittings, offsets and pipe runs based on field measurements and at no additional cost or time to the Government. Coordinate with other trades for space available and relative location of HVAC equipment and accessories to be connected on ceiling grid. Pipe location in the contract documents shall be altered by contractor where necessary to avoid interferences and clearance difficulties.

C. Store materials to avoid excessive exposure to weather or foreign materials. Keep inside of piping relatively clean during installation and protect open ends when work is not in progress.

D. Support piping securely. Refer to PART 3, Section 23 05 11, COMMON WORK RESULTS FOR HVAC. Install heat exchangers at height sufficient to provide gravity flow of condensate to the flash tank and condensate pump.

E. Install piping generally parallel to walls and column center lines, unless shown otherwise in the contract documents. Space piping, including insulation, to provide 25 mm (1 inch) minimum clearance between adjacent piping or other surface. Unless shown otherwise, slope drain piping down in the direction of flow not less than 25 mm (1 inch) in 12 m (40 feet). Provide eccentric reducers to keep bottom of sloped piping flat.

F. Locate and orient valves to permit proper operation and access for maintenance of packing, seat and disc. Generally, locate valve stems in overhead piping in horizontal position. Provide a union adjacent to one end of all threaded end valves. Control valves usually require reducers to connect to pipe sizes shown in the contract documents. Install

butterfly valves with the valve open as recommended by the manufacturer to prevent binding of the disc in the seat.

G. Offset equipment connections to allow valving off for maintenance and repair with minimal removal of piping. Provide flexibility in equipment connections and branch line take-offs with 3-elbow swing joints where noted in the contract documents.

H. Tee water piping runouts or branches into the side of mains or other branches. Avoid bull-head tees, which are two return lines entering opposite ends of a tee and exiting out the common side.

I. Provide manual or automatic air vent at all piping system high points and drain valves at all low points. Install piping to floor drains from all automatic air vents.

J. Connect piping to equipment as shown in the contract documents. Install components furnished by others such as:
   1. Water treatment pot feeders and condenser water treatment systems.
   2. Flow elements (orifice unions), control valve bodies, flow switches, pressure taps with valve, and wells for sensors.

K. Thermometer Wells: In pipes 63 mm (2-1/2 inches) and smaller increase the pipe size to provide free area equal to the upstream pipe area.

L. Firestopping: Fill openings around uninsulated piping penetrating floors or fire walls, with firestop material. For firestopping insulated piping refer to Section 23 07 11, HVAC AND BOILER PLANT INSULATION.

M. Where copper piping is connected to steel piping, provide dielectric connections.

3.2 PIPE JOINTS

A. Welded: Beveling, spacing and other details shall conform to ASME B31.9 and AWS B2.1/B2.1M. See Welder’s qualification requirements in paragraph QUALITY ASSURANCE of Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. Screwed: Threads shall conform to ASME B1.20.1; joint compound shall be applied to male threads only and joints made up so no more than 3 threads show. Coat exposed threads on steel pipe with joint compound, or red lead paint for corrosion protection.

C. 125 Pound Cast-Iron Flange (Plain Face): Mating flange shall have raised face, if any, removed to avoid overstressing the cast-iron flange.

D. Solvent Welded Joints: As recommended by the manufacturer.

3.3 EXPANSION JOINTS (BELLOWS AND SLIP TYPE)

A. Anchors and Guides: Provide type, quantity and spacing as recommended by manufacturer of expansion joint and as shown. A professional engineer shall verify in writing that anchors and guides are properly designed for forces and moments which will be imposed.

B. Cold Set: Provide setting of joint travel at installation as recommended by the manufacturer for the ambient temperature during the installation.

C. Preparation for Service: Remove all apparatus provided to restrain joint during shipping or installation. Representative of manufacturer shall visit the site and verify that installation is proper.

D. Access: Expansion joints shall be located in readily accessible space. Locate joints to permit access without removing piping or other devices. Allow clear space to permit replacement of joints and to permit access to devices for inspection of all surfaces and for adding.

3.4 SEISMIC BRACING ABOVEGROUND PIPING

A. Provide in accordance with Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

3.5 LEAK TESTING ABOVEGROUND PIPING

A. Inspect all joints and connections for leaks and workmanship and make corrections as necessary to the satisfaction of the COR. Tests shall be either of those below, or a combination, as approved by the COR.

B. An operating test at design pressure, and for hot systems, design maximum temperature.

C. A hydrostatic test at 1.5 times design pressure. For water systems, the design maximum pressure would usually be the static head, or expansion tank maximum pressure, plus pump head. Factory tested equipment (convertors, exchangers, coils, etc.) need not be field tested. Isolate equipment where necessary to avoid excessive pressure on mechanical seals and safety devices.

3.6 FLUSHING AND CLEANING PIPING SYSTEMS

A. Water Piping: Clean systems as recommended by the suppliers of chemicals specified in Section 23 25 00, HVAC WATER TREATMENT.

B. Initial Flushing: Remove loose dirt, mill scale, metal chips, weld beads, rust, and like deleterious substances without damage to any system component. Provide temporary piping or hose to bypass coils, control valves, exchangers and other factory cleaned equipment unless acceptable means of protection are provided and subsequent inspection of hide-out areas takes place. Isolate or protect clean system components, including pumps and pressure vessels, and remove any component which may be damaged. Open all valves, drains, vents and strainers at all system levels. Remove plugs, caps, spool pieces, and components to facilitate early debris discharge from system. Sectionalize system to obtain debris carrying velocity of 1.8 m/s (5.9 f/s), if possible. Connect dead-end supply and return headers as necessary. Flush bottoms of risers. Install temporary strainers where necessary to protect down-stream equipment. Supply and remove flushing water and drainage by various type hose, temporary and permanent piping and Contractor's booster pumps. Flush until clean as approved by the COR.

C. Cleaning: Using products supplied in Section 23 25 00, HVAC WATER TREATMENT, circulate systems at normal temperature to remove adherent organic soil, hydrocarbons, flux, pipe mill varnish, pipe joint compounds, iron oxide, and like deleterious substances not removed by flushing, without chemical or mechanical damage to any system component. Removal of tightly adherent mill scale is not required. Keep isolated equipment which is "clean" and where dead-end debris accumulation cannot occur. Sectionalize system, if possible, to circulate at velocities not less than 1.8 m/s (5.9 f/s). Circulate each section for not less than 4 hours. Blow-down all strainers or remove and clean as frequently as necessary. Drain and prepare for final flushing.

D. Final Flushing: Return systems to conditions required by initial flushing after all cleaning solution has been displaced by clean make-up. Flush all dead ends and isolated clean equipment. Gently operate

all valves to dislodge any debris in valve body by throttling velocity. Flush for not less than one hour.

3.7 STARTUP AND TESTING

A. Perform tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.

B. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.

C. The CxA will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with COR and CxA. Provide a minimum notice of 10 working days prior to startup and testing.

D. Adjust red set hand on pressure gauges to normal working pressure.

3.8 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

B. Components provided under this section of the specification will be tested as part of a larger system.

3.9 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer’s technical representative for 4 hours to instruct each VA personnel responsible in operation and maintenance of the system.

B. Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

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SECTION 23 21 23
HYDRONIC PUMPS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Hydronic pumps for heating, ventilating and air conditioning.

B. Definitions:

1. Capacity: Liters per second (L/s) (Gallons per minute (gpm)) of the fluid pumped.
2. Head: Total dynamic head in kPa (feet) of the fluid pumped.
3. Flat head-capacity curve: Where the shutoff head is less than 1.16 times the head at the best efficiency point.

C. A complete listing of common acronyms and abbreviations are included in Section 23 05 10, COMMON WORK RESULTS FOR BOILER PLANT AND STEAM GENERATION Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.

B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

D. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

E. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

F. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

G. Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC AND STEAM GENERATION EQUIPMENT.

H. Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.

I. Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.

J. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

K. Section 23 21 13, HYDRONIC PIPING.

1.3 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Where conflicts occur, these specifications and the VHA standard will govern.

B. American Society of Mechanical Engineers (ASME):
B16.1-2020.....Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250

C. American Society for Testing and Materials (ASTM):
A48/48M-2003(R2021).....Standard Specification for Gray Iron Castings
B62-2017.....Standard Specification for Composition Bronze or Ounce Metal Castings

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 XX XX XX, SECTION TITLE", 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. Pumps and accessories.
   2. Motors and drives.
   3. Variable speed motor controllers.

D. Characteristic Curves: Head-capacity, efficiency-capacity, brake horsepower-capacity, and NPSHR-capacity for each pump and for combined pumps in parallel or series service. Identify pump and show fluid pumped, specific gravity, pump speed and curves plotted from zero flow to maximum for the impeller being furnished and at least the maximum diameter impeller that can be used with the casing.

E. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replacement parts, and troubleshooting guide:
   1. Include complete list indicating all components of the systems.
   2. Include complete diagrams of the internal wiring for each item of equipment.
   3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

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 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

G. Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

1.5 QUALITY ASSURANCE

A. Design Criteria:

1. Pumps design and manufacturer shall conform to Hydraulic Institute Standards.
2. Pump sizes, capacities, pressures, operating characteristics and efficiency shall be as scheduled.
3. Head-capacity curves shall slope up to maximum head at shut-off.. Select pumps near the midrange of the curve, so the design capacity falls to the left of the best efficiency point, to allow a cushion for the usual drift to the right in operation, without approaching the pump curve end point and possible cavitation and unstable operation. Select pumps for open systems so that required net positive suction head (NPSHR) does not exceed the net positive head available (NPSHA). Provide pumps with non-overloading motors.
4. Pump Driver: Furnish with pump. Size shall be non-overloading at any point on the head-capacity curve, including in a parallel or series pumping installation with one pump in operation.
5. Provide all pumps with motors, impellers, drive assemblies, bearings, coupling guard and other accessories specified. Statically and dynamically balance all rotating parts.
6. Furnish each pump and motor with a nameplate giving the manufacturers name, serial number of pump, capacity in gpm and head in feet at design condition, horsepower, voltage, frequency, speed and full load current and motor efficiency. Name plates shall be visible when pumps are insulated.
7. Test all pumps before shipment. The manufacturer shall certify all pump ratings.
8. After completion of balancing, provide replacement of impellers or trim impellers to provide specified flow at actual pumping head, as installed.

B. Allowable Vibration Tolerance for Pump Units: Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.

C. 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 section. For more information regarding the product categories covered by the Bio-Preferred Program, visit http:www.biopreferred.gov.

D. Refer to Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS for additional sustainable design requirements.

1.6 AS-BUILT DOCUMENTATION

A. Comply with requirements in paragraph AS-BUILT DOCUMENTATION of Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL PUMPS, BRONZE FITTED

A. General:

1. Provide pumps that will operate continuously without overheating bearings or motors at every condition of operation on the pump curve, or produce noise audible outside the room or space in which installed.
2. Provide pumps of size, type and capacity as indicated, complete with electric motor and drive assembly, unless otherwise indicated. Design pump casings for the indicated working pressure and factory test at 1-1/2 times the designed pressure.
3. Provide pumps of the same type, the product of a single manufacturer, with pump parts of the same size and type interchangeable.
4. General Construction Requirements:
   a. Balance: Rotating parts, statically and dynamically.
   b. Construction: To permit servicing without breaking piping or motor connections.
   c. Pump Motors: Provide high efficiency motors, inverter duty for variable speed service. Refer to Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC AND STEAM GENERATION EQUIPMENT. Motors shall be open drip-proof TEFC and operate at 1750 RPM unless noted otherwise.

d. Heating pumps shall be suitable for handling water to 107 degrees C (225 degrees F).
e. Provide coupling guards that meet OSHA requirements.
f. Pump Connections: Flanged.
g. Pump shall be factory tested.
h. Performance: As scheduled in the contract documents.

5. Variable Speed Pumps:
a. The pumps shall be the type shown in the contract documents and specified herein flex coupled to an open drip proof a TEFC motor.
b. Variable Speed Motor Controllers: Refer to Section 26 29 11, MOTOR CONTROLLERS and to Section 23 05 10, COMMON WORK RESULTS FOR BOILER PLANT AND STEAM GENERATION Section 23 05 11, COMMON WORK RESULTS FOR HVAC paragraph, VARIABLE SPEED MOTOR CONTROLLERS. Furnish controllers with pumps and motors.
c. Pump operation and speed control shall be as shown in the contract documents.

B. Inline Type, Base Mounted End Suction or Double Suction Type:
1. Casing and Bearing Housing: Close-grained cast-iron, ASTM A48/A48M.
2. Casing Wear Rings: Bronze.
3. Suction and Discharge: Plain face flange, 861 kPa (125 psig), ASME B16.1 Union End.
4. Casing Vent: Manual brass cock at high point.
5. Casing Drain and Gauge Taps: 13 mm (1/2 inch) plugged connections minimum size.
6. Impeller: Bronze, ASTM B62, enclosed type, keyed to shaft.
7. Shaft: Steel, Type 1045 or stainless-steel.
8. Shaft Seal: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless-steel spring, and NBR EPDM FKM bellows and gasket.
9. Shaft Sleeve: Bronze or stainless-steel.
10. Motor: Furnish with pump. Refer to Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC AND STEAM GENERATION EQUIPMENT.
11. Base Mounted Pumps:
a. Designed for disassembling for service or repair without disturbing the piping or removing the motor.
b. Impeller Wear Rings: Bronze.

c. Shaft Coupling: Non-lubricated steel flexible type or spacer type with coupling guard, bolted to the baseplate.

d. Bearings (Double-Suction pumps): Regreaseable ball or roller type.

e. Provide lip seal and slinger outboard of each bearing.

f. Base: Cast-iron or fabricated steel for common mounting to a concrete base.

12. Provide line sized shut-off valve and suction strainer, maintain manufacturer recommended straight pipe length on pump suction (with blowdown valve). Contractor option: Provide suction diffuser as follows:

a. Body: Cast-iron with steel inlet vanes and combination diffuser-strainer-orifice cylinder with 5 mm (3/16 inch) diameter openings for pump protection. Provide taps for strainer blowdown and gauge connections.

b. Provide adjustable foot support for suction piping.

c. Strainer free area: Not less than 5 times the suction piping.

d. Provide disposable startup strainer.

2.2 AUTOMATIC CONDENSATE PUMP UNITS

A. Packaged units with corrosion-resistant pump, plastic tank with cover, and automatic controls. Collects and removes condensate from fan coil units, air handling units, condensing boilers, and similar components. Include factory- or field-installed check valve and 1829 mm (72 inch) minimum, electrical power cord with plug.

PART 3 - EXECUTION

3.1 INSTALLATION

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

B. Follow manufacturer's written instructions for pump mounting and startup. Access/Service space around pumps shall not be less than minimum space recommended by pumps manufacturer.

C. Provide drains for bases and seals for base mounted pumps, piped to and discharging into floor drains.

D. Coordinate location of thermometer and pressure gauges as per Section 23 21 13, HYDRONIC PIPING.

3.2 STARTUP AND TESTING

A. Perform tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.

B. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.

C. The CxA will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with COR and CxA. Provide a minimum notice of 10 working days prior to startup and testing.

D. Verify that the piping system has been flushed, cleaned and filled.

E. Lubricate pumps before startup.

F. Prime the pump, vent all air from the casing and verify that the rotation is correct. To avoid damage to mechanical seals, never start or run the pump in dry condition.

G. Verify that correct size heaters-motor over-load devices are installed for each pump controller unit.

H. Field modifications to the bearings and or impeller (including trimming) are prohibited. If the pump does not meet the specified vibration tolerance, send the pump back to the manufacturer for a replacement pump. All modifications to the pump shall be performed at the factory.

I. Ensure the disposable strainer is free of debris prior to testing and balancing of the hydronic system.

J. After several days of operation, replace the disposable startup strainer with a regular strainer in the suction diffuser.

3.3 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

B. Components provided under this section of the specification will be tested as part of a larger system.

3.4 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer's technical representative for 4 hours to instruct each VA personnel responsible in operation and maintenance of the system.

B. Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

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SECTION 23 22 13
STEAM AND CONDENSATE HEATING PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Steam, condensate, and vent piping inside buildings.

B. A complete listing of common acronyms and abbreviations are included in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.

B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

D. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

E. Section 09 91 00, PAINTING.

F. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

G. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

H. Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.

I. Section 23 07 11, HVAC AND BOILER PLANT INSULATION.

J. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

K. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

L. Section 23 25 00, HVAC WATER TREATMENT.

1.3 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Where conflicts occur these specifications and the VHA standards shall govern.

B. American Society of Mechanical Engineers (ASME):

B1.20.1-2013.....Pipe Threads, General Purpose (Inch)

B16.5-2020.....Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard

B16.9-2018.....Factory Made Wrought Buttwelding Fittings

B16.11-2016.....Forged Fittings, Socket-Welding and Threaded

B16.42-2016.....Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300

B31.1-2020.....Power Piping

B31.9-2020.....Building Services Piping

B40.100-2013.....Pressure Gauges and Gauge Attachments

ASME Boiler and Pressure Vessel Code (BPVC) -

BPVC Section II-2021 Materials

BPVC Section VIII-2021 Rules for Construction of Pressure Vessels, Division 1

BPVC Section IX-2021Welding, Brazing, and Fusing Qualifications

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

A53/A53M-2020.....Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

A106/A106M-2019a.....Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service

A193/A193M-24a.....Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications

A216/A216M-2018.....Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service

A285/A285M-2017.....Standard Specification for Pressure Vessel Plates, Carbon Steel, Low-and Intermediate-Tensile Strength

A516/A516M-2017.....Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service

A536-1984(2019)e1.....Standard Specification for Ductile Iron Castings

B62-2017.....Standard Specification for Composition Bronze or Ounce Metal Castings

D. American Welding Society (AWS):

B2.1/B2.1M-2014.....Specification for Welding Procedure and Performance Qualifications

Z49.1-2012.....Safety in Welding and Cutting and Allied Processes

E. Manufacturers Standardization Society (MSS) of the Valve and Fitting Industry, Inc.:

SP-80-2019.....Bronze Gate, Globe, Angle, and Check Valves

F. Military Specifications (Mil. Spec.):
MIL-DTL-901E-2017.....Shock Tests, H.I. (High Impact) Shipboard Machinery, Equipment, and Systems

G. National Board of Boiler and Pressure Vessel Inspectors (NB):
Relieving Capacities of Safety Valves and Relief Valves

H. Tubular Exchanger Manufacturers Association (TEMA):
TEMA Standards-2019.....10th Edition

1.4 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 23 22 13, STEAM AND CONDENSATE HEATING PIPING", with applicable paragraph identification.

C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.

1. Pipe and equipment supports. Submit calculations for variable spring and constant support hangers.
2. Pipe and tubing, with specification, class or type, and schedule.
3. Pipe fittings, including miscellaneous adapters and special fittings.
4. Flanges, gaskets and bolting.
5. Valves of all types.
6. Steam traps.
7. Steam trap monitoring system.
8. Strainers.
9. Pipe alignment guides.
10. Expansion joints.
11. Expansion compensators.
12. Flexible ball joints: Catalog sheets, performance charts, schematic drawings, specifications and installation instructions.
13. All specified steam system components.
14. Gauges.
15. Thermometers and test wells.

16. Electric heat tracing systems.
17. Seismic bracing details for piping.

D. Manufacturer's certified data report, Form No. U-1, for ASME pressure vessels:
1. Heat Exchangers (Steam-to-Hot Water).
2. Flash tanks.

E. Coordination Drawings: Refer to paragraph, SUBMITTALS of Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

F. As-Built Piping Diagrams: Provide drawing as follows for steam and steam condensate piping and other central plant equipment.
1. One wall-mounted stick file for prints. Mount stick file in the chiller plant or adjacent control room along with control diagram stick file.
2. One set of reproducible drawings.

G. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replacement parts, and troubleshooting guide:
1. Include complete list indicating all components of the systems.
2. Include complete diagrams of the internal wiring for each item of equipment.
3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

H. Completed System Readiness Checklist provided by the 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 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

I. Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

1.5 QUALITY ASSURANCE

A. Section 23 05 11, COMMON WORK RESULTS FOR HVAC, which includes welding qualifications.

B. The products and execution of work specified in this section shall conform to the referenced codes and standards as required by the specifications. Local codes and amendments shall be enforced, along with requirements of local utility companies. The most stringent requirements of these specifications, local codes, or utility company

requirements shall always apply. Any conflicts shall be brought to the attention of the COR.

C. Welding Qualifications: Before any welding is performed, contractor shall submit a certificate certifying that welders comply with the following requirements:
   1. Qualify welding processes and operators for piping according to ASME BPVC Section IX, AWS Z49.1 and AWS B2.1/B2.1M.
   2. Comply with provisions in ASME B31.9 ASME B31.1.
   3. Certify that each welder and welding operator has passed AWS qualification tests for welding processes involved and that certification is current and recent. Submit documentation to the COR.
   4. All welds shall be stamped according to the provisions of the American Welding Society.

D. ASME Compliance: Comply with ASME B31.9 ASME B31.1 for materials, products, and installation. Safety valves and pressure vessels shall bear appropriate ASME labels.

1.6 AS-BUILT DOCUMENTATION

A. Submit manufacturer’s literature and data updated to include submittal review comments and any equipment substitutions.

B. Submit operation and maintenance data updated to include submittal review comments, VA approved substitutions and construction revisions shall be in electronic version on CD or DVD inserted into a three-ring binder. All aspects of system operation and maintenance procedures, including applicable piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices shall be included. A List of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.

C. The installing contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set

at the time of final systems certification testing. Should the installing contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement. Provide record drawings as follows:

1. As-built drawings are to be provided, with a copy of them in three-dimensional Building Information Modeling (BIM) software version provided on CD or DVD.

D. The as-built drawings shall indicate the location and type of all lockout/tagout points for all energy sources for all equipment and pumps to include breaker location and numbers, valve tag numbers, etc. Coordinate lockout/tagout procedures and practices with local VA requirements.

E. Certification documentation shall be provided to COR 21 working days prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and provide documentation/certification that all results of tests were within limits specified. Test results shall contain written sequence of test procedure with written test results annotated at each step along with the expected outcome or setpoint. The results shall include all readings, including but not limited to data on device (make, model and performance characteristics), normal pressures, switch ranges, trip points, amp readings, and calibration data to include equipment serial numbers or individual identifications, etc.

PART 2 - PRODUCTS

2.1 PIPE AND EQUIPMENT SUPPORTS, PIPE SLEEVES, AND WALL AND CEILING PLATES

A. Provide in accordance with Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

2.2 PIPE AND TUBING

A. Steam Piping: Steel, ASTM A53/A53M, Grade B, seamless or ERW; ASTM A106/A106M Grade B, seamless; Schedule 40.

B. Steam Condensate and Pumped Condensate Piping: Steel, ASTM A53/A53M, Grade B, seamless or ERW; or ASTM A106/A106M Grade B, seamless, Schedule 80.

C. Vent Piping: Steel, ASTM A53/A53M, Grade B, seamless or ERW; ASTM A106/A106M Grade B, seamless; Schedule 40, galvanized.

2.3 FITTINGS FOR STEEL PIPE

A. 50 mm (2 inches) and Smaller: Screwed or welded.
   1. Cast iron fittings or piping is prohibited for steam and steam condensate piping. Bushing reduction or use of close nipples is prohibited.
   2. Forged steel, socket welding or threaded: ASME B16.11, 13,790 kPa (2000 psig) class with ASME B1.20.1 threads. Use Schedule 80 pipe and fittings for threaded joints. Lubricant or sealant shall be oil and graphite, or other compound approved for the intended service.
   3. Unions: Forged steel, 13,790 kPa (2000 psig) class or 20,685 kPa (3000 psig) class on piping 50 mm (2 inches) and less.
   4. Steam line drip station and strainer quick-couple blowdown hose connection: Straight through, plug and socket, screw or cam locking type for 15 mm (1/2 inch) ID hose. No integral shut-off is required.

B. 65 mm (2-1/2 inches) and Larger: Welded or flanged joints.
   1. Cast iron fittings or piping is prohibited for steam and steam condensate piping.
   2. Butt welding fittings: ASME B16.9 with same wall thickness as connecting piping. Elbows shall be long radius type, unless otherwise noted.
   3. Welding flanges and bolting: ASME B16.5:
      a. Steam service: Weld neck or slip-on, raised face, with non-asbestos gasket. Non-asbestos gasket shall either be stainless steel spiral wound strip with flexible graphite filler or compressed inorganic fiber with nitrile binder rated for saturated and superheated steam service 400 degrees C (750 degrees F) and 10,342 kPa (1500 psig).
      b. Flange bolting: Alloy-Steel or Stainless Steel, ASTM A193.

C. Welded Branch and Tap Connections: Forged steel weldolets, or branchlets and threadolets may be used for branch connections up to one pipe size smaller than the main. Forged steel half-couplings, ASME B16.11 may be used for drain, vent and gauge connections.

2.4 DIELECTRIC FITTINGS

A. Provide where dissimilar metal pipe are joined.

B. 50 mm (2 inches) and Smaller: Threaded dielectric union.

C. 65 mm (2-1/2 inches) and Larger: Flange union with dielectric gasket and bolt sleeves, ASME B16.42.

D. Temperature Rating, 121 degrees C (250 degrees F) for steam condensate and as required for steam service.

E. Contractor's option: On pipe sizes 50 mm (2 inches) and smaller, screwed end steel gate valves or dielectric nipples may be used in lieu of dielectric unions.

2.5 VALVES

A. Asbestos packing is prohibited.

B. All valves of the same type shall be products of a single manufacturer.

C. Provide chain operators for valves 150 mm (6 inches) and larger when the centerline is located 2.1 meter (7 feet) or greater above the floor or operating platform.

D. Shut-Off Valves:

1. Ball Valves:

a. 50 mm (2 inches) and smaller: Forged steel body, rated for 1380 kPa (200 psig) saturated steam, 2758 kPa (400 psig) WOG, bronze wedges and Monel or stainless-steel seats, threaded ends, rising stem, and union bonnet.

b. 65 mm (2-1/2 inches) and larger: Flanged, outside screw and yoke.

1) High pressure steam 421 kPa (61 psig) and above system: Cast steel body, ASTM A216/A216M grade WCB, 1035 kPa (150 psig) at 260 degrees C (500 degrees F), 11-1/2 to 13 percent chrome stainless steel solid disc and seats. Provide 25 mm (1 inch) factory installed bypass with globe valve on valves 100 mm (4 inches) and larger.

2) All other services: Forged steel body, Class B, rated for 850 kPa (123 psig) saturated steam, 1380 kPa (200 psig) WOG, bronze or bronze face wedge and seats, 850 kPa (123 psig) ASME flanged ends, OS&Y, rising stem, bolted bonnet, and renewable seat rings.

E. Ball Valves: Reduced port permitted for bypass (throttling) service; full port required for all other services, one-fourth turn to open.

1. Type 501: Type 316 stainless steel body, ball and stem, rated for 1034 kPa at 185 degrees C (150 psig at 365 degrees F), 4137 kPa at

93 degrees C (600 psig at 200 degrees F); reinforced TFE seat, stem seal and thrust washer; end entry, threaded ends.

2. Type 502: Steel body, rated for 1034 kPa at 185 degrees C (150 psig at 365 degrees F), 1724 kPa at 121 degrees C (250 psig at 250 degrees F), reinforced TFE seat, stem seal and thrust washer; end entry, threaded ends, UL-listed for natural or LP gas shut off service when used on those services.
3. Type 503: Carbon steel body, steam service, rated for 1380 kPa at 200 degrees C (200 psig at 392 degrees F), stainless steel ball and stem, Polyfil seat, live-loaded or adjustable stem seal, threaded ends.

F. Globe and Angle Valves:

1. Globe Valves:
   a. 50 mm (2 inches) and smaller: Forged steel body, rated for 1380 kPa (200 psig) saturated steam, 2758 kPa (400 psig) WOG, hardened stainless steel disc and seat, threaded ends, rising stem, union bonnet, and renewable seat rings.
   b. 65 mm (2-1/2 inches) and larger:
      1) Globe valves for high pressure steam 421 kPa (61 psig): Cast steel body, ASTM A216/A216M grade WCB, flanged, OS&Y, 1035 kPa (150 psig) at 260 degrees C (500 degrees F), 11-1/2 to 13 percent chrome stainless steel disc and renewable seat rings.
      2) All other services: Steel body, rated for 850 kPa (123 psig) saturated steam, 1380 kPa (200 psig) WOG, bronze or bronze-faced disc (Teflon or composition facing permitted) and seat, 850 kPa (123 psig) ASME flanged ends, OS&Y, rising stem, bolted bonnet, and renewable seat rings.
2. Angle Valves:
   a. 50 mm (2 inches) and smaller: Cast steel 1035 kPa (150 psig), union bonnet with metal plug type disc.
   b. 65 mm (2-1/2 inches) and larger:
      1) Angle valves for high pressure steam 421 kPa (61 psig): Cast steel body, ASTM A216/A216M grade WCB, flanged, OS&Y, 1035 kPa (150 psig) at 260 degrees C (500 degrees F), 11-1/2 to 13 percent chrome stainless steel disc and renewable seat rings.

2) All other services: 861 kPa (125 psig), flanged, cast steel body, and bronze trim.

G. Swing Check Valves:

1. 50 mm (2 inches) and smaller: Cast steel, 1035 kPa (150 psig), 45-degree swing disc.
2. 65 mm (2-1/2 inches) and Larger:
   a. Check valves for high pressure steam 421 kPa (61 psig)and above system: Cast steel body, ASTM A216/A216M grade WCB, flanged, OS&Y, 1035 kPa (150 psig) at 260 degrees C (500 degrees F), 11-1/2 to 13 percent chrome stainless steel disc and renewable seat rings.
   b. All other services: 861 kPa (125 psig), flanged, cast steel body, and bronze trim.

H. Manual Radiator/Convector Valves: Brass, packless, with position indicator.

2.6 STRAINERS

A. Basket or Y Type. Tee type is acceptable for gravity flow and pumped steam condensate service.

B. High Pressure Steam: Rated 1035 kPa (150 psig) saturated steam.

1. 50 mm (2 inches) and smaller: Cast steel, rated for saturated steam at 1034 kPa (150 psig) threaded ends.
2. 65 mm (2-1/2 inches) and larger: Cast steel rated for 1034 kPa (150 psig) saturated steam with 1034 kPa (150 psig) ASME flanged ends or forged steel with 1724 kPa (250 psig) ASME flanged ends.

C. All Other Services: Rated 861 kPa (125 psig) saturated steam.

1. 50 mm (2 inches) and smaller: Cast steel body.
2. 65 mm (2-1/2 inches) and larger: Flanged, cast steel body.

D. Screens: Bronze, Monel metal or 18-8 stainless steel, free area not less than 2-1/2 times pipe area, with perforations as follows:

1. 75 mm (3 inches) and smaller: 20 mesh for steam and 1.1 mm (0.045 inch) diameter perforations for liquids.
2. 100 mm (4 inches) and larger: 1.1 mm (0.045) inch diameter perforations for steam and 3.2 mm (1/8 inch) diameter perforations for liquids.

2.7 PIPE ALIGNMENT

A. Guides: Provide factory-built guides along the pipe line to permit axial movement only and to restrain lateral and angular movement. Guides shall be designed to withstand a minimum of 15 percent of the axial force which will be imposed on the expansion joints and anchors. Field-built guides may be used if detailed in the contract documents.

2.8 EXPANSION JOINTS

A. Factory built devices, inserted in the pipe lines, designed to absorb axial cyclical pipe movement which results from thermal expansion and contraction. This includes factory-built or field-fabricated guides located along the pipe lines to restrain lateral pipe motion and direct the axial pipe movement into the expansion joints.

B. Minimum Service Requirements:

1. Pressure Containment:
   a. Steam Service 35-200 kPa (5-29 psig): Rated 345 kPa (50 psig) at 148 degrees C (298 degrees F).
   b. Steam Service 214-850 kPa (31-123 psig): Rated 1035 kPa (150 psig) at 186 degrees C (366 degrees F).
   c. Steam Service 869-1035 kPa (126-150 psig): Rated 1380 kPa (200 psig) at 194 degrees C (381 degrees F).
   d. Condensate Service: Rated 690 kPa (100 psig) at 154 degrees C (309 degrees F).
2. Number of Full Reverse Cycles without failure: Minimum 1000.
3. Movement: As shown on contract documents plus recommended safety factor of manufacturer.

C. Manufacturing Quality Assurance: Conform to Expansion Joints Manufacturers Association Standards.

D. Bellows - Internally Pressurized Type:

1. Multiple corrugations of Type 304 or Type A240-321 stainless steel.
2. Internal stainless-steel sleeve entire length of bellows.
3. External cast iron equalizing rings for services exceeding 345 kPa (50 psig).
4. Welded ends.
5. Design shall conform to standards of EJMA and ASME B31.1.

6. External tie rods designed to withstand pressure thrust force upon anchor failure if one or both anchors for the joint are at change in direction of pipeline.
7. Integral external cover.

E. Bellows - Externally Pressurized Type:
1. Multiple corrugations of Type 304 stainless steel.
2. Internal and external guide integral with joint.
3. Design for external pressurization of bellows to eliminate squirm.
4. Welded ends.
5. Conform to the standards of EJMA and ASME B31.1.
6. Threaded connection at bottom, 25 mm (1 inch) minimum, for drain or drip point.
7. Integral external cover and internal sleeve.

F. Expansion Joint Identification: Provide stamped brass or stainless-steel nameplate on each expansion joint listing the manufacturer, the allowable movement, flow direction, design pressure and temperature, date of manufacture, and identifying the expansion joint by the identification number in the contract documents.

2.9 FLEXIBLE BALL JOINTS

A. Design and Fabrication: One-piece component construction, fabricated from steel with welded ends, designed for a working steam pressure of 1725 kPa (250 psig) and a temperature of 232 degrees C (450 degrees F). Each joint shall provide for 360 degrees rotation in addition to a minimum angular flexible movement of 30 degrees for sizes 6 mm (1/4 inch) to 150 mm (6 inch) inclusive, and 15 degrees for sizes 65 mm (2-1/2 inches) to 762 mm (30 inches). Joints through 355 mm (14 inches) shall have forged pressure retaining members, while size 406 mm (16 inches) through 762 mm (30 inches) shall be of one-piece construction.

B. Material:
1. Cast or forged steel pressure containing parts and bolting in accordance with ASME BPVC Section II or ASME B31.1. Retainer may be ductile iron ASTM A536, Grade 65-45-12, or ASME BPVC Section II SA 515, Grade 70.
2. Gaskets: Steam pressure molded composition design for a temperature range of from minus 10 degrees C (50 degrees F) to plus 274 degrees C (525 degrees F).

C. Certificates: Submit qualifications of ball joints in accordance with the following test data:
   1. Low pressure leakage test: 41 kPa (6 psig) saturated steam for 60 days.
   2. Flex cycling: 800 Flex cycles at 3447 kPa (500 psig) saturated steam.
   3. Thermal cycling: 100 saturated steam pressure cycles from atmospheric pressure to operating pressure and back to atmospheric pressure.
   4. Environmental shock tests: Forward certificate from a recognized test laboratory, that ball joints of the type submitted has passed shock testing in accordance with Mil. Spec MIL-S-901.
   5. Vibration: 170 hours on each of three mutually perpendicular axes at 25 to 125 Hz; 1.3 mm to 2.5 mm (0.05 inch to 0.10 inch) double amplitude on a single ball joint and 3 ball joint off set.

2.10 STEAM SYSTEM COMPONENTS

A. Heat Exchanger (Steam to Hot Water): Shell and tube type, U-bend removable tube bundle, steam in shell, water in tubes, equipped with support cradles.
   1. Maximum tube velocity: 2.3 meter/second (7.5 feet/second).
   2. Tube fouling factor: TEMA Standards, but not less than 0.00018 square meters K/W (0.001 square foot/hour degrees F/Btu).
   3. Materials:
      a. Shell: Steel.
      b. Tube sheet and tube supports: Steel or brass.
      c. Tubes: 20 mm (3/4 inch) OD copper.
      d. Head or bonnet: Steel.
   4. Construction: In accordance with ASME Pressure Vessel Code for 861 kPa (125 psig) working pressure for shell and tubes. Provide manufacturer's certified data report, Form No. U-1.

B. Optional Heat Transfer Package: In lieu of field erected individual components, the Contractor may provide a factory or shop assembled package of heat exchangers, pumps, and other components, pre-piped and pre-wired and supported on a welded steel frame or skid.

C. Steam Pressure Reducing Valves in PRV Stations:
   1. Type: Single-seated, diaphragm operated, spring-loaded, external or internal steam pilot-controlled, normally closed, adjustable set pressure. Pilot shall sense controlled pressure downstream of main valve.
   2. Service: Provide controlled reduced pressure to steam piping systems.
   3. Pressure control shall be smooth and continuous with maximum drop of 10 percent deviation from set pressure. Maximum flow capacity of each valve shall not exceed capacity of downstream safety valve(s).
   4. Main valve and pilot valve shall have replaceable valve plug and seat of stainless steel, Monel, or similar durable material.
      a. Pressure rating for high pressure steam: Not less than 1035 kPa (150 psig) saturated steam.
      b. Connections: Flanged for valves 65 mm (2-1/2 inches) and larger; flanged or threaded ends for smaller valves.
   5. Select pressure reducing valves to develop less than 85 dBA at 1.5-meter (5 feet) elevation above adjacent floor, and 1.5 meter (5 feet) distance in any direction. Inlet and outlet piping for steam pressure reducing valves shall be Schedule 80 minimum for required distance to achieve required levels or sound attenuators shall be applied.
   6. Direct-Digital Control PRV Valves: May be furnished in lieu of steam operated valves. All specification requirements for steam operated valves apply. In the event of signal failure, valves shall be normally closed failsafe device accessory in the actuator to stroke valve to predetermined position indicated. Install per manufacturer’s recommendation.

D. Safety Valves and Accessories: Comply with ASME BPVC Section VIII. Capacities shall be certified by National Board of Boiler and Pressure Vessel Inspectors, maximum accumulation 10 percent. Provide lifting lever. Provide drip pan elbow where shown. Valve shall have stainless steel seats and trim.

E. Steam PRV for Individual Equipment: Cast steel body, screwed or flanged ends, rated 861 kPa (125 psig), or 20 percent above the working

pressure, whichever is greater. Single-seated, diaphragm operated, spring loaded, adjustable range, all parts renewable.

F. Moisture Separator: Shall be of the high efficiency internal baffle type, with a pressure drop that does not exceed an equivalent length of straight pipe. Body shall be iron, steel or cast steel with screwed, socket weld or flanged connections as detailed on drawing schedule. Steel construction shall be in accordance with Section VIII, Division 1 of the ASME Boiler and Pressure Vessel Code with ASME Class 150, 300 or 600 RF flange connections. A bottom drain connection shall be provided for the installation of a trap to discharge any accumulated liquid. Separators shall be installed before steam PRV and Control Valves.

G. Flash Tanks: Horizontal or vertical vortex type, constructed of copper bearing steel, ASTM A516/A516M or ASTM A285/A285M, for a steam working pressure of 861 kPa (125 psig) to comply with ASME Code for Unfired Pressure Vessels and stamped with "U" symbol. Perforated pipe inside tank shall be ASTM A53/A53M Grade B, seamless or ERW, or ASTM A106/A106M Grade B seamless, Schedule 80. Corrosion allowance of 1.6 mm (1/16 inch) may be provided in lieu of the copper bearing requirement. Provide data Form No. U-1.

H. Steam Trap: Each type of trap shall be the product of a single manufacturer. Provide trap sets at all low points and at 61 meter (200 feet) intervals on the horizontal main lines.

1. Floats and linkages shall provide sufficient force to open trap valve over full operating pressure range available to the system. Unless otherwise indicated in the contract documents, traps shall be sized for capacities indicated at minimum pressure drop as follows:
   a. For equipment with modulating control valve: 1.7 kPa (1/4 psig), based on a condensate leg of 300 mm (12 inches) at the trap inlet and gravity flow to the receiver.
   b. For main line drip trap sets and other trap sets at steam pressure: Up to 70 percent of design differential pressure. Condensate may be lifted to the return line.
2. Trap bodies: Steel and stainless-steel, constructed to permit ease of removal and servicing working parts without disturbing connecting piping. The use of raised face flange is required on pipe sizes 1-1/2 inch and greater. The use of unions is acceptable for pipe sizes

less than 1—1/2 inches. For systems without relief valve traps shall be rated for the pressure upstream of the steam supplying the system.

3. Balanced pressure thermostatic elements: Phosphor bronze, stainless steel or Monel metal.
4. Valves and seats: Suitable hardened corrosion resistant alloy.
5. Mechanism: Brass, stainless steel or corrosion resistant alloy.
6. Floats: Stainless steel.
7. Inverted bucket traps: Provide bi-metallic thermostatic element for rapid release of non-condensables.
8. Thermodynamic steam traps: Shall have tight shut-off with no steam loss allowed either by bleed or "controlled leak" and shall have an integral seat design with hardened disc and seating surfaces. Thermodynamic traps for steam pressures below 600 psi shall be all stainless-steel construction with threaded, socket weld or flanged connections on a common centerline, and shall be capable of operating in any position. Traps shall be capable of operating with up to 80% back pressure and shall be standard with insulating cover to reduce heat loss. Thermodynamic traps for steam pressures 600 psi or higher shall be of alloy steel construction with threaded, socket weld or flanged connections on a common centerline, and will operate in any position. Steam trap shall be capable of operating with up to 80% back pressure with operating pressure up to 900 psi. Thermodynamic trap shall have three equidistant discharge ports between seat land surfaces to minimize disc and seat wear.

I. Factory-Packaged Trap Station: As an option for drip points requiring isolation valves, strainer, trap, check-valve, valved test ports, and monitoring provide factory packaged trap station including all these features:

1. Shall consist of compact stainless steel design comprising upstream and downstream isolation valves, a quick- fit universal trap connector, strainer, and check valve. The trap station shall be single-piece construction. Once installed, the station remains permanently in the line. Steam traps shall be installed and removed from the station by two bolts, facilitating simple and rapid installation and replacement.

2. Isolation valves, check valve, and strainer shall be maintainable.
3. Steam trap station shall be suitable for use with and shall include thermodynamic, inverted bucket, float & thermostatic, or thermostatic steam traps fitted with universal connectors. The selected steam trap shall be attached to the connector by bolts.
4. Steam Trap Station shall be designed for maximum operating pressure (PMO) with saturated steam of 1751 kPa (254 psig). For ANSI 150 connections PMO shall be 1379 kPa (200 psig).
5. All components of the packaged trap station shall meet specified requirements for individual components specified in this section.

J. Pressure Driven Condensate Pump Trap:
1. Unit shall automatically trap and pump condensate from process and heating equipment under all operating conditions including vacuum.
2. Body shall be constructed of cast iron with all stainless-steel internals. The mechanism shall incorporate Inconel alloy stainless steel springs.
3. Motive Force: The pump trap shall utilize steam, to remove condensate from the receiving vessel.
4. Pumps shall require no electricity for operation.
5. The pump trap shall include a bronze water level gauge with shut off valves.
6. Check valves at inlet and outlet shall be steel stainless steel.
7. ASME BPVC Section VIII.
8. Provide pump trap with removable insulation cove and digital cycle counter.
9. Manufacturer standard paint finish coated in electroless nickel plate.

K. Thermostatic Air Vent (Steam): Steel body, balanced pressure bellows, stainless steel (renewable) valve and seat, rated 861 kPa (125 psig) working pressure, 20 mm (3/4 inch) screwed connections. Air vents shall be balanced pressure type that responds to steam pressure-temperature curve and vents air at any pressure.

2.11 GAUGES, PRESSURE AND COMPOUND

A. ASME B40.100, Accuracy Grade 1A, (pressure, vacuum, or compound), initial mid-scale accuracy 1 percent of scale (Qualify grade), metal or phenolic case, 115 mm (4-1/2 inches) in diameter, 6 mm (1/4 inch) NPT

bottom connection, white dial with black graduations and pointer, clear glass or acrylic plastic window, suitable for board mounting. Provide red "set hand" to indicate normal working pressure.

B. Provide steel, lever handle union cock. Provide steel or stainless-steel pressure snubber for gauges in water service. Provide steel pigtail syphon for steam gauges.

C. Pressure gauge ranges shall be selected such that the normal operating pressure for each gauge is displayed near the midpoint of each gauge's range. Gauges with ranges selected such that the normal pressure is displayed at less than 30 percent or greater than 70 percent of the gauge's range are prohibited. The units of pressure shall be kPa psig.

2.12 PRESSURE/TEMPERATURE TEST PROVISIONS

A. Provide one each of the following test items to the COR:

1. 6 mm (1/4 inch) FPT by 3.2 mm (1/8 inch) diameter stainless steel pressure gauge adapter probe for extra-long test plug. Pressure/temperature plug is an example.
2. 90 mm (3-1/2 inch) diameter, one percent accuracy, compound gauge, 762 mm (30 inches) Hg to 690 kPa (100 psig) range.
3. 0 to 104 degrees C (32 to 220 degrees F) pocket thermometer one-half degree accuracy, 25 mm (1 inch) dial, 125 mm (5 inch) long stainless-steel stem, plastic case.

2.13 FIRESTOPPING MATERIAL

A. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

PART 3 - EXECUTION

3.1 GENERAL

A. If in the substantiated evaluation of the COR, the installation fails to meet the requirements of the construction documents with respect to function and maintainability, an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no additional cost or time to the Government.

B. The contract documents show the general arrangement of pipe and equipment but do not show all required fittings and offsets that may be necessary to connect pipes to equipment, fan-coils, coils, radiators, etc., and to coordinate with other trades. Provide all necessary fittings, offsets and pipe runs based on field measurements and at no additional cost or time to the Government. Coordinate with other trades

for space available and relative location of HVAC equipment and accessories to be connected on ceiling grid. Pipe location in the contract documents shall be altered by contractor where necessary to avoid interferences and clearance difficulties.

C. Store materials to avoid excessive exposure to weather or foreign materials. Keep inside of piping relatively clean during installation and protect open ends when work is not in progress.

D. Support piping securely. Refer to PART 3, Section 23 05 11, COMMON WORK RESULTS FOR HVAC. Install convertors and other heat exchangers at height sufficient to provide gravity flow of condensate to the flash tank and condensate pump.

E. Install piping generally parallel to walls and column center lines, unless shown otherwise in the contract documents. Space piping, including insulation, to provide 25 mm (1 inch) minimum clearance between adjacent piping and another surface. Unless shown otherwise, slope steam, condensate and drain piping down in the direction of flow not less than 25 mm (1 inch) in 12 meter (40 feet). Provide eccentric reducers to keep bottom of sloped piping flat.

F. Locate and orient valves to permit proper operation and access for maintenance of packing, seat and disc. Generally, locate valve stems in overhead piping in horizontal position. Provide a union adjacent to one end of all threaded end valves. Control valves usually require reducers to connect to pipe sizes shown in the contract documents.

G. Offset equipment connections to allow valving off for maintenance and repair with minimal removal of piping. Provide flexibility in equipment connections and branch line take-offs with 3-elbow swing joints where noted in the contract documents.

H. Tee water piping runouts or branches into the side of mains or other branches. Avoid bull-head tees, which are two return lines entering opposite ends of a tee and exiting out the common side.

I. Connect piping to equipment as shown in the contract documents. Install components furnished by others such as flow elements (orifice unions), control valve bodies, flow switches, pressure taps with valve, and wells for sensors.

J. Firestopping: Fill openings around uninsulated piping penetrating floors or fire walls, with firestop material. For firestopping

insulated piping refer to Section 23 07 11, HVAC AND BOILER PLANT INSULATION.

K. Pipe vents to the exterior. Where a combined vent is provided, the cross-sectional area of the combined vent shall be equal to sum of individual vent areas. Slope vent piping 25 mm (1 inch) in 12 meter (40 feet) 0.25 percent in direction of flow. Provide a drip pan elbow on relief valve outlets if the vent rises to prevent backpressure. Terminate vent minimum 300 mm (12 inches) above the roof or through the wall minimum 2.4 meter (8 feet) above grade with down turned elbow.

L. Contract documents do not identify all locations where steam trap sets are required. Contractor shall provide at no additional cost as many trap-sets as are necessary for the proper, reliable operation of the system. Provide trap-sets at all low points and at 61 meter (200 feet) intervals on all horizontal main lines.

3.2 WELDING

A. The contractor is entirely responsible for the quality of the welding and shall:

1. Conduct tests of the welding procedures used on the project, verify the suitability of the procedures used, verify that the welds made will meet the required tests, and also verify that the welding operators have the ability to make sound welds under standard conditions.
2. Perform all welding operations required for construction and installation of the piping systems.

B. Qualification of Welders: Rules of procedure for qualification of all welders and general requirements for fusion welding shall conform with the applicable portions of ASME B31.1, AWS B2.1/B2.1M, AWS Z49.1, and also as outlined below.

C. Examining Welder: Examine each welder at job site, in the presence of the COR, to determine the ability of the welder to meet the qualifications required. Test welders for piping for all positions, including welds with the axis horizontal (not rolled) and with the axis vertical. Each welder shall be allowed to weld only in the position in which he has qualified and shall be required to identify his welds with his specific code marking signifying his name and number assigned.

D. Examination Results: Provide the COR with a list of names and corresponding code markings. Retest welders who fail to meet the prescribed welding qualifications. Disqualify welders, who fail the second test, for work on the project.

E. Beveling: Field bevels and shop bevels shall be done by mechanical means or by flame cutting. Where beveling is done by flame cutting, surfaces shall be thoroughly cleaned of scale and oxidation just prior to welding. Conform to specified standards.

F. Alignment: Provide approved welding method for joints on all pipes greater than 50 mm (2 inches) to assure proper alignment, complete weld penetration, and prevention of weld spatter reaching the interior of the pipe.

G. Erection: Piping shall not be split, bent, flattened, or otherwise damaged before, during, or after installation. If the pipe temperature falls to 0 degrees C (32 degrees F) or lower, the pipe shall be heated to approximately 38 degrees C (100 degrees F) for a distance of 300 mm (1 foot) on each side of the weld before welding, and the weld shall be finished before the pipe cools to 0 degrees C (32 degrees F).

H. Non-Destructive Examination of Piping Welds:

1. Perform radiographic examination of 50 percent of the first 10 welds made and 10 percent of all additional welds made. The COR reserves the right to identify individual welds for which the radiographic examination shall be performed. All welds shall be visually inspected by the COR. The VA reserves the right to require testing on additional welds up to 100 percent if greater than 25 percent of the examined welds fail the inspection.
2. An approved independent testing firm regularly engaged in radiographic testing shall perform the radiographic examination of pipe joint welds. All radiographs shall be reviewed and interpreted by an ASNT Certified Level III radiographer, employed by the testing firm, who shall sign the reading report.
3. Comply with ASME B31.1. Furnish a set of films showing each weld inspected, a reading report evaluating the quality of each weld, and a location plan showing the physical location where each weld is to be found in the completed project. The COR and the CxA shall be

given a copy of all reports to be maintained as part of the project records and shall review all inspection records.

I. Defective Welds: Replace and reinspect defective welds. Repairing defective welds by adding weld material over the defect or by peening are prohibited. Welders responsible for defective welds shall be requalified prior to resuming work on the project.

J. Electrodes: Electrodes shall be stored in a dry heated area and be kept free of moisture and dampness during the fabrication operations. Discard electrodes that have lost part of their coating.

3.3 PIPE JOINTS

A. Welded: Beveling, spacing and other details shall conform to ASME B31.1 and AWS B2.1/B2.1M. See Welder’s qualification requirements under "Quality Assurance" in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. Screwed: Threads shall conform to ASME B1.20.1; joint compound shall be applied to male threads only and joints made up so no more than three threads show. Coat exposed threads on steel pipe with joint compound, or red lead paint for corrosion protection.

C. 125 Pound Cast Steel Flange (Plain Face): Mating flange shall have raised face, if any, removed to avoid overstressing the cast steel flange.

3.4 EXPANSION JOINTS (BELLOWS AND SLIP TYPE)

A. Anchors and Guides: Provide type, quantity and spacing as recommended by manufacturer of expansion joint and as shown. A professional engineer shall verify in writing that anchors and guides are properly designed for forces and moments which will be imposed.

B. Cold Set: Provide setting of joint travel at installation as recommended by the manufacturer for the ambient temperature during the installation.

C. Preparation for Service: Remove all apparatus provided to restrain joint during shipping or installation. Representative of manufacturer shall visit the site and verify that installation is proper.

D. Access: Expansion joints shall be located in readily accessible space. Locate joints to permit access without removing piping or other devices. Allow clear space to permit replacement of joints and to permit access to devices for inspection of all surfaces and for adding packing.

3.5 STEAM TRAP PIPING

A. Install to permit gravity flow to the trap. Provide gravity flow (avoid lifting condensate) from the trap where modulating control valves are used. Support traps weighing over 11 kg (24 pounds) independently of connecting piping.

1. On pipe size 1-1/2 inch and greater a raised face flange is required to allow for removal of the steam trap without disturbing surrounding piping.
2. On pipe size less than 1-1/2inch raised face flanges or unions may be used to allow for removal of the traps.

3.6 SEISMIC BRACING

A. Provide in accordance with Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

3.7 LEAK TESTING

A. Inspect all joints and connections for leaks and workmanship and make corrections as necessary to the satisfaction of the COR in accordance with the specified requirements. Testing shall be performed in accordance with the specification requirements.

B. An operating test at design pressure, and for hot systems, design maximum temperature.

C. A hydrostatic test at 1.5 times design pressure. For water systems, the design maximum pressure would usually be the static head, or expansion tank maximum pressure, plus pump head. Factory tested equipment (convertors, exchangers, coils, etc.) need not be field tested. Avoid excessive pressure on mechanical seals and safety devices.

D. Prepare and submit test and inspection reports to the COR within 5 working days of test completion and prior to covering the pipe.

E. All tests shall be witnessed by the COR, their representative, or the CxA and be documented by each section tested, date tested, and list or personnel present.

3.8 FLUSHING AND CLEANING PIPING SYSTEMS

A. Steam, Condensate and Vent Piping: The piping system shall be flushed clean prior to equipment connection. Cleaning includes pulling all strainer screens and cleaning all scale/dirt legs during startup operation. Contractor shall be responsible for damage caused by inadequately cleaned/flushed systems.

3.9 STARTUP AND TESTING

A. Perform tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.

B. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.

C. The CxA shall observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with COR and CxA. Provide a minimum notice of 10 working days prior to startup and testing.

D. Adjust red set hand on pressure gauges to normal working pressure.

3.10 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

B. Components provided under this section of the specification shall be tested as part of a larger system.

3.11 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer’s technical representative for 8 hours to instruct each VA personnel responsible in operation and maintenance of the system.

B. Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

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SECTION 23 25 00
HVAC WATER TREATMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. A complete listing of common acronyms and abbreviations are included in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. This section specifies cleaning of circulating HVAC water systems, including the following.

1. Cleaning compounds.

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.

D. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

E. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

F. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

G. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

H. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

I. Section 23 21 13, HYDRONIC PIPING.

J. Section 23 22 13, STEAM and CONDENSATE HEATING PIPING.

1.3 APPLICABLE PUBLICATIONS

A. The publication listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Where conflicts occur these specifications and the VHA standards will govern.

B. American Society of Mechanical Engineers (ASME):
ASME Boiler and Pressure Vessel Code (BPVC):
BPVC Section VIII-2021..Rules for Construction of Pressure Vessels, Division 1

C. American Society for Testing and Materials (ASTM):
A666-2015.....Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar

F441/F441M-2020.....Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80

D. National Fire Protection Association (NFPA):

70-2020.....National Electric Code (NEC)

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 XX XX XX, SECTION TITLE", with applicable paragraph identification.

C. Manufacturer's Literature and Data Including: Full item description and optional features and accessories.

1. Cleaning compounds and recommended procedures for their use.

E. Completed System Readiness Checklist provided by the CxA and completed by the contractor, signed by a qualified technician, and dated on the date of completion, in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

1.5 QUALITY ASSURANCE

A. Refer to paragraph QUALITY ASSURANCE in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. Chemicals: Chemicals shall be non-toxic approved by local authorities and meeting applicable EPA requirements.

C. 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 specification section. For more information regarding the product categories covered by the Bio-Preferred Program, visit http:www.biopreferred.gov.

D. Refer to Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS for additional sustainable design requirements.

1.6 AS-BUILT DOCUMENTATION

A. Comply with requirements in paragraph AS-BUILT DOCUMENTATION of Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

PART 2 - PRODUCTS

2.1 CLEANING COMPOUNDS

A. Alkaline phosphate or non-phosphate detergent/surfactant/specific to remove organic soil, hydrocarbons, flux, pipe mill varnish, pipe compounds, iron oxide, and like deleterious substances, with or without inhibitor, suitable for system wetted metals without deleterious effects.

B. All chemicals to be acceptable for discharge to sanitary sewer.

C. Refer to Section 23 21 13, HYDRONIC PIPING and Section 23 22 13, STEAM and CONDENSATE HEATING PIPING, PART 3, for flushing and cleaning procedures.

2.2 EQUIPMENT AND MATERIALS IDENTIFICATION

A. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

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SECTION 23 31 00
HVAC DUCTS AND CASINGS

PART 1 - GENERAL

1.1 DESCRIPTION

A. A complete listing of common acronyms and abbreviations are included in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. Ductwork and accessories for HVAC including the following:

1. Supply air, return air, outside air, exhaust, make-up air, and relief systems.
2. Exhaust duct with HEPA filters for Sterile Processing Decontamination.
3. “Wet exhaust” ducts.

C. Definitions:

1. Seal or Sealing: Use of liquid or mastic sealant, with or without compatible tape overlay, or gasketing of flanged joints, to keep air leakage at duct joints, seams and connections to an acceptable minimum.
2. Duct Pressure Classification: SMACNA HVAC Duct Construction Standards, Metal and Flexible.
3. Exposed Duct: Exposed to view in a finished room, exposed to weather.

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.

D. Section 07 84 00, FIRESTOPPING.

E. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

F. Section 22 11 00, FACILITY WATER DISTRIBUTION.

G. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

H. Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT.

I. Section 23 05 93, TESTING, ADJUSTING, and BALANCING FOR HVAC.

J. Section 23 07 11, HVAC and BOILER PLANT INSULATION.

K. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

L. Section 23 34 00, HVAC FANS.

M. Section 23 36 00, AIR TERMINAL UNITS.

N. Section 23 40 00, HVAC AIR CLEANING DEVICES.

O. Section 23 82 16, AIR COILS.

P. Section 28 31 00, FIRE DETECTION and ALARM.

1.3 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.Where conflicts occur these specifications and the VHA standards will govern.

B. American Society of Civil Engineers (ASCE):

7-2016.....Minimum Design Loads for Associated Criteria for Buildings and Other Structures

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

A653/A653M-2020.....Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

A1011/A1011-2018a.....Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High Strength Low-Alloy with Improved Formability, and Ultra-High Strength

B209-2021.....Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

C1071-2019.....Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)

E1-2014(R2020).....Standard Specification for ASTM Liquid-in-Glass Thermometers

E77-2014(R2021).....Standard Test Method for Inspection and Verification of Thermometers

E84-2021a.....Standard Test Method for Surface Burning Characteristics of Building Materials

D. National Fire Protection Association (NFPA):

90A-2021.....Standard for the Installation of Air-Conditioning and Ventilating Systems

96-2021.....Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations

E. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):

006-2020.....HVAC Duct Construction Standards, Metal and Flexible, 4th Edition

016-2012.....HVAC Air Duct Leakage Test Manual, 2nd Edition

2016.....Fibrous Glass Duct Construction Standards, 7th Edition

F. Underwriters Laboratories, Inc. (UL):

181-2013(R2017).....Standard for Factory-Made Air Ducts and Air Connectors

555-2006(R2020) .....Standard for Fire Dampers

555S-2014(R2020).....Standard for Smoke Dampers

G. Department of Veterans Affairs (VA):

PG-18-10-2015.....Physical Security Design Manual for VA Mission Critical Facilities

1.4 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 23 XX XX, SECTION TITLE", 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. Rectangular Ducts:
   a. Schedules of duct systems, materials and selected SMACNA construction alternatives for joints, sealing, gauge and reinforcement.
   b. Duct liner.
   c. Sealants and gaskets.
   d. Access doors.
2. Round and Flat Oval DuctS:

a. Manufacturer's details for duct fittings.

b. Sealants and gaskets.

c. Access sections.

d. Installation instructions.

3. Volume dampers, back draft dampers.
4. Upper hanger attachments.
5. Fire dampers, fire doors, and smoke dampers with installation instructions.
6. Sound attenuators, including pressure drop and acoustic performance.
7. Flexible ducts and clamps, with manufacturer's installation instructions.
8. Flexible connections.
9. Instrument test fittings.
10. Details and design analysis of alternate or optional duct systems.

D. Coordination Drawings: Refer to paragraph SUBMITTALS in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

E. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replaceable parts, and troubleshooting guide:

1. Include complete list indicating all components of the systems.
2. Include complete diagrams of the internal wiring for each item of equipment.
3. Diagrams shall have their terminals identified to facilitate installation, operation, and maintenance.

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.

B. Refer to Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS for additional sustainable design requirements.

C. Fire Safety Code: Comply with NFPA 90A.

D. Duct System Construction and Installation: Referenced SMACNA Standards are the minimum acceptable quality.

E. Duct Sealing, Air Leakage Criteria, and Air Leakage Tests: Ducts shall be sealed as per duct sealing requirements of SMACNA HVAC Air Duct Leakage Test Manual for duct pressure classes shown in the contract documents.

F. Duct accessories exposed to the air stream, such as dampers of all types (except smoke dampers) and access openings, shall be of the same material as he duct or provide at least the same level of corrosion resistance.

1.6 AS-BUILT DOCUMENTATION

A. Comply with requirements in paragraph AS-BUILT DOCUMENTATION of Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

PART 2 - PRODUCTS

2.1 DUCT MATERIALS AND SEALANTS

A. General: Except for systems specified otherwise, construct ducts, casings, and accessories of galvanized sheet steel, ASTM A653/A653M, coating G90; or, aluminum sheet, ASTM B209, alloy 1100, 3003 or 5052.

B. Specified Corrosion Resistant Systems: Stainless-steel sheet, Class 302 or 304, Condition A (annealed) Finish No. 4 for exposed ducts and Finish No. 2B for concealed duct or ducts located in mechanical rooms.

C. Joint Sealing: Refer to SMACNA HVAC Duct Construction Standards, Metal and Flexible.

1. Sealant: Elastomeric compound, gun or brush grade, maximum 25 flame spread, and 50 smoke developed (dry state) compounded specifically for sealing ductwork as recommended by the manufacturer. Generally, provide liquid sealant, with or without compatible tape, for low clearance slip joints and heavy, permanently elastic, mastic type where clearances are larger. Oil base caulking and glazing compounds are prohibited because they do not retain elasticity and bond.
2. Tape: Use only tape specifically designated by the sealant manufacturer and apply only over wet sealant. Pressure sensitive tape shall not be used on bare metal or on dry sealant.
3. Gaskets in Flanged Joints: Soft neoprene.

D. Approved factory-made joints may be used.

2.2 DUCT CONSTRUCTION AND INSTALLATION

A. Regardless of the pressure classifications outlined in the SMACNA Standards, fabricate and seal the ductwork in accordance with the following pressure classifications:

B. Duct Pressure Classification:

1. 0 to 13 mm (0 to 1/2 inch)
2. 13 mm to 25 mm (1/2 inch to 1 inch)
3. 25 mm to 50 mm (1 inch to 2 inch)
4. 50 mm to 75 mm (2 inch to 3 inch)
5. 75 mm to 100 mm (3 inch to 4 inch)

C. Seal Class: All ductwork shall receive Class A Seal.

D. Wet Air Exhaust Ducts and Accessories: Ducts for cart washers and manual cart washers shall be 1.3 mm (18 gauge) stainless-steel made liquid tight with continuous external weld for all seams and joints. Provide neoprene gaskets at flanged connections. Where ducts are not self-draining back to the equipment, provide low point drain pocket with copper drain pipe to sanitary sewer. Provide access door in side of duct at drain pockets.

E. Provide a welded stainless-steel duct section for housing the duct-mounted terminal humidifiers. Ductwork shall be at least 914 mm (3 feet) long on the upstream side and 1829 mm (6 feet) long on the downstream side. Slope the ductwork against the direction of airflow and provide drain connections.

F. Duct for Negative Pressure Up to 750 Pa (3 inch WG): Provide for exhaust duct between HEPA filters and exhaust fan inlet.

1. Round Duct: Galvanized steel, spiral lock seam construction with standard slip joints.
2. Rectangular Duct: Galvanized steel, minimum 1.0 mm (20 gauge), Pittsburgh lock seam, companion angle joints 32 mm by 3.2 mm (1-1/4 by 1/8 inch) minimum at no greater than 2.4 m (8 feet) spacing. Approved pre-manufactured joints are acceptable in lieu of companion angles.

G. Round and Flat Oval Ducts: Furnish duct and fittings made by the same manufacturer to ensure good fit of slip joints. When submitted and approved in advance, round and flat oval duct, with size converted on

the basis of equal pressure drop, may be furnished in lieu of rectangular duct design shown in the contract documents.

1. Elbows: Diameters 75 through 203 mm (3 through 8 inches) shall be two sections die stamped, all others shall be gored construction, maximum 18 degree angle, with all seams continuously welded or standing seam. Coat galvanized areas of fittings damaged by welding with corrosion resistant aluminum paint or galvanized repair compound.
2. Provide bell mouth, conical tees or taps, laterals, reducers, and other low loss fittings as shown in SMACNA HVAC Duct Construction Standards, Metal and Flexible.
3. Ribbed Duct Option: Lighter gauge round/oval duct and fittings may be furnished provided certified tests indicating that the rigidity and performance is equivalent to SMACNA standard gauge ducts are submitted.
   a. Ducts: Manufacturer's published standard gauge, G90 coating, spiral lock seam construction with an intermediate standing rib.
   b. Fittings: May be manufacturer's standard as shown in published catalogs, fabricated by spot welding and bonding with neoprene base cement or machine formed seam in lieu of continuous welded seams.
4. Provide flat side reinforcement of oval ducts as recommended by the manufacturer and SMACNA HVAC Duct Construction Standards, Metal and Flexble. Because of high pressure loss, do not use internal tie-rod reinforcement unless approved by the COR.

H. Reagent Grade Water Treatment Room: Constructed of 1.3 mm (18 gauge) stainless-steel.

I. Casings and Plenums: Construct in accordance with SMACNA HVAC Duct Construction Standards, Metal and Flexible, including curbs, access doors, pipe penetrations, eliminators and drain pans. Access doors shall be hollow metal, insulated, with latches and door pulls, 508 mm (20 inches) wide by 1219 to 1372 mm (48 to 54 inches) high. Provide view port in the doors where shown. Provide drain for outside air louver plenum. Outside air plenum shall have exterior insulation. Drain piping shall be routed to the nearest floor drain.

J. Volume Dampers: Single blade or opposed blade, multi-louver type as detailed in SMACNA Standards. Refer to SMACNA for Single Blade and Multi-blade Volume Dampers.

K. Duct Hangers and Supports: Refer to SMACNA Standards. Avoid use of trapeze hangers for round duct.

2.3 DUCT LINER (WHERE INDICATED IN THE CONTRACT DOCUMENTS)

A. Duct sizes shown in the contract documents for lined duct are clear opening inside lining.

B. Duct liner is only permitted to be used for return, relief and general exhaust ducts. Duct liner is prohibited for outside air ducts, supply air ducts or any other positive pressure ductwork (provide exterior insulation only).

C. Rectangular Duct or Casing Liner: ASTM C1071, Type I (flexible), or Type II (board), 25 mm (1 inch) minimum thickness, applied with mechanical fasteners and 100 percent coverage of adhesive in conformance with SMACNA.

2.4 DUCT ACCESS DOORS, PANELS AND SECTIONS

A. Provide access doors, sized and located for maintenance work, upstream, in the following locations:

1. Each duct mounted coil and humidifier.
2. Each fire damper (for link service), smoke damper and automatic control damper.
3. Each duct mounted smoke detector.

B. Openings shall be as large as feasible in small ducts, 305 mm by 305 mm (12 inch by 12 inch) minimum where possible. Access sections in insulated ducts shall be double-wall, insulated. Transparent shatterproof covers are preferred for uninsulated ducts.

1. For Rectangular Ducts: Refer to SMACNA HVAC Duct Construction Standards, Metal and Flexible.
2. For Round and Flat Oval Ducts: Refer to SMACNA HVAC Duct Construction Standards, Metal and Flexible.

2.5 FIRE DAMPERS

A. Galvanized steel, interlocking blade type, UL listing and label, 1-1/2-hour rating, 70 degrees C (158 degrees F) fusible line, 100 percent free opening with no part of the blade stack or damper frame in the air stream.

B. Fire dampers in wet air exhaust shall be of stainless-steel construction, all others may be galvanized steel.

C. Minimum Requirements for Fire Dampers:

1. The damper frame may be of design and length as to function as the mounting sleeve, thus eliminating the need for a separate sleeve, as allowed by UL 555. Otherwise provide sleeves and mounting angles, minimum 1.9 mm (14 gauge), required to provide installation equivalent to the damper manufacturer's UL test installation.
2. Submit manufacturer's installation instructions conforming to UL rating test.

2.6 SMOKE DAMPERS

A. Maximum air velocity, through free area of open damper, and pressure loss: Low pressure and medium pressure duct (supply, return, exhaust, outside air): 457 m/min (1500 fpm). Maximum static pressure loss: 32 Pa (0.13 inch WG).

B. Leakage: Class I.

C. Maximum Air Leakage, Closed Damper: 0.32 cubic meters /min/square meter (4.0 cfm per square foot) at 750 Pa (3 inch WG) differential pressure.

D. Minimum Requirements for Dampers:

1. Shall comply with requirements of UL 555S, except for the Fire Endurance and Hose Stream Test.
2. Frame: Galvanized steel channel with side, top and bottom stops or seals.
3. Blades: Galvanized steel, parallel type preferably, 305 mm (12 inch) maximum width, edges sealed with neoprene, rubber or felt, if required to meet minimum leakage. Airfoil (streamlined) type for minimum noise generation and pressure drop are preferred for duct mounted dampers.
4. Shafts: Galvanized steel.
5. Bearings: Nylon, bronze sleeve or ball type.
6. Hardware: Zinc plated.
7. Operation: Automatic open/close. No smoke damper that requires manual reset or link replacement after actuation is acceptable. See contract documents for required control operation.

E. Motor Operator (Actuator): Provide pneumatic or electric as required by the automatic control system, externally mounted on stand-offs to allow complete insulation coverage.

2.7 FLEXIBLE AIR DUCT

A. Flexible air duct is prohibited in operating room suites, SPS processing spaces, Pharmacy compounding spaces, Protective Environment spaces, Isolation Rooms, Clean Rooms, Bio-containment Laboratories, Research Laboratories, and Clinical Laboratories.

2.8 FLEXIBLE DUCT CONNECTIONS

A. Where duct connections are made to fans and air handling units, install a non-combustible flexible connection of 822 g (29 ounces) neoprene coated fiberglass fabric approximately 152 mm (6 inches) wide. For connections exposed to sun and weather provide hypalon coating in lieu of neoprene. Burning characteristics shall conform to NFPA 90A. Securely fasten flexible connections to round ducts with stainless-steel or zinc-coated iron draw bands with worm gear fastener. For rectangular connections, crimp fabric to sheet metal and fasten sheet metal to ducts by screws 50 mm (2 inches) on center. Fabric shall not be stressed other than by air pressure. Allow at least 25 mm (one inch) slack to ensure that no vibration is transmitted.

2.9 PREFABRICATED ROOF CURBS

A. Galvanized steel or extruded aluminum 305 mm (12 inches) above finish roof service, continuous welded corner seams, treated wood nailer, 38 mm (1-1/2 inch) thick, 48 kg/cubic meter (3 pound/cubic feet) density rigid mineral fiberboard insulation with metal liner, built-in cant strip (except for gypsum or tectum decks). For surface insulated roof deck, provide raised cant strip (recessed mounting flange) to start at the upper surface of the insulation. Curbs shall be constructed for pitched roof or ridge mounting as required to keep top of curb level.

2.10 FIRESTOPPING MATERIAL

A. Refer to Section 07 84 00, FIRESTOPPING.

2.11 SEISMIC RESTRAINT FOR DUCTWORK

A. Refer to Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

2.12 DUCT MOUNTED THERMOMETER (AIR)

A. Stem Type Thermometers: ASTM E1, 7 inch scale, red appearing mercury, lens front tube, cast aluminum case with enamel finish and clear glass or polycarbonate window, brass stem, 2 percent of scale accuracy to ASTM E77 scale calibrated in degrees Fahrenheit.

B. Thermometer Supports:

1. Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.
2. Flange: 75 mm (3 inch) outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

2.13 DUCT MOUNTED TEMPERATURE SENSOR (AIR)

A. Refer to Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

2.14 INSTRUMENT TEST FITTINGS

A. Manufactured type with a minimum 50 mm (2 inch) length for insulated duct, and a minimum 25 mm (1 inch) length for duct not insulated. Test hole shall have a flat gasket for rectangular ducts and a concave gasket for round ducts at the base, and a screw cap to prevent air leakage.

B. Provide instrument test holes at each duct or casing mounted temperature sensor or transmitter, and at entering and leaving side of each heating coil, cooling coil, and heat recovery unit.

2.15 AIR FLOW CONTROL VALVES (AFCV)

A. Refer to Section 23 36 00, AIR TERMINAL UNITS and Section 23 82 00, CONVECTION HEATING and COOLING UNITS.

PART 3 - EXECUTION

3.1 INSTALLATION

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

B. Comply with provisions of Section 23 05 11, COMMON WORK RESULTS FOR HVAC, particularly regarding coordination with other trades and work in existing buildings.

C. Fabricate and install ductwork and accessories in accordance with referenced SMACNA Standards:

1. Contract documents show the general layout of ductwork and accessories but do not show all required fittings and offsets that

may be necessary to connect ducts to equipment, boxes, diffusers, grilles, etc., and to coordinate with other trades. Fabricate ductwork based on field measurements. Provide all necessary fittings and offsets at no additional cost to the Government. Coordinate with other trades for space available and relative location of HVAC equipment and accessories on ceiling grid. Duct sizes in the contract documents are inside dimensions which shall be altered by Contractor to other dimensions with the same air handling characteristics where necessary to avoid interferences and clearance difficulties.

2. Provide duct transitions, offsets and connections to dampers, coils, and other equipment in accordance with SMACNA Standards. Provide streamliner, when an obstruction cannot be avoided and must be taken in by a duct. Repair galvanized areas with galvanizing repair compound.
3. Provide bolted construction and tie-rod reinforcement in accordance with SMACNA Standards.
4. Construct casings, eliminators, and pipe penetrations in accordance with SMACNA Standards. Design casing access doors to swing against air pressure so that pressure helps to maintain a tight seal.

D. Install duct hangers and supports in accordance with SMACNA Standards.

E. Install fire dampers and smoke dampers in accordance with the manufacturer's instructions to conform to the installation used for the rating test. Install fire dampers and smoke dampers at locations indicated and where ducts penetrate fire rated and/or smoke rated walls, shafts and where required by the COR. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges per UL and NFPA. Demonstrate resetting of fire dampers and operation of smoke dampers to the COR.

F. Seal openings around duct penetrations of floors and fire rated partitions with fire stop material as required by NFPA 90A.

G. Flexible Duct Installation: Refer to SMACNA Standards. Ducts shall be continuous, single pieces not over 1.5 m (5 feet) long per NFPA 90A, as straight and short as feasible, adequately supported. Centerline radius of bends shall be not less than two duct diameters. Make connections

with clamps as recommended by SMACNA. Clamp per SMACNA with one clamp on the core duct and one on the insulation jacket. Flexible ducts shall not penetrate floors, or any chase or partition designated as a fire or smoke barrier, including corridor partitions fire rated one hour or two hours. Support ducts SMACNA Standards.

H. Where diffusers, registers and grilles cannot be installed to avoid seeing inside the duct, paint the inside of the duct with flat black paint to reduce visibility.

I. Control Damper Installation:

1. Provide necessary blank-off plates required to install dampers that are smaller than duct size. Provide necessary transitions required to install dampers larger than duct size.
2. Assemble multiple sections dampers with required interconnecting linkage and extend required number of shafts through duct for external mounting of damper motors.
3. Provide necessary sheet metal baffle plates to eliminate stratification and provide air volumes specified. Locate baffles by experimentation, and affix and seal permanently in place, only after stratification problem has been eliminated.
4. Install all damper control/adjustment devices on stand-offs to allow complete coverage of insulation.

J. Air Flow Measuring Devices: Install units with minimum straight run distances, upstream and downstream as recommended by the manufacturer.

K. Low Pressure Duct Liner: Install in accordance with SMACNA Standards.

L. Protection and Cleaning: Adequately protect equipment and materials against physical damage. Place equipment in first class operating condition or return to source of supply for repair or replacement, as determined by COR. Protect equipment and ducts during construction against entry of foreign matter to the inside and clean both inside and outside before operation and painting. When new ducts are connected to existing ductwork, clean both new and existing ductwork by mopping and vacuum cleaning inside and outside before operation.

3.2 DUCT LEAKAGE TESTS AND REPAIR

A. Ductwork leakage testing shall be performed by the Testing and Balancing Contractor directly contracted by the General Contractor and independent of the Sheet Metal Contractor.

B. Ductwork leakage testing shall be performed for the entire air distribution system (including all supply, return, exhaust and relief ductwork), section by section, including fans, coils and filter sections. Based upon satisfactory initial duct leakage test results, the scope of the testing may be reduced by the COR on ductwork constructed to the 500 Pa (2 inches WG) duct pressure classification. In no case shall the leakage testing of ductwork constructed above the 500 Pa (2 inches WG) duct pressure classification or ductwork located in shafts or other inaccessible areas be eliminated.

C. Test procedure, apparatus and report shall conform to SMACNA HVAC Air Duck Leakage Test Manual. The maximum leakage rate allowed is 4 percent of the design air flow rate.

D. All ductwork shall be leak tested first before enclosed in a shaft or covered in other inaccessible areas.

E. All tests shall be performed in the presence of the COR and the Test and Balance agency. The Test and Balance agency shall measure and record duct leakage and report to the COR and identify leakage source with excessive leakage.

F. If any portion of the duct system tested fails to meet the permissible leakage level, the Contractor shall rectify sealing of ductwork to bring it into compliance and shall retest it until acceptable leakage is demonstrated to the COR.

G. All tests and necessary repairs shall be completed prior to insulation or concealment of ductwork.

H. Make sure all openings used for testing flow and temperatures by TAB Contractor are sealed properly.

3.3 DUCTWORK EXPOSED TO WIND VELOCITY

A. Provide additional support and bracing to all exposed ductwork installed on the roof or outside the building to withstand wind velocity of 145 km/h (9140mph).

3.4 TESTING, ADJUSTING, AND BALANCING (TAB)

A. Refer to Section 23 05 93, TESTING, ADJUSTING, and BALANCING FOR HVAC.

3.5 OPERATING AND PERFORMANCE TESTS

A. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

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03-01-23

SECTION 23 34 00
HVAC FANS

PART 1 - GENERAL

1.1 DESCRIPTION

A. A complete listing of common acronyms and abbreviations are included in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. Fans for heating, ventilating and air conditioning.

C. Product Definitions: AMCA 99.

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.

D. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

E. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

F. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

G. Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC and STEAM GENERATION EQUIPMENT.

H. Section 23 05 41, NOISE and VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT.

I. Section 23 05 93, TESTING, ADJUSTING, and BALANCING FOR HVAC.

J. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

K. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

L. Section 23 82 16, AIR COILS.

1.3 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Where conflicts occur these specifications and the VHA standards will govern.

B. Air Movement and Control Association International, Inc. (AMCA):

99-2016.....Standards Handbook

210-2016.....Laboratory Methods of Testing Fans for Aerodynamic Performance Rating

300-2014.....Reverberant Room Method for Sound Testing of Fans

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

B117-2019.....Standard Practice for Operating Salt Spray (Fog) Apparatus

D1735-2014.....Standard Practice for Testing Water Resistance of Coatings Using Water Fog Apparatus

D3359-2017.....Standard Test Methods for Rating Adhesion by Tape Test

G152-2013(R2021).....Standard Practice for Operating Open Flame Carbon Arc Light Apparatus for Exposure of NonMetallic Materials

G153-2013(R2021).....Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of NonMetallic Materials

D. National Fire Protection Association (NFPA):

NFPA 96-2021.....Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations

E. National Sanitation Foundation (NSF):

37-2020 .....Air Curtains for Entranceways in Food and Food Service Establishments

F. Underwriters Laboratories, Inc. (UL):

181-2013.....Standard for Factory-Made Air Ducts and Air Connectors

1.4 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 23 XX XX, SECTION TITLE", with applicable paragraph identification.

C. Manufacturers 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. Plenum fan, motors, and drives.
2. Centrifugal fans, motors, drives, accessories, and coatings.
   a. Inline centrifugal fans.
   b. Tubular Centrifugal Fans.

c. Up-blast kitchen hood exhaust fans.

d. Industrial fans.

e. Utility fans and vent sets.

3. Power roof and wall ventilators.

4. Centrifugal ceiling fans.

5. Propeller fans.

6. Packaged hood make-up air units.

7. Vane axial fans.

8. Tube-axial fans.

9. Air curtain units.

10. Belt guards.

D. Certified sound power levels for each fan.

E. Motor ratings, types, electrical characteristics, and accessories.

F. Certified fan performance curves for each fan showing cubic feet per minute (CFM) versus static pressure, efficiency, and horsepower for design point of operation.

G. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replaceable parts, and troubleshooting guide:

1. Include complete list indicating all components of the systems.

2. Include complete diagrams of the internal wiring for each item of equipment.

3. Diagrams shall have their terminals identified to facilitate installation, operation, and maintenance.

H. 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 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

I. Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

1.5 QUALITY ASSURANCE

A. Fans and power ventilators shall bear the AMCA performance seal.

B. Operating Limits for Centrifugal Fans: AMCA 99 (Class I, II, and III).

C. Fans and power ventilators shall comply with the following standards:

1. Testing and Rating: AMCA 210.

2. Sound Rating: AMCA 300.

D. Vibration Tolerance for Fans and Power Ventilators: Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT.

E. Performance Criteria:

1. The fan schedule shall show the design air volume and static pressure. Select the fan motor hp by increasing the fan bhp by 10 percent to account for the drive losses and field conditions.
2. Select the fan operating point as follows:
   a. Forward Curve and Axial Flow Fans: Right hand side of peak pressure point.
   b. Air Foil, Backward Inclined, or Tubular: At or near the peak static efficiency.

F. Safety Criteria: Provide manufacturer's standard screen on fan inlet and discharge where exposed to operating and maintenance personnel.

G. Corrosion Protection:

1. Except for fans in fume hood exhaust service, all steel shall be mill-galvanized, or phosphatized and coated with minimum two coats, corrosion resistant enamel paint. Manufacturer’s paint and paint system shall meet the minimum requirements of ASTM D1735 water fog, ASTM B117 salt spray, ASTM D3359 adhesion, and ASTM G152 and ASTM G153 for carbon arc light apparatus for exposure of non-metallic material.
2. Fans for general purpose fume hoods, or chemical hoods, and radioisotope hoods shall be constructed of materials compatible with the chemicals being transported in the air through the fan.

H. Spark resistant construction: If flammable gas, vapor or combustible dust is present in concentrations above 20 percent of the Lower Explosive Limit (LEL), the fan construction shall be as recommended by AMCA's Classification for Spark Resistant Construction. Drive set shall be comprised of non-static belts for use in an explosive.

I. 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.

J. Refer to Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS for additional sustainable design requirements.

1.6 AS-BUILT DOCUMENTATION

A. Comply with requirements in paragraph AS-BUILT DOCUMENTATION of Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

1.7 EXTRA MATERIALS

A. Provide one additional set of belts for all belt-driven fans.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL FANS

A. Record factory vibration test results on the fan or furnish to the Contractor.

B. Fan arrangement, unless noted or approved otherwise:

1. DWDl fans: Arrangement 3.
2. SWSl fans: Arrangement 1, 3, 9 or 10, except for fume hood (H7 or H13) exhaust fans Arrangement 3 shall not be acceptable.

C. Construction: Wheel diameters and outlet areas shall be in accordance with AMCA standards.

1. Housing: Low carbon steel, arc welded throughout, braced and supported by structural channel or angle iron to prevent vibration or pulsation, flanged outlet, inlet fully streamlined. Provide lifting clips, and casing drain. Provide manufacturer's standard access door. Provide 13 mm (1/2 inches) wire mesh screens for fan inlets without duct connections.
2. Wheel: Steel plate with die formed blades welded or riveted in place, factory balanced statically and dynamically.
3. Shaft: Designed to operate at no more than 70 percent of the first critical speed at the top of the speed range of the fans class.
4. Bearings: Heavy duty ball or roller type sized to produce a B10 life of not less than 50,000 hours, and an average fatigue life of 200,000 hours. Extend filled lubrication tubes for interior bearings or ducted units to outside of housing.
5. Belts: Oil resistant, non-sparking and non-static.
6. Belt Drives: Factory installed with final alignment belt adjustment made after installation.
7. Motors and Fan Wheel Pulleys: Adjustable pitch for use with motors through 15 hp, fixed pitch for use with motors greater than 15 hp.

Select pulleys so that pitch adjustment is at the middle of the adjustment range at fan design conditions.

8. Motor, adjustable motor base, drive and guard: Furnish from factory with fan. Provide protective sheet metal enclosure for fans located outdoors. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC for specifications.
9. Furnish variable speed fan motor controllers where shown in the contract documents. Refer to Section 26 29 11, MOTOR CONTROLLERS. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC for controller/motor combination requirements.

D. Inline Centrifugal Fans: Provide minimum 18 Gauge galvanized steel housing with inlet and outlet flanges, backward inclined aluminum centrifugal fan wheel, bolted access door and supports as required. Motors shall be factory pre-wired to an external junction box. Provide factory wired disconnect switch.

E. Tubular Centrifugal Fans: Provide hot rolled steel, one-piece design housing incorporating integral guide vanes, motor mounts, bolted access hatch and end flanges. Provide spun inlet bell and screen for unducted inlet and screen for unducted outlet. Provide welded steel, flanged inlet and outlet cones for ducted connection. Provide mounting legs or suspension brackets as required for support. Guide vanes shall straighten the discharge air pattern to provide linear flow.

F. Industrial Fans: Use where scheduled or in lieu of centrifugal fans for low volume high static service. Provide material handling flat blade type fan wheel.

G. Utility Fans, Vent Sets and Small Capacity Fans: Class l design, arc welded housing, spun intake cone. Requirement for AMCA seal is waived for wheel diameters less than 300 mm (l2 inches) and housings may be cast-iron.

H. Spark Resistant/Explosion Proof Fans: If flammable gas, vapor, or combustible dust is present in concentrations above 20 percent of the Lower Explosive Limit (LEL), provide AMCA construction option: A, B or C as indicated. Drive set shall be comprised of non-static belts for use in an explosive atmosphere. Motor shall be explosion proof type if located in air stream.

2.2 POWER ROOF VENTILATOR

A. Type: Centrifugal fan, backward inclined blades. Provide down-blast or up-blast type as indicated.

B. Construction: Steel or aluminum, completely weatherproof, for curb mounting, exhaust cowl or entire drive assembly readily removable for servicing, aluminum bird screen on discharge, UL approved safety disconnect switch, conduit for wiring, vibration isolators for wheel, motor and drive assembly. Provide self-acting back draft damper. Provide electric motor operated damper where indicated.

C. Motor and Drive: Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC. Bearings shall be pillow block ball type with a minimum L-50 life of 200,000 hours. Motor shall be located out of air stream.

D. Up-blast Type: Top discharge exhauster, motor out of air stream. For kitchen hood exhaust applications, provide grease trough on base and threaded drain. The mounting height of the kitchen up-blast exhaust fan shall be in compliance with NFPA 96. (Provide vented curb extension if required to maintain required clearances.)

PART 3 - EXECUTION

3.1 INSTALLATION

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

B. Install fan, motor and drive in accordance with manufacturer's instructions.

C. Align fan and motor sheaves to allow belts to run true and straight.

D. Bolt equipment to curbs with galvanized lag bolts.

E. Install vibration control devices as shown in the contract documents and specified in Section 23 05 41, NOISE and VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT.

3.2 PRE-OPERATION MAINTENANCE

A. Lubricate bearings, pulleys, belts and other moving parts with manufacturer recommended lubricants.

B. Rotate impeller by hand and check for shifting during shipment and check all bolts, collars, and other parts for tightness.

C. Clean fan interiors to remove foreign material and construction dirt and dust.

3.3 STARTUP AND TESTING

A. Verify operation of motor, drive system and fan wheel according to the contract documents.

B. Check vibration and correct as necessary for air balance work.

C. After air balancing is complete and permanent sheaves are in place perform necessary field mechanical balancing to meet vibration tolerance in Section 23 05 41, NOISE and VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT.

D. Perform tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.

E. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.

F. The CxA will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and CxA. Provide a minimum notice of 10 working days prior to startup and testing.

3.3 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

B. Components provided under this section of the specification will be tested as part of a larger system.

3.4 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer’s technical representative for 4 hours to instruct each VA personnel responsible in operation and maintenance of the system.

B. Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

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SECTION 23 36 00
AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 DESCRIPTION

A. A complete listing of common acronyms and abbreviations are included in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. Air terminal units and air flow control valves.

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.

D. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

E. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

F. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

G. Section 23 05 41, NOISE and VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT.

H. Section 23 05 93, TESTING, ADJUSTING, and BALANCING FOR HVAC.

I. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

J. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

K. Section 23 31 00, HVAC DUCTS and CASINGS.

L. Section 23 34 00, HVAC FANS

M. Section 23 82 16, AIR COILS.

1.3 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Where conflicts occur these specifications and the VHA standards will govern.

B. Air Conditioning, Heating, and Refrigeration Institute (AHRI):
880-2017.....Performance Rating of Air Terminals

C. American Society for Testing and Materials (ASTM):
C665-2017.....Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing

D. National Fire Protection Association (NFPA):
90A-2021.....Standard for the Installation of Air-Conditioning and Ventilating Systems

E. Underwriters Laboratories, Inc. (UL):
181-2013(R2017).....Standard for Factory-Made Air Ducts and Air Connectors

F. Department of Veterans Affairs (VA):
PG-18-10-2017(R2020)....HVAC Design Manual

1.4 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 23 XX XX, SECTION TITLE", 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. Air flow control valves.

D. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replaceable parts, and troubleshooting guide:
   1. Include complete list indicating all components of the systems.
   2. Include complete diagrams of the internal wiring for each item of equipment.
   3. Diagrams shall have their terminals identified to facilitate installation, operation, and maintenance.

E. Completed System Readiness Checklist provided by the CxA and completed by the contractor, signed by a qualified technician, and dated on the date of completion, in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

F. Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

1.5 QUALITY ASSURANCE

A. 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. Refer to Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS for additional sustainable design requirements.

1.6 AS-BUILT DOCUMENTATION

A. Comply with requirements in paragraph AS-BUILT DOCUMENTATION of Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

PART 2 - PRODUCTS

2.1 GENERAL

A. Coils:

1. All Air Terminal Units: Provide aluminum fins and copper coils for all hot water reheat coils.
2. Water Heating Coils:
   a. AHRI certified, continuous plate or spiral fin type, leak tested at 2070 kPa (300 psig).
   b. Capacity: As indicated, based on scheduled entering water temperature.
   c. Headers: Copper or Brass.
   d. Fins: Aluminum, maximum 315 fins per meter (8 fins per inch).
   e. Tubes: Copper, arrange for counter-flow of heating water.
   f. Water Flow Rate: Minimum 0.032 Liters/second (0.5 gpm).
   g. Provide vent and drain connection at high and low point, respectively of each coil.
   h. Coils shall be guaranteed to drain.

B. Labeling: Control box shall be clearly marked with an identification label that lists such information as nominal CFM, maximum and minimum factory-set airflow limits, coil type and coil connection orientation, where applicable.

C. Factory-calibrate air terminal units to air flow rate indicated. All settings including maximum and minimum air flow shall be field adjustable.

D. Dampers with internal air volume control, see Section 23 31 00, HVAC DUCTS and CASINGS.

E. Terminal sound attenuators, see Section 23 31 00, HVAC DUCTS and CASINGS.

F. Air terminal performance shall be in compliance with AHRI 880.

2.3 AIR FLOW CONTROL VALVE (AFCV)

A. Airflow control device shall be a venturi valve type air flow control valve.

B. Pressure independent over a 150 Pa - 750 Pa (0.6 inch WG – 3 inch WG) drop across valve.

C. Volume control accurate to plus or minus 5 percent of airflow over an airflow turndown range of 16 to 1. No minimum entrance or exit duct diameters shall be required to ensure accuracy or pressure independence.

D. Response time to change in command signal and duct static pressure within three seconds.

E. 316 stainless-steel continuous welded seam valve body, control device, shaft, shaft support bracket, pivot arm and internal mounting link. The control device shall have a baked on corrosion resistant phenolic coating. The shaft shall have a Teflon coating and all shaft bearing surfaces shall be made of Teflon. The pressure independent springs shall be made of stainless-steel.

F. The airflow device shall have no exposed aluminum or stainless-steel components. The shaft support brackets, pivot arm, internal mounting link, and pressure independent springs shall have a baked-on corrosion resistant phenolic coating. Internal nuts, bolts, and rivets shall be titanium or phenolic coated stainless-steel.

G. Constant Volume Units:

1. Actuator to be factory mounted to the valve.
2. Closed loop control of airflow by way of flow feedback signal with less than 1 second response time.
3. Shaft positioned using direct potentiometer measurement to produce a linear factory calibrated feedback.
4. The maximum and minimum airflows shall be as scheduled.

H. Variable Volume Units:

1. Actuator to be factory mounted to the valve.

2. Closed loop control of airflow by way of flow feedback signal with less than 1 second response time.
3. Shaft positioned using direct potentiometer measurement to produce a linear factory calibrated feedback.

I. Certification:
1. Control Device: Factory calibrated to airflows detailed on plans using NIST traceable air stations and instrumentation having a combined accuracy of plus or minus 1 percent of signal over the entire range of measurement.
2. Electronic Airflow Control Devices: Further calibrated and their accuracy verified to plus or minus 5 percent of signal at a minimum of eight different airflows across the full operating range of the device.
3. All Airflow Control Devices: Individually marked with device specific, factory calibration data to include tag number, serial number, model number, eight point characterization information (for electronic devices), and quality control inspection numbers.

J. Airflow measuring devices and airflow control devices that are not venturi valves (e.g., Pitot tube, flow cross, air bar, orifice ring, vortex shedder, etc.) are acceptable, provided the following conditions are met:
1. They meet the performance and construction characteristics stated throughout this section of the specification.
2. Suppliers of airflow control devices or airflow measuring devices requiring minimum duct diameters shall provide revised duct layouts showing the required straight duct runs upstream and downstream of these devices.
3. Supplier of the airflow control system shall submit coordination drawings reflecting these changes and include static pressure loss calculations as part of submittal.

PART 3 - EXECUTION

3.1 INSTALLATION

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

B. Work shall be installed as shown and according to the manufacturer’s diagrams and recommendations.

C. Handle and install units in accordance with manufacturer's written instructions.

D. Support units rigidly so they always remain stationary. Cross-bracing or other means of stiffening shall be provided as necessary. Method of support shall be such that distortion and malfunction of units cannot occur.

E. Locate air terminal units to provide a straight section of inlet duct for proper functioning of volume controls.

3.2 STARTUP AND TESTING

A. Perform tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.

B. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.

C. The CxA will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and CxA. Provide a minimum notice of 10 working days prior to startup and testing.

3.3 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

B. Components provided under this section of the specification will be tested as part of a larger system.

3.4 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer’s technical representative for 4 hours to instruct each VA personnel responsible in operation and maintenance of the system.

B. Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

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SECTION 23 37 00
AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.1 DESCRIPTION

A. A complete listing of common acronyms and abbreviations are included in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. Air Outlets and Inlets: Diffusers, registers, and grilles.

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.

D. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

E. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

F. Section 23 05 41, NOISE and VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT.

G. Section 23 05 93, TESTING, ADJUSTING, and BALANCING FOR HVAC.

1.3 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Where conflicts occur these specifications and the VHA standards will govern.

B. Air Duct Council:
Flexible Duct Performance & Installation Standards (Manual), 5th Edition
Green Book

C. American Society of Civil Engineers (ASCE):
7-2016.....Minimum Design Loads and Associated Criteria for Buildings and Other Structures

D. American Society for Testing and Materials (ASTM):
B209/B209M-2021.....Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

E. National Fire Protection Association (NFPA):
90A-2021.....Standard for the Installation of Air-Conditioning and Ventilating Systems

F. Underwriters Laboratories, Inc. (UL):
181-2013(R2017).....Standard for Factory-Made Air Ducts and Air Connectors

1.4 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 23 XX XX, SECTION TITLE", 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. Air intake/exhaust hoods.
   2. Diffusers, registers, grilles, and accessories.

D. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replaceable parts, and troubleshooting guide:
   1. Include complete list indicating all components of the systems.
   2. Include complete diagrams of the internal wiring for each item of equipment.
   3. Diagrams shall have their terminals identified to facilitate installation, operation, and maintenance.

1.5 QUALITY ASSURANCE

A. Fire Safety Code: Comply with NFPA 90A.

B. 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.

C. Refer to Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS for additional sustainable design requirements.

1.6 AS-BUILT DOCUMENTATION

A. Comply with requirements in paragraph AS-BUILT DOCUMENTATION of Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

PART 2 - PRODUCTS

2.1 GRAVITY INTAKE/EXHAUST VENTILATORS (ROOF MOUNTED)

A. Aluminum, ASTM B209/B209M, louvered, spun, or fabricated using panel sections with roll-formed edges, 13 mm (1/2 inch) mesh aluminum welded wire bird screen, with gravity or motorized dampers where shown, accessible interior, designed for wind velocity specified in paragraph Intake/Exhaust Hoods Exposed to Wind Velocity in this section.

1. Spun Intake/Exhaust Ventilators: Spun aluminum structural components shall be constructed of minimum 1.6 mm (16 Gauge) marine alloy aluminum, bolted to a rigid aluminum support structure. The aluminum base shall have continuously welded curb cap corners for maximum leak protection. The spun aluminum baffle shall have a rolled bead for added strength.
2. Louvered Intake/Exhaust Hoods: Louvered hood constructed from 0.081 mm (0.003 inch) extruded aluminum tiers welded to a minimum 4.3 mm (8 Gauge) aluminum support structure. The aluminum hood shall be constructed of a minimum 0.064 mm (0.025 inch) marine alloy aluminum and provided with a layer of anti-condensate coating. The aluminum base shall have continuously welded curb cap corners for maximum leak protection.
3. Low Silhouette Intake/Exhaust Ventilator: The unit shall be of bolted and welded construction utilizing corrosion resistant fasteners. The aluminum hood shall be constructed of minimum 1.9 mm (14 Gauge) marine alloy aluminum, bolted to a minimum 4.3 mm (8 Gauge) aluminum support structure. The aluminum base shall have continuously welded curb cap corners for maximum leak protection. Birdscreen constructed of 13 mm (1/2 inch) mesh shall be mounted across the relief opening.

B. See ventilator schedule on the contract drawings. Sizes shown on the contract drawings designate throat size. Area of ventilator perimeter opening shall be not less than the throat area.

C. Dampers for Gravity Ventilators without Duct Connection: Construct damper of the same material as the ventilator and of the design to

completely close opening or remain wide open. Hold damper in closed position by a brass chain and catch. Extend chains 305 mm (12 inches) below and engage catch when damper is closed.

D. See paragraph Intake/Exhaust Hoods Exposed to Wind Velocity in this section for exposure to high wind velocities.

E. Provide roof curb by unit manufacturer. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC for additional requirements.

2.2 EQUIPMENT SUPPORTS

A. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

2.3 AIR OUTLETS AND INLETS

A. Materials:

1. Aluminum. Provide manufacturer's standard gasket.
2. Exposed Fastenings: The same material as the respective inlet or outlet. Fasteners for aluminum may be stainless-steel.
3. Contractor shall review all ceiling drawings and details and provide all ceiling mounted devices with appropriate dimensions and trim for the specific locations.

B. Performance Test Data: In accordance with Air Duct Council “Flexible Duct Performance & Installation Standards (Manual), Green Book”. Refer to Section 23 05 41, NOISE and VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT for NC criteria.

C. Air Supply Outlets:

1. Ceiling Diffusers: Suitable for surface mounting, exposed T-bar or special tile ceilings, off-white finish, square or round neck connection as shown on the contract drawings. Provide plaster frame for units in plaster ceilings.
   a. Square, Louver, Fully Adjustable Pattern: Round neck, surface mounting unless shown otherwise on the contract drawings. Provide equalizing or control grid and volume control damper.
   b. Louver Face Type: Square or rectangular, removable core for 1, 2, 3, or 4 way directional pattern. Provide equalizing or control grid and opposed blade damper.
   c. Perforated Face Type: Manual adjustment for one-, two-, three-, or four-way horizontal air distribution pattern without change of air volume or pressure. Provide equalizing or control grid and opposed blade over overlapping blade damper. Perforated face

diffusers for VAV systems shall have the pattern controller on the inner face, rather than in the neck and designed to discharge air horizontally at the ceiling maintaining a Coanda effect.

d. Slot diffuser/plenum:
   1) Diffuser: Frame and support bars shall be constructed of heavy gauge extruded aluminum. Form slots or use adjustable pattern controllers, to provide stable, horizontal air flow pattern over a wide range of operating conditions.
   2) Galvanized steel boot lined with 13 mm (1/2 inch) thick fiberglass conforming to NFPA 90A and complying with UL 181 for erosion. The internal lining shall be factory-fabricated, anti-microbial, and non-friable.
   3) Provide inlet connection diameter equal to duct diameter shown on the contract drawings or provide transition coupling if necessary. Inlet duct and plenum size shall be as recommended by the manufacturer.
   4) Maximum pressure drop at design flow rate: 37 Pa (0.15 inch WG)

f. Linear Bar Grilles and Diffusers: Extruded aluminum, manufacturer's standard finish, and positive holding concealed fasteners.
   1. Margin Frame: Flat, 19 mm (3/4 inch) wide.
   2. Bars: Minimum 5 mm (3/16 inch) wide by 19 mm (3/4 inch) deep, zero deflection unless otherwise shown. Bar spacing shall be a minimum of 3.2 mm (1/8 inch) on center. Reinforce bars on 457 mm (18 inch) center for sidewall units and on 152 mm (6 inch) center for units installed in floor or sills.
   3. Provide opposed blade damper and equalizing or control grid where shown.

2. Operating Room Air Distribution Devices:
   a. Devices shall consist of a non-aspirating perforated panel center air supply providing downward airflow over the operating table and fixed nonadjustable multiple slot perimeter panels surrounding the operating table area to provide an air curtain which shall be projected outward from the operating table area at not less than a five degree angle nor greater than a 15 degree

angle. Velocity of air distribution at operating table height shall not exceed 12 m/min (40 fpm) for the center supply or 15 m/min (50 fpm) for the air curtain. Perforated pressure plates shall be provided over the perimeter and center air distribution faces to equalize pressure and airflow throughout the system.

b. All components of the system inside the operating room shall be fabricated of 0.95 mm (20 Gauge) thick 18-8 stainless-steel, No. 4 finish, and outside the operating room shall be of the manufacturer’s standard aluminum finish. All distribution components and pressure plates shall be attached to the face panels at both the perimeter and center. The face panels shall be retained with 1/4 turn fasteners. Plenums shall be supplied by the manufacturer and shall be sized to permit them to be easily wiped out by hand with germicidal solution for sterilization purposes and all horizontal corners of the plenums shall have a minimum radius of 19 mm (3/4 inch). Connecting elbows shall be radialized and be sized to permit manual sterilization of the plenums.

3. Supply Registers: Double deflection type with horizontal face bars and opposed blade damper with removable key operator.
   a. Margin: Flat, 32 mm (1-1/4 inches) wide.
   b. Bar Spacing: 19 mm (3/4 inch) maximum.
   c. Finish: Off white baked enamel for ceiling mounted units. Wall units shall have a prime coat for field painting or shall be extruded with manufacturer's standard finish.
4. Supply Grilles: Same as registers but without the opposed blade damper.
5. Drum Louvers: Aluminum construction, drum louver, with pivoted blades and rotating drum to adjust length of throw and direction.
   a. Register shall have integral, face adjustable, opposed blade damper constructed of heavy gauge steel. Damper shall be operable from the face of the register. Units shall be nozzle type with adjustable discharge pattern.
6. Jet Diffusers: Aluminum construction (nozzle and frame) suitable for wall or ceiling mounting or direct mounting on ducts.

D. Return and Exhaust Registers and Grilles: Provide opposed blade damper without removable key operator for registers.
   1. Finish: Off-white baked enamel for ceiling mounted units. Wall units shall have a prime coat for field painting or shall be extruded aluminum with manufacturer's standard aluminum finish.
   2. Standard Type: Fixed horizontal face bars set at 30 to 45 degrees, approximately 32 mm (1-1/4 inch) margin.
   3. Perforated Face Type: To match supply units.
   4. Grid Core Type: 13 mm by 13 mm (1/2 inch by 1/2 inch) core with 32 mm (1-1/4 inch) margin.
   5. Linear Type: To match supply units.
   6. Door Grilles: Are furnished with the doors.
   7. Egg Crate Grilles: Aluminum or Painted Steel 13 mm by 13 mm by 13 mm (1/2 inch by 1/2 inch by 1/2) inch grid providing 90 percent free area.
      a. Heavy extruded aluminum frame shall have countersunk screw mounting. Unless otherwise indicated, register blades and frame shall have factory applied white finish.
      b. Grille shall be suitable for duct or surface mounting as indicated on the contract drawings. All necessary appurtenances shall be provided to allow for mounting.

E. Supply Registers in Psychiatric Rooms: Supply air registers shall be security type, steel with perforated faceplate, flat surface margin, extension sleeve, opposed blade damper and back mounting flanges. Faceplate shall be 5 mm (3/16 inch) minimum with 5 mm by 5 mm holes on 7 mm (3/16 inch by 3/16 inch holes on 9/32 inch) spacing and a minimum free area of 45 percent. Wall sleeve shall be 5 mm (3/16 inch) thick (minimum).

F. Air Inlet Registers in Psychiatric Rooms: Return, exhaust, transfer, and relief air registers shall be security type, steel with perforated faceplate, flat surface margin, wall sleeve, opposed blade damper and back mounting flanges. Faceplate shall be 5 mm (3/16 inch) minimum with 5 mm by 5 mm holes on 7 mm (3/16 inch by 3/16 inch holes on 9/32 inch) spacing and a minimum free area of 45 percent. Wall sleeve shall be 5 mm (3/16 inch) thick minimum.

G. Acoustic Transfer Grille: Aluminum, suitable for partition or wall mounting.

2.4 WIRE MESH GRILLE

A. Fabricate grille with 2 by 2 inch mesh 13 mm (1/2 inch) galvanized steel or aluminum hardware cloth in a spot welded galvanized steel frame with approximately 38 mm (1-1/2 inch) margin.

B. Use grilles where shown in unfinished areas such as mechanical rooms.

2.5 FILTER RETURN/EXHAUST GRILLE

A. Provide grille within stream 25 mm (1 inch) deep MERV 4 filter and removable face.

1. Finish: Off-white baked enamel for ceiling mounted units. Wall units shall have a prime coat for field painting or shall be extruded aluminum with manufacturer's standard aluminum finish. Stainless-steel shall be No. 4 finish.
2. Standard Type: Fixed horizontal face bars set at 30 to 45 degrees, approximately 32 mm (1-1/4 inch) margin.
3. Steel, aluminum, or stainless-steel as scheduled.
4. Standard face connected to a mounting frame with space for a throwaway filter. Hold face closed by a locking screw. Provide retaining clips to hold filter in place. Provide fiberglass throwaway filter.

PART 3 - EXECUTION

3.1 INSTALLATION

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

B. Comply with provisions of Section 23 05 11, COMMON WORK RESULTS FOR HVAC, particularly regarding coordination with other trades and work in existing buildings.

C. Protection and Cleaning: Protect equipment and materials against physical damage. Place equipment in first class operating condition or return to source of supply for repair or replacement, as determined by COR. Protect equipment during construction against entry of foreign matter to the inside and clean both inside and outside before operation and painting.

3.2 INTAKE/EXHAUST HOODS EXPOSED TO WIND VELOCITY

A. Provide additional support and bracing to all exposed ductwork installed on the roof or outside the building to withstand wind velocity of 145 km/h (140 mph)

3.3 TESTING, ADJUSTING, AND BALANCING (TAB)

A. Refer to Section 23 05 93, TESTING, ADJUSTING, and BALANCING FOR HVAC.

3.4 STARTUP AND TESTING

A. Perform tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.

B. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.

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SECTION 23 40 00
HVAC AIR CLEANING DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION

A. A complete listing of common acronyms and abbreviations are included in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. Air filters for heating, ventilating and air conditioning.

C. Definitions: Refer to ASHRAE 52.2 for definitions of face velocity, net effective filtering area, media velocity, initial resistance (pressure drop), MERV (Minimum Efficiency Reporting Value), PSE (Particle Size Efficiency), particle size ranges for each MERV number, dust holding capacity and explanation of electrostatic media based filtration products versus mechanical filtration products. Refer to ASHRAE 52.2 for definition of MERV-A.

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.

D. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

E. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

F. Section 23 37 00, AIR OUTLETS AND INLETS.

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. Where conflicts occur these specifications and the VHA standards will govern.

B. Air-Conditioning, Heating, and Refrigeration Institute (AHRI):
850-2013.....Performance Rating of Commercial and Industrial Air Filter Equipment

C. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE):
52.2-2017.....Method of Testing General Ventilation Air Cleaning Devices for Removal Efficiency by Particle Size
170-2021.....Ventilation of Health Care Facilities

D. American Society of Mechanical Engineers (ASME):
ASME Boiler and Pressure Vessel Code -
BPVC Section IX-2021....Welding, Brazing, and Fusing Qualifications

E. American Welding Society (AWS):
D9.1/D9.1M-2018.....Sheet Metal Welding Code

F. International Organization for Standardization (ISO):
9001-2015(R2021).....Quality Management Systems - Requirements

G. Underwriters Laboratories, Inc. (UL):
586-2009(R2017).....Standard for High-Efficiency, Particulate, Air Filter Units
900-2015.....Standard for Air Filter Units

1.4 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 23 XX XX, SECTION TITLE", 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. Extended surface filters.
   2. Holding frames. Identify locations.
   3. Side access housings. Identify locations, verify insulated doors.
   4. HEPA filters.
   5. Magnehelic gauges.
   6. Carbon Filters.

D. Air Filter performance reports.

E. Suppliers warranty.

F. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replaceable parts, and troubleshooting guide:
   1. Include complete list indicating all components of the systems.
   2. Include complete diagrams of the internal wiring for each item of equipment.

3. Diagrams shall have their terminals identified to facilitate installation, operation, and maintenance.

1.5 QUALITY ASSURANCE

A. Air Filter Performance Report for Extended Surface Filters:

1. Submit a test report for each Grade of filter being offered. The report shall not be more than three (3) years old and prepared by using test equipment, method and duct section as specified by ASHRAE 52.2 for type filter under test and acceptable to COR, indicating that filters comply with the requirements of this specification. Filters utilizing partial or complete synthetic media will be tested in compliance with pre-conditioning steps as stated in ASHRAE 52.2. All testing is to be conducted on filters with a nominal 610 mm by 610 mm (24 inch by 24 inch) face dimension. Test for 150 m/min (500 fpm) will be accepted for lower velocity rated filters provided the test report of an independent testing laboratory complies with all the requirements of this specification.

3. Guarantee Performance: The manufacturer shall supply ASHRAE 52.2 test reports on each filter type submitted. Any filter supplied will be required to maintain the minimum efficiency shown on the ASHRAE 52.2 report throughout the time the filter is in service. Within the first 6 to 12 weeks of service a filter may be pulled out of service and sent to an independent laboratory for ASHRAE 52.2 testing for initial efficiency only. If this filter fails to meet the minimum level of efficiency shown in the previously submitted reports, the filter manufacturer/distributor shall take back all filters and refund the owner all monies paid for the filters, cost of installation, cost of freight and cost of testing.

B. Filter Warranty for Extended Surface Filters: Guarantee the filters against leakage, blow-outs, and other deficiencies during their normal useful life, up to the time that the filter reaches the final pressure drop. Defective filters shall be replaced at no additional cost or time to the Government.

C. Comply with UL 900 for flame test.

D. Nameplates: Each filter shall bear a label or name plate indicating manufacturer's name, filter size, rated efficiency, UL classification , and file number.

E. 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.

F. Refer to Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS for additional sustainable design requirements.

1.6 AS-BUILT DOCUMENTATION

A. Comply with requirements in paragraph AS-BUILT DOCUMENTATION of Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

PART 2 - PRODUCTS

2.1 REPLACEMENT FILTER ELEMENTS TO BE FURNISHED

A. To allow temporary use of HVAC systems for testing and in accordance with Paragraph, TEMPORARY USE OF MECHANICAL AND ELECTRICAL SYSTEMS in Section 01 00 00, GENERAL REQUIREMENTS. Provide one complete set of additional filters to the COR.

B. The COR will direct whether these additional filters will either be installed as replacements for dirty units or turned over to VA for future use as replacements.

2.2 EXTENDED SURFACE AIR FILTERS

A. Use factory assembled air filters of the extended surface type with supported or non-supported cartridges for removal of particulate matter in air conditioning, heating and ventilating systems. Filter units shall be of the extended surface type fabricated for disposal when the contaminant load limit is reached as indicated by maximum (final) pressure drop.

B. Filter Classification: UL listed and approved conforming to UL 900.

C. HVAC Filter Types:

HVAC Filter Types				
MERV Value ASHRAE 52.2		Application	Particle Size	Thickness /Type
8		Pre-Filter	3 to 10 Microns	50 mm (2 inch) Throwaway
11		After-Filter	1 to 3 Microns	152 mm (6 inch) or 305 mm (12

				inch) Rigid Cartridge
13		(Alternate) After-Filter	0.3 to 1 Microns	152 mm (6 inch) or 305 mm (12 inch) Rigid Cartridge
14		After-Filter	0.3 to 1 Microns	152 mm (6 inch) or 305 mm (12 inch) Rigid Cartridge

D. HEPA Filters:

HEPA Filters				
Efficiency at 0.3 Micron	Application	Initial Resistance (inches WG)	Rated cfm	Construction
99.97	Final Filter	1.35	1100	Galvanized Frame X-Body
99.97	Final Filter	1.00	2000	Aluminum Frame V-Bank

2.3 MEDIUM EFFICIENCY PLEATED PANEL PRE-FILTERS (50 MM (2 INCH); MERV 8; UL 900 CLASS 2)

A. Construction: Air filters shall be medium efficiency ASHRAE pleated panels consisting of cotton and synthetic or 100 percent virgin synthetic media, self-supporting media with required media stabilizers, and beverage board enclosing frame. Filter media shall be lofted to a uniform depth and formed into a uniform radial pleat. The media stabilizers shall be bonded to the downstream side of the media to maintain radial pleats and prevent media oscillation. An enclosing frame of no less than 28-point high wet-strength beverage board shall provide a rigid and durable enclosure. The frame shall be bonded to the media on all sides to prevent air bypass. Integral diagonal support members on the air entering and air exiting side shall be bonded to the apex of each pleat to maintain uniform pleat spacing in varying airflows.

B. Performance: The filter shall have a Minimum Efficiency Reporting Value of MERV 8 when evaluated under the guidelines of ASHRAE 52.2. The media shall maintain or increase in efficiency over the life of the filter. All testing is to be conducted on filters with a nominal 610 mm by 610 mm (24 inch by 24 inch) face dimension.

Minimum Efficiency Reporting (MERV)	8
Dust Holding Capacity (Grams)	105
Nominal Size (Inches Width x Height x Depth)	24x24x2
Rated Air Flow Capacity (cfm)	2,000
Rated Air Flow Rate (fpm)	500
Final Resistance (Inches WG) Maximum Recommended Change-Out Resistance (Inches WG)	1.0 0.66
Rated Initial Resistance (Inches WG)	0.33

C. The filters shall be approved and listed by Underwriters Laboratories, Inc. as Class 2 when tested according to UL 900.

2.4 HIGH EFFICIENCY EXTENDED SURFACE (INTERMEDIATE/AFTER (FINAL)) CARTRIDGE FILTERS (305 MM (12 INCH); MERV 14/13/11; UL 900 CLASS 2)

A. Construction: Air filters shall consist of 8 pleated media packs assembled into 4 V-banks within a totally plastic frame. The filters shall be capable of operating at temperatures up to 80 degrees C (176 degrees F). The filters shall either fit without modification or be adaptable to the existing holding frames. The molded end panels are to be made of high impact polystyrene plastic. The center support members shall be made of ABS plastic. No metal components are to be used.

B. Media: The media shall be made of micro glass fibers with a water repellent binder. The media shall be a dual density construction, with coarser fibers on the air entering side and finer fibers on the air leaving side. The media shall be pleated using separators made of continuous beads of low profile thermoplastic material. The media packs shall be bonded to the structural support members at all points of contact, this improves the rigidity as well as eliminates potential air bypass in the filter.

C. Performance: Filters of the size, air flow capacity and nominal efficiency (MERV) shall meet the following rated performance specifications based on the ASHRAE 52.2 test method. All testing is to be conducted on filters with a nominal 610 mm by 610 mm (24 inch by 24 inch) header dimension.

Minimum Efficiency Reporting Value (MERV)	14	13	11
Gross Media Area (sf) Dust Holding Capacity (Grams)	197 486	197 430	197 465
Nominal Size (Inches Width x Height x Depth)	24x24x12	24x24x12	24x24x12
Rated Air Flow Capacity (cfm)	2,000	2,000	2,000
Rated Air Flow Rate (fpm)	500	500	500
Final Resistance (Inches WG) Maximum Recommended Change-Out Resistance (Inches WG)	2.0 0.74	2.0 0.68	2.0 0.54
Rated Initial Resistance (Inches WG)	0.37	0.34	0.27

2.5 HIGH EFFICIENCY PARTICULATE AIR (HEPA) FILTERS STANDARD CAPACITY (FINAL FILTER APPLICATION)

A. Air filters shall be HEPA grade standard capacity air filters with waterproof micro glass fiber media, corrugated aluminum separators, urethane sealant, 1.6 mm (16 gauge) steel enclosing frame and fluid sealing gasket. Sizes shall be as noted on enclosed drawings or other supporting materials.

B. Construction: Filter media shall be one continuous pleating of microfine glass fiber media. Pleats shall be uniformly separated by corrugated aluminum separators incorporating a hemmed edge to prevent damage to the media. The media pack shall be potted into the enclosing frame with a fire-retardant urethane sealant. The enclosing frame shall be of 1.6 mm (16 gauge) steel, with a zinc aluminum alloy finish, and shall be bonded to the media pack to form a rugged and durable enclosure. The filter shall be assembled without the use of fasteners to ensure no frame penetrations. Overall dimensional tolerance shall be correct within -3.2 mm (-1/8 inch), +0 mm (+0 inch), and square within 3.2 mm (1/8 inch). A poured-in-place seamless sealing gasket shall be included on the downstream side of the enclosing frame to form a positive seal upon installation.

C. Performance: The filter shall have a tested efficiency of 99.97 percent when evaluated according to IEST Recommended Practice. Initial resistance to airflow shall not exceed 250 Pa (1 inch WG) at rated

capacity. Filter shall be listed by Underwriters Laboratories as UL 900. The filter shall be capable of withstanding 2500 Pa (10 inches WG) without failure of the media pack. Manufacturer shall provide evidence of facility certification to ISO 9001.

HEPA Performance (Standard Capacity)		
Nominal Size (Inches Height x Width x Depth)	Airflow Capacity (cfm)	Media Area (sf)
24x24x12	1080 at 1 Inch WG	153
24x12x12	500 at 1 Inch WG	33
Follow manufacturer’s recommendation for change out resistance, typically double the initial.		

D. Supporting Data: The filter shall be labeled as to tested efficiency, rated/tested cfm, pressure drop and shall be serialized for identification. The manufacturer shall supply a Certificate of Conformance for each HEPA filter supplied to the facility.

2.6 HEPA FILTERS HIGH CAPACITY V-BANK HIGH CAPACITY FILTERS (FINAL FILTER APPLICATION)

A. Air filters shall be absolute grade HEPA filters consisting of pleated media packs assembled in a V-bank configuration, polyurethane sealant, anodized aluminum enclosure and seamless fluid sealing gasket. Sizes shall be as noted on enclosed drawings or other supporting materials.

B. Construction: Filter media shall be micro fiber glass formed into mini-pleat pleat-in-pleat V-bank design. The media packs shall be potted into the enclosing frame with fire retardant polyurethane sealant. An enclosing frame of anodized extruded aluminum shall form a rugged and durable enclosure. A seamless sealing gasket shall be included on the downstream side of the filter to form a positive seal upon installation.

C. Performance: Filter efficiency at 0.3 micron shall be 99.99 percent when evaluated according to the IEST Recommended Practice for applicable type. Each filter shall be labeled as to tested performance. Initial resistance target shall not exceed 250 Pa (1 inch WG) at rated airflow.

HEPA Performance V-Bank Style (High Capacity)		
Nominal Size (Inches	Airflow Capacity	Media Area

Height x Width x Depth)	(cfm)	(sf)
24x24x12	2000 at 1 Inch WG	390
24x12x12	900 at 1 Inch WG	174
Follow manufacturer's recommendation for change out resistance, typically double the initial.		

D. Supporting Data: The filter shall be labeled as to tested efficiency, rated/tested cfm, pressure drop and shall be serialized for identification. The manufacturer shall supply a Certificate of Conformance for each HEPA filter supplied to the facility.

E. Filter shall be listed as UL 586 and UL 900 per Underwriters Laboratories. Manufacturer shall provide evidence of facility certification to ISO 9001.

2.7 FILTER HOUSINGS/SUPPORT FRAMES

A. Side Servicing Housings (HVAC Grade):

1. Filter housing shall be two-stage filter system consisting of 1.6 mm (16 gauge) galvanized steel enclosure, aluminum filter mounting track, universal filter holding frame, insulated dual-access doors, static pressure tap, filter gaskets and seals. Inline housing depth shall not exceed 533 mm (21 inches). Sizes shall be as noted on enclosed drawings or other supporting materials.

2. Construction: The housing shall be constructed of 1.6 mm (16 gauge) galvanized steel with pre-drilled standing flanges to facilitate attachment to other system components. Corner posts of Z-channel construction shall ensure dimensional adherence. Where installed outdoors, the housing shall be weatherproof and suitable for rooftop/outdoor installation. The housing shall incorporate the capability of two stages of filtration without modification to the housing. A filter track, of aluminum construction shall be an integral component of housing construction. The track shall accommodate a 50 mm (2 inch) deep prefilter, a 152 mm (6 inch) or 305 mm (12 inch) deep rigid final filter, or a pocket filter with header. Insulated dual access doors, swing-open type, shall include high-memory sponge neoprene gasket to facilitate a door-to-filter seal. Each door shall be equipped with adjustable and replaceable positive sealing UV-resistant star-style knobs and replaceable door

hinges. A universal holding frame constructed of 1.3 mm (18 gauge) galvanized steel, equipped with centering dimples, multiple fastener lances, and polyurethane filter sealing gasket, shall be included to facilitate installation of high-efficiency filters. The housing shall include a pneumatic pressure fitting to allow the installation of a static pressure gauge to evaluate pressure drop across a single filter or any combination of installed filters.

3. Performance: Leakage at rated airflow, upstream to downstream of filter, holding frame, and slide mechanism shall be less than 1 percent at 750 Pa (3 inches WG). Leakage in to or out of the housing shall be less than one half of 1 percent at 750 Pa (3 inches WG). Accuracy of pneumatic pressure fitting, when to evaluate a single-stage, or multiple filter stages, shall be accurate within ± 3 percent at 150 Pa (0.6 inch WG).
4. Manufacturer shall provide evidence of facility certification to ISO 9001.

B. Holding Frame System (HVAC Grade):

1. Air filter-holding frames shall be 1.6 mm (16 gauge) galvanized steel with filter sealing flange, centering dimples, sealing gasket and lances for appropriate air filter fasteners. Sizes shall be as noted on enclosed drawings or other supporting materials.
2. Construction: Filter holding frame shall be constructed of 1.6 mm (16 gauge) galvanized steel. The frame shall be assembled from two corner sections and welded to assure a rigid and durable frame assembly. The frame shall include a variety of pre-punched lances for filter fastener attachment. Fastener shall be capable of being installed without the use of tools, nuts or bolts. Lance penetrations shall be upstream of filter flange to assure leak-free integrity. The frame shall include filter-centering dimples on each frame wall to facilitate ease of filter installation and assure filter centering against filter sealing flange. A 19 mm (3/4 inch) filter-sealing flange shall be an integral component of the holding frame. All corners shall be flush mitered and a permanently mounted polyurethane foam gasket shall be mounted on the sealing flange to assure filter to frame sealing integrity.

3. Manufacturer shall provide evidence of facility certification to ISO 9001.

C. Side-Access Housing (HEPA Grade):

1. Filter housing shall be two-stage filter system consisting of 1.9 mm (14 gauge) galvanized steel enclosure, spring-loaded crank-type sealing assembly for gasket seal type final filters, insulated dual-access doors with gasketing and positive sealing doorknobs. Inline housing depth shall not exceed 635 mm (25 inches). Sizes shall be as noted on enclosed drawings or other supporting materials.
2. Construction: The housing shall be constructed of 1.9 mm (14 gauge) galvanized steel with mating flanges to facilitate attachment to other system components. All pressure boundaries shall be of all welded construction. The housing shall be weatherproof and suitable for rooftop/outdoor installation. A prefilter track to accommodate nominal 50 mm (2 inch) deep prefilters, shall be an integral component of the housing. The housing shall incorporate a spring-loaded crank-type final filter sealing mechanism. The mechanism shall be geared to exert 700 pounds of pressure against each filter. The clamping frame shall have a continuous flat surface seal to compress all four downstream gasketed surfaces of the downstream seal filter. The final filter locking mechanism shall include a 19 mm (3/4 inch) socket adapter to facilitate opening or closing the mechanism. Insulated dual access doors shall include high-memory sponge neoprene gasket to facilitate a door-to-filter seal. Each door shall be equipped with adjustable and replaceable UV-resistant positive sealing knobs. The access doors shall be both hinged for swing open operation or designed to be completely removable. The housing shall include static pressure ports 3.2 mm (1/8 inch NPT male) to facilitate pressure drop measurements across prefilter, final filter, or combination thereof.
3. Performance: Manufacturer shall provide evidence of facility certification to ISO 9001.

D. Built-Up Bank HEPA Holding Frames:

1. Holding frames shall be constructed of 1.9 mm (14 guage) galvanized steel. Frames shall be welded and include centering dimples, pre-drilled mounting holes, filter sealing flange and swing bolt

assemblies. An appropriate number of swing bolts to match air filters shall also be included. Sizes shall be as noted on enclosed drawings or other supporting materials.

2. Construction: Filter frame shall be all-welded construction of 1.9 mm (14 guage) galvanized steel. The frame shall include pre-drilled mounting holes to align frame-to-frame and ensure built-up bank support. Annular based centering dimples shall be an integral component to assist in proper seating of filter gasket to filter sealing flange. Assembly holes shall be within dimples to recess assembly bolts. Filter securing swing bolt assemblies, of the same construction as the frame, shall be offset to facilitate multiple filter installations. The assembly shall include appropriate swing bolts to match filter depth and equi-bearing clamps to allow uniform filter gasket sealing.
3. Performance: The sealing assembly shall be capable of sealing each element with 1680 mm/kg (30 inch/lbs.) of torque to 50 percent filter gasket compression. Manufacturer shall provide evidence of facility certification to ISO 9001.

E. Bag-In/Bag-Out HEPA Air Filter Housing:

1. Housing shall be side-access bag-in/bag-out, fluid seal housing. The housing shall be adequately reinforced to withstand a negative or positive pressure of 3736 Pa (15 inches WG). Housing design and filter arrangement shall allow air to enter and exit housing without changing direction. The housing shall accommodate standard size filters that do not require any special attachments or devices to function properly in the housing. The housing shall accommodate fluid seal filters which require a penetrating knife edge installed on all filter sealing surfaces. The knife edge shall insert into the fluid filled perimeter channel located on the face of the filter. By engaging the filter seal/release mechanism the filter shall move (push) the fluid filled channel to the sealed position. For removal of the air filters the filter seal/release mechanism shall remove (pull) the filter free of the blade type knife edge. This entire process is performed from inside the filter change out bag.
2. Construction:

a. Housing shall be constructed of 1.9 mm (14 gauge) and 3.2 mm (11 gauge) T-304 stainless-steel metal. All pressure retaining joints and seams shall be continuously welded with no porosities. Joints and seams requiring intermittent welds, such as reinforcement members, shall be intermittently welded. Housing shall be free of burrs and sharp edges. All weld joints and seams that are a portion of any gasket setting surface, and duct connection flanges, shall be ground smooth and flush with adjacent base metals. All welded joints and seams shall be wire brushed to remove heat discoloration. The housing shall be reinforced to withstand a positive or negative pressure of 3736 Pa (15 inches WG). The upstream and downstream ductwork connections shall have 38 mm (1-1/2 inch) outward-turned flanges.
b. The housing shall have a bagging ring around each filter access port that is sealed by a gasketed filter access door. The filter access door gasket shall be silicone and shall be replaceable, if necessary. The bagging ring shall have two (2) continuous formed raised ridges to secure the PVC change-out bag. The bagging ring shall be hemmed on the outer edge to prevent the change-out bag from tearing.
c. Ancillary hardware including filter seal/release mechanism, door handles, door studs and labels shall be 300 series stainless-steel. Filter access door knobs shall be cast aluminum and designed to prevent galling of threads.
d. One (1) PVC change-out bag shall be furnished with each filter access port. Change-out bags shall be 8-mil. thick with a yellow translucent, non-sticking, matte finish. It shall include a 6 mm (1/4 inch) diameter elastic shock cord hemmed into the opening of the bag so when stretched around the housing bagging ring flange, a secure fit is created. The bag shall include three (3) integral glove ports to assist in filter change-out. One (1) nylon security strap shall be included per filter access port to prevent the bag from sliding off the bagging flange during the change-out process. Design of components shall be such that all change-out operations shall be within the bag so there is a barrier between the worker and the filter at all times.

3. Performance: All welding procedures, welders, and welder operators shall be qualified in accordance with ASME BPVC Section IX. All production welds shall be visually inspected by qualified personnel, incorporating the workmanship acceptance criteria described in AWS D9.1/D9.1M.
4. The filter housing shall be factory tested for filter fit, alignment of filter sealing knife edge and operation of filter clamping mechanism. The filter sealing surface shall be tested at +2500 Pa (+10 inches WG) and have a maximum leak rate of 0.0005 cfm per cubic foot of housing volume. The overall system pressure boundary shall be leak tested at +2500 Pa (+15 inches WG) and have a maximum leak rate of 0.0005 cfm per cubic foot of housing volume.
5. Filter bags shall be capable of continuous operating to temperature extremes of -18°C to 65°C (0°F to 150°F).
6. Multi-wide housing shall be equipped with a filter removal rod to pull the filters to the change-out position. The removal rod shall operate from the inside of the filter change out bag.
7. Manufacturer shall provide evidence of facility certification to ISO 9001.

F. Equipment Identification: Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

2.8 INSTRUMENTATION

A. Magnehelic Differential Pressure Filter Gauges: Nominal 100 mm (4 inch) diameter, 0 to 500 Pa (0 to 2 inches WG), 3 inch for HEPA range, except for MERV 17 HEPA final filters, where the range shall be 0 to 750 Pa (0 to 3 inches WG). Gauges shall be flush-mounted in aluminum panel board, complete with static tips, copper or aluminum tubing, and accessory items to provide zero adjustment.

B. DDC Static (Differential) Air Pressure Measuring Station: Refer to Section 23 09 23, DIRECT DIGITAL CONTROL SYSTEM FOR HVAC.

C. Provide one DDC sensor across each extended surface filter. Provide Petcocks for each gauge or sensor.

D. Provide one common filter gauge for two-stage filter banks with isolation valves to allow differential pressure measurement.

PART 3 – EXECUTION

3.1 INSTALLATION

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

B. Install supports, filters, and gauges in accordance with manufacturer's instructions.

C. Label clearly with words "Contaminated Air" on exhaust ducts leading to the HEPA filter housing.

3.2 STARTUP AND TESTING

A. Clean and vacuum air handling units and plenums prior to starting air handling systems.

B. Replace pre-filters and install clean filter units prior to final inspection as directed by the COR.

C. Perform tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.

D. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.

E. The CxA will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and CxA. Provide a minimum notice of 10 working days prior to startup and testing.

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SECTION 23 82 16
AIR COILS

PART 1 - GENERAL

1.1 DESCRIPTION

A. A complete listing of common acronyms and abbreviations are included in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. Heating and cooling coils for air handling units and duct applications.

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.

D. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

E. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

F. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

G. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

H. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEMS for HVAC.

I. Section 23 31 00, HVAC DUCTS AND CASINGS.

J. Section 23 36 00, AIR TERMINAL UNITS

1.3 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Where conflicts occur these specifications and the VHA standards will govern.

B. Air Conditioning and Refrigeration Institute (AHRI):
Directory of Certified Applied Air Conditioning Products
AHRI 410-2001.....Forced-Circulation Air-Cooling and Air-Heating Coils

C. American Society for Testing and Materials (ASTM):
B75/75M-2020.....Standard Specifications for Seamless Copper Tube

D. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE):
15-2019.....Safety Standard for Refrigeration Systems
34-2022.....Designation and Classification of Refrigerants (ANSI)

D. National Electric Manufacturers Association (NEMA):
250-2020.....Enclosures for Electrical Equipment (1,000 Volts Maximum)

E. National Fire Protection Association (NFPA):
70-2020.....National Electric Code

F. Underwriters Laboratories, Inc. (UL):
1996-2021.....Electric Duct Heaters

G. Department of Veterans Affairs (VA):
PG-18-10-2017(R2023)....HVAC Design Manual

1.4 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 23 XX XX, SECTION TITLE", 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. Submit type, size, arrangements, and performance details. Present application ratings in the form of tables, charts, or curves.

D. Provide installation, operating and maintenance instructions.

E. Certification Compliance: Evidence of listing in current AHRI Directory of Certified Applied Air Conditioning Products.

F. Coils may be submitted with Section 23 36 00, AIR TERMINAL UNITS, Section 23 73 00, INDOOR CENTRAL-STATION AIR-HANDLING UNITS.

G. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replaceable parts, and troubleshooting guide:

1. Include complete list indicating all components of the systems.
2. Include complete diagrams of the internal wiring for each item of equipment.
3. Diagrams shall have their terminals identified to facilitate installation, operation, and maintenance.

H. 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 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

I. Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

1.5 QUALITY ASSURANCE

A. Refer to paragraph QUALITY ASSURANCE of Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. Unless specifically exempted by these specifications, heating and cooling coils shall be tested, rated, and certified in accordance with AHRI 410 and shall bear the AHRI certification label.

C. 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.

D. Refer to Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS for additional sustainable design requirements.

1.6 AS-BUILT DOCUMENTATION

A. Comply with requirements in paragraph AS-BUILT DOCUMENTATION of Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

PART 2 - PRODUCTS

2.1 HEATING AND COOLING COILS

A. Conform to ASTM B75/75M and AHRI 410.

B. Tubes: Minimum 16 mm (0.625 inch) tube diameter; Seamless copper tubing.

C. Fins: 0.1397 mm (0.0055 inch) aluminum or 0.1143 mm (0.0045 inch) copper mechanically bonded or soldered or helically wound around tubing.

D. Headers: Copper, welded steel or cast-iron. Provide seamless copper tubing or resistance welded steel tube for volatile refrigerant coils.

E. "U" Bends, Where Used: Machine die-formed, silver brazed to tube ends.

F. Coil Casing: 1.6 mm (16 gauge) galvanized steel with tube supports at 1219 mm (48 inch) maximum spacing. Construct casing to eliminate air bypass and moisture carry-over. Provide duct connection flanges.

G. Pressures kPa (PSIG):

Pressure	Water Coil		Refrigerant Coil
Test	2070 (300)		2070 (300)
Working	1380 (200)		1724 (250)

H. Protection: Unless protected by the coil casing, provide cardboard, plywood, or plastic material at the factory to protect tube and finned surfaces during shipping and construction activities.

I. Vents and Drain: Coils that are not vented or drainable by the piping system shall have capped vent/drain connections extended through coil casing.

2.2 REHEAT COILS, DUCT MOUNTED

A. The coils shall be continuous circuit booster type for hot water as shown in contract documents. Use the same coil material as listed in paragraph HEATING AND COOLING COILS.

2.3 WATER COILS, INCLUDING GLYCOL-WATER

A. Use the same coil material as listed in paragraph HEATING AND COOLING COILS.

B. Drainable Type (Self-Draining, Self-Venting); Manufacturer Standard:

1. Cooling, all types.
2. Heating or preheat.

C. Cleanable Tube Type; Manufacturer Standard:

1. Well water applications.
2. Wastewater applications.

PART 3 - EXECUTION

3.1 INSTALLATION

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

B. Follow coil manufacturer's instructions for handling, cleaning, installation, and piping connections.

C. Comb fins, if damaged. Eliminate air bypass or leakage at coil sections.

3.2 STARTUP AND TESTING

A. Perform tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.

B. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.

C. The CxA will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and CxA. Provide a minimum of 10 working days prior to startup and testing.

3.3 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

B. Components provided under this section of the specification will be tested as part of a larger system.

3.4 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer’s technical representative for 4 hours to instruct VA personnel responsible in operation and maintenance of the system.

B. Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

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SECTION 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 whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.
3. Certified: Materials and equipment which:
   a. Have been tested and found by a NRTL to meet nationally recognized standards or to be safe for use in a specified manner.
   b. Are periodically inspected by a NRTL.
   c. Bear a label, tag, or other record of certification.
4. Nationally Recognized Testing Laboratory: Testing laboratory which is recognized and approved by the Secretary of Labor in accordance with OSHA regulations.

1.4 QUALIFICATIONS (PRODUCTS AND SERVICES)

A. Manufacturer’s Qualifications: The manufacturer shall regularly and currently produce, as one of the manufacturer's principal products, the materials and equipment specified for this project, and shall have manufactured the materials and equipment for at least three years.

B. Product Qualification:

1. Manufacturer's materials and equipment shall have been in satisfactory operation, on three installations of similar size and type as this project, for at least three years.
2. The Government reserves the right to require the Contractor to submit a list of installations where the materials and equipment have been in operation before approval.

C. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within four hours of receipt of notification that service is needed. Submit name and address of service organizations.

1.5 APPLICABLE PUBLICATIONS

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

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

1.6 MANUFACTURED PRODUCTS

A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, and for which replacement parts shall be available. Materials and equipment furnished shall be new, and shall have superior quality and freshness.

B. When more than one unit of the same class or type of materials and equipment is required, such units shall be the product of a single manufacturer.

C. Equipment Assemblies and Components:

1. Components of an assembled unit need not be products of the same manufacturer.
2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
3. Components shall be compatible with each other and with the total assembly for the intended service.
4. Constituent parts which are similar shall be the product of a single manufacturer.

D. Factory wiring and terminals shall be identified on the equipment being furnished and on all wiring diagrams.

E. When Factory Tests are specified, Factory Tests shall be performed in the factory by the equipment manufacturer, and witnessed by the contractor. In addition, the following requirements shall be complied with:

1. The Government shall have the option of witnessing factory tests. The Contractor shall notify the Government through the COR a minimum of thirty (30) days prior to the manufacturer's performing of the factory tests.
2. When factory tests are successful, contractor shall furnish four (4) copies of the equipment manufacturer's certified test reports to the COR fourteen (14) days prior to shipment of the equipment, and not more than ninety (90) days after completion of the factory tests.
3. When factory tests are not successful, factory tests shall be repeated in the factory by the equipment manufacturer, and witnessed by the Contractor. The Contractor shall be liable for all additional expenses for the Government to witness factory re-testing.

1.7 VARIATIONS FROM CONTRACT REQUIREMENTS

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

1.8 MATERIALS AND EQUIPMENT PROTECTION

A. Materials and equipment shall be protected during shipment and storage against physical damage, vermin, dirt, corrosive substances, fumes, moisture, cold, freeze 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, NFPA 780, 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 spaces or working clearances shall comply with NEC's requirements, at a minimum.

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 shall indicate sources of supply, recommended spare and replacement parts, and name of servicing organization.

j. List of factory approved or qualified permanent servicing organizations for equipment repair and periodic testing and maintenance, including addresses and factory certification qualifications.

G. Approvals will be based on complete submission of shop drawings, manuals, test reports, certifications, and samples as applicable.

H. After approval and prior to installation, furnish the COR with one sample of each of the following:

1. A minimum 300 mm (12 inches) length of each type and size of wire and cable along with the tag from the coils or reels from which the sample was taken. The length of the sample shall be sufficient to show all markings provided by the manufacturer.
2. Each type of conduit coupling, bushing, and termination fitting.
3. Conduit hangers, clamps, and supports.
4. Duct sealing compound.
5. Each type of receptacle, toggle switch, lighting control sensor, outlet box, manual motor starter, device wall plate, engraved nameplate, wire and cable splicing and terminating material, and branch circuit single pole molded case circuit breaker.

1.13 SINGULAR NUMBER

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

1.14 POLYCHLORINATED BIPHENYL (PCB) EQUIPMENT

A. This project requires the removal, transport, and disposal of electrical equipment containing Polychlorinated Biphenyls (PCB) in accordance with the Federal Toxic Substances Control Act (TSCA).

B. The equipment to be removed is shown on the drawings.

C. The selective demolition shall be in accordance with Section 02 41 00, DEMOLITION.

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)

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11-01-22

SECTION 26 05 19
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, connection, and testing of the electrical conductors and cables for use in electrical systems rated 600 V and below, indicated as cable(s), conductor(s), wire, or wiring in this section.

1.2 RELATED WORK

A. Section 07 84 00, FIRESTOPPING: Sealing around penetrations to maintain the integrity of fire-resistant rated construction.

B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.

C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.

D. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits for conductors and cables.

1.3 QUALITY ASSURANCE

A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:

1. Shop Drawings:
   a. Submit sufficient information to demonstrate compliance with drawings and specifications.
   b. Submit the following data for approval:
      1) Electrical ratings and insulation type for each conductor and cable.
      2) Splicing materials and pulling lubricant.
2. Certifications: Two weeks prior to final inspection, submit the following.

a. Certification by the manufacturer that the conductors and cables conform to the requirements of the drawings and specifications.

b. Certification by the Contractor that the conductors and cables have been properly installed, adjusted, and tested.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are reference in the text by designation only.

B. American Society of Testing Material (ASTM):

D2301-10.....Standard Specification for Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape

D2304-18.....Test Method for Thermal Endurance of Rigid Electrical Insulating Materials

D3005-17.....Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape

C. National Electrical Manufacturers Association (NEMA):

WC 70-21.....Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy

D. National Fire Protection Association (NFPA):

70-23.....National Electrical Code (NEC)

E. Underwriters Laboratories, Inc. (UL):

44-18.....Thermoset-Insulated Wires and Cables

83-17.....Thermoplastic-Insulated Wires and Cables

467-13.....Grounding and Bonding Equipment

486A-486B-18.....Wire Connectors

486C-18.....Splicing Wire Connectors

486D-15.....Sealed Wire Connector Systems

486E-15.....Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors

493-18.....Thermoplastic-Insulated Underground Feeder and Branch Circuit Cables

514B-12.....Conduit, Tubing, and Cable Fittings

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Conductors and cables shall be in accordance with ASTM, NEMA, NFPA, UL, as specified herein, and as shown on the drawings.

B. Conductors shall be copper.

C. Single Conductor:

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. Conductor 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. 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 cadmium-plated steel.

D. Above Ground Splices for 250 kcmil and Larger:

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

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

1. Solderless, screw-on, reusable pressure cable type, with integral insulation. Listed for wet locations, and approved for copper and aluminum conductors.

2. The integral insulator shall have a skirt to completely cover the stripped conductors.
3. The number, size, and combination of conductors used with the connector, as listed on the manufacturer's packaging, shall be strictly followed.

F. Underground Splices for No. 8 AWG and Larger:
1. Mechanical type, of high conductivity and corrosion-resistant material. Listed for wet locations, and approved for copper and aluminum conductors.
2. Insulate with materials approved for the particular use, location, voltage, and temperature. Insulation level shall be not less than the insulation level of the conductors being joined.
3. Splice and insulation shall be product of the same manufacturer.

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

2.3 CONNECTORS AND TERMINATIONS

A. Mechanical type of high conductivity and corrosion-resistant material, listed for use with copper and aluminum conductors.

B. Long barrel compression type of high conductivity and corrosion-resistant material, with minimum of two compression indents per wire, listed for use with copper and aluminum conductors.

C. All bolts, nuts, and washers used to connect connections and terminations to bus bars or other termination points shall be zinc-plated cadmium-plated steel.

2.4 CONTROL WIRING

A. Unless otherwise specified elsewhere in these specifications, control wiring shall be as specified herein, except that the minimum size shall be not less than No. 14 AWG, or as required by the control wiring equipment manufacturer.

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 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. For conductors installed in vertical raceways, provide conductor support (also known as cable support), to counter gravity pull on conductor weight. Conductor support shall be split-wedge conductor support type. Prior to installing the conductor support plug, remove all pulling compound from conductors where they pass through the conductor support body. After installing the conductor support plug, tap the conductor support plug firmly in the conductor support body.

F. In panelboards, cabinets, wireways, switches, enclosures, and equipment assemblies, neatly form, train, and tie the conductors with non-metallic "zip" 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 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. Number of conductors for branch circuits shall not exceed more than three branch circuits in any one conduit.

K. When stripping stranded conductors, use a tool that does not damage the conductor or remove conductor strands.

3.2 INSTALLATION IN MANHOLES

A. Train the conductors around the manhole walls, but do not bend to a radius less than six times the overall conductor diameter.

B. Fireproofing:

1. Install fireproofing on low-voltage conductors where the low-voltage conductors are installed in the same manholes with medium-voltage conductors.
2. Use fireproofing tape as specified in Section 26 05 13, MEDIUM-VOLTAGE CABLES, and apply the tape in a single layer, half-lapped, or as recommended by the manufacturer. Install the tape with the coated side towards the cable and extend it not less than 25 mm (1 inch) into each duct.
3. Secure the fireproofing tape in place by a random wrap of glass cloth tape.

3.3 SPLICE AND TERMINATION INSTALLATION

A. Splices and terminations shall be mechanically and electrically secure, and tightened to manufacturer’s published torque values using a torque screwdriver or wrench.

B. Where the Government determines that unsatisfactory splices or terminations have been installed, replace the splices or terminations at no additional cost to the Government.

3.4 CONDUCTOR IDENTIFICATION

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

3.5 FEEDER CONDUCTOR IDENTIFICATION

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

3.6 EXISTING CONDUCTORS

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

3.7 CONTROL WIRING INSTALLATION

A. Unless otherwise specified in other sections, install control wiring and connect to equipment to perform the required functions as specified or as shown on the drawings.

B. Install a separate power supply circuit for each system, except where otherwise shown on the drawings.

3.8 CONTROL WIRING IDENTIFICATION

A. Install a permanent wire marker on each wire at each termination.

B. Identifying numbers and letters on the wire markers shall correspond to those on the wiring diagrams used for installing the systems.

C. Wire markers shall retain their markings after cleaning.

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

3.9 DIRECT BURIAL CABLE INSTALLATION

A. Tops of the cables:

1. Below the finished grade: Minimum 600 mm (24 inches) unless greater depth is shown.
2. Below road and other pavement surfaces: In conduit as specified, minimum 760 mm (30 inches) unless greater depth is shown.
3. Do not install cables under railroad tracks.

B. Under road and paved surfaces: Install cables in concrete-encased galvanized steel rigid conduits. Size as shown on plans, but not less than 50 mm (2 inches) trade size with bushings at each end of each conduit run. Provide size/quantity of conduits required to accommodate cables plus one spare.

C. Work with extreme care near existing ducts, conduits, cables, and other utilities to prevent any damage.

D. Excavation and backfill is specified in Section 31 20 00, EARTH MOVING. In addition:

1. Place 75 mm (3 inches) bedding sand in the trenches before installing the cables.
2. Place 75 mm (3 inches) shading sand over the installed cables.

3. Install continuous horizontal 25 mm by 200 mm (1 inch x 8 inches) preservative-impregnated wood planking 75 mm (3 inches) above the cables before backfilling.

E. Provide horizontal slack in the cables for contraction during cold weather.

F. Install the cables in continuous lengths. Splices within cable runs shall not be accepted.

G. Connections and terminations shall be listed submersible-type designed for the cables being installed.

H. Warning tape shall be continuously placed 300 mm (12 inches) above the buried cables.

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.

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11-01-22

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):

B1-13.....Standard Specification for Hard-Drawn Copper Wire

B3-13(R2018).....Standard Specification for Soft or Annealed Copper Wire

B8-11(R2017).....Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

C. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

81-12.....IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System Part 1: Normal Measurements

D. National Fire Protection Association (NFPA):

70-23.....National Electrical Code (NEC)

70E-21.....National Electrical Safety Code

99-21.....Health Care Facilities

E. Underwriters Laboratories, Inc. (UL):

44-18 .....Thermoset-Insulated Wires and Cables

83-17 .....Thermoplastic-Insulated Wires and Cables

467-13 .....Grounding and Bonding Equipment

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING CONDUCTORS

A. Equipment grounding conductors shall be insulated stranded copper, except that sizes No. 10 AWG and smaller shall be solid copper. Insulation color shall be continuous green for all equipment grounding

conductors, except that wire sizes No. 4 AWG and larger shall be identified per NEC.

B. Bonding conductors shall be bare stranded copper, except that sizes No. 10 AWG and smaller shall be bare solid copper. Bonding conductors shall be stranded for final connection to motors, transformers, and vibrating equipment.

C. Conductor sizes shall not be less than shown on the drawings, or not less than required by the NEC, whichever is greater.

D. Insulation: THHN-THWN and XHHW-2. XHHW-2 shall be used for isolated power systems.

2.2 GROUND RODS

A. Steel or copper clad steel Stainless 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-platedcadmium-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-platedcadmium-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-platedcadmium-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 cadmium-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.

2.7 GROUNDING BUS BAR

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

PART 3 - EXECUTION

3.1 GENERAL

A. 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

A. Switchgear: Provide a bare grounding electrode conductor from the switchgear ground bus to the grounding electrode system.

B. Duct Banks and Manholes: Provide an insulated equipment grounding conductor in each duct containing medium-voltage conductors, sized per NEC except that minimum size shall be No. 2 AWG. Bond the equipment grounding conductors to the switchgear ground bus, to all manhole grounding provisions and hardware, to the cable shield grounding provisions of medium-voltage cable splices and terminations, and to equipment enclosures.

C. Pad-Mounted Transformers:

1. Provide a driven ground rod and bond with a grounding electrode conductor to the transformer grounding pad.
2. Ground the secondary neutral.

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 nearest component of the grounding electrode system 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 a equipment grounding conductor to the equipment ground bus.

B. Feeders and Branch Circuits: Install equipment grounding conductors with all feeders, and all 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

A. Fences shall be grounded as shown on the drawings. Fences shall be grounded with a ground rod at each fixed gate post and at each corner post.

B. Drive ground rods until the top is 300 mm (12 inches) below grade. Attach a No. 4 AWG copper conductor by exothermic weld to the ground rods, and extend underground to the immediate vicinity of fence post. Lace the conductor vertically into 300 mm (12 inches) of fence mesh and fasten by two approved bronze compression fittings, one to bond the wire to post and the other to bond the wire to fence. Each gate section shall be bonded to its gatepost by a 3 mm x 25 mm (0.375 inch x 1 inch) flexible, braided copper strap and ground post clamps. Clamps shall be of the anti-electrolysis type.

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

A. Bond the lightning protection system to the electrical grounding electrode system.

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

A. Provide 6.1 M (20 feet) of No. 4 AWG bare copper coiled at bottom of pole base excavation prior to pour, plus additional un-spliced length in and above foundation as required to reach pole ground stud.

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.

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11-01-22

SECTION 26 05 33

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, and connection of conduit, fittings, and boxes, to form complete, coordinated, grounded raceway systems. Raceways are required for all wiring unless shown or specified otherwise.

B. Definitions: The term conduit, as used in this specification, shall mean any or all of the raceway types specified.

1.2 RELATED WORK

A. Section 06 10 00, ROUGH CARPENTRY: Mounting board for telephone closets.

B. Section 07 84 00, FIRESTOPPING: Sealing around penetrations to maintain the integrity of fire rated construction.

C. Section 07 92 00, JOINT SEALANTS: Sealing around conduit penetrations through the building envelope to prevent moisture migration into the building.

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

E. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Conduits bracing.

F. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.

G. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.

1.3 QUALITY ASSURANCE

A. 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. 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 Iron and Steel Institute (AISI):
S100-16.....North American Specification for the Design of Cold-Formed Steel Structural Members

C. National Electrical Manufacturers Association (NEMA):
C80.1-20.....Electrical Rigid Steel Conduit
C80.3-20.....Steel Electrical Metal Tubing
C80.6-18.....Electrical Intermediate Metal Conduit

FB1-14.....Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable

FB2.10-21.....Selection and Installation Guidelines for Fittings for use with Non-Flexible Conduit or Tubing (Rigid Metal Conduit, Intermediate Metallic Conduit, and Electrical Metallic Tubing)

FB2.20-21.....Selection and Installation Guidelines for Fittings for use with Flexible Electrical Conduit and Cable

TC-2-20.....Electrical Polyvinyl Chloride (PVC) Tubing and Conduit

TC-3-21.....PVC Fittings for Use with Rigid PVC Conduit and Tubing

D. National Fire Protection Association (NFPA):

70-23.....National Electrical Code (NEC)

E. Underwriters Laboratories, Inc. (UL):

1-05.....Flexible Metal Conduit

5-16.....Surface Metal Raceway and Fittings

6-07.....Electrical Rigid Metal Conduit - Steel

50-15.....Enclosures for Electrical Equipment

360-13.....Liquid-Tight Flexible Steel Conduit

467-13.....Grounding and Bonding Equipment

514A-13.....Metallic Outlet Boxes

514B-12.....Conduit, Tubing, and Cable Fittings

514C-14.....Nonmetallic Outlet Boxes, Flush-Device Boxes and Covers

651-11.....Schedule 40 and 80 Rigid PVC Conduit and Fittings

651A-11.....Type EB and A Rigid PVC Conduit and HDPE Conduit

797-07.....Electrical Metallic Tubing

1242-06.....Electrical Intermediate Metal Conduit - Steel

PART 2 - PRODUCTS

2.1 MATERIAL

A. Conduit Size: In accordance with the NEC, but not less than 13 mm (0.5-inch) unless otherwise shown. Where permitted by the NEC, 13 mm (0.5-inch) flexible conduit may be used for tap connections to recessed lighting fixtures.

B. Conduit:

1. Size: In accordance with the NEC, but not less than 13 mm (0.5-inch).
2. Rigid Steel Conduit (RMC): Shall conform to UL 6 and NEMA C80.1.
3. Rigid aluminum: Shall conform to UL 6A and NEMA C80.5.
4. Rigid Intermediate Steel Conduit (IMC): Shall conform to UL 1242 and NEMA C80.6.
5. Electrical Metallic Tubing (EMT): Shall conform to UL 797 and NEMA C80.3. Maximum size not to exceed 105 mm (4 inches) and shall be permitted only with cable rated 600 V or less.
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, NEMA C80.3, and NEMA FB1.

b. Only steel or malleable iron materials are acceptable.

c. Compression Couplings and Connectors: Concrete-tight and rain-tight, with connectors having insulated throats.

d. Set Screw 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. Connector shall have insulated throat.

e. Indent-type connectors or couplings are prohibited.

f. Die-cast or pressure-cast zinc-alloy fittings or fittings made of "pot metal" are prohibited.

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. Comply with UL-50 and UL-514A.

2. Rustproof cast metal where required by the NEC or shown on drawings.

3. Sheet Metal Boxes: Galvanized steel, except where shown on drawings.

F. Metal Wireways: Equip with hinged covers, except as shown on drawings. Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for a complete system.

PART 3 - EXECUTION

3.1 PENETRATIONS

A. Cutting or Holes:

1. Cut holes in advance where they should be placed in the structural elements, such as ribs or beams. Obtain the approval of the 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 NEC, NEMA, UL, as shown on drawings, and as specified herein.

B. Raceway systems used for Essential Electrical Systems (EES) shall be entirely independent of other raceway systems.

C. Install conduit as follows:

1. In complete mechanically and electrically continuous runs before pulling in cables or wires.
2. Unless otherwise indicated on the drawings or specified herein, installation of all conduits shall be concealed within finished walls, floors, and ceilings.

3. Flattened, dented, or deformed conduit is not permitted. Remove and replace the damaged conduits with new conduits.
4. Assure conduit installation does not encroach into the ceiling height head room, walkways, or doorways.
5. Cut conduits square, ream, remove burrs, and draw up tight.
6. Independently support conduit at 2.4 M (8 feet) on centers with specified materials and as shown on drawings.
7. Do not use suspended ceilings, suspended ceiling supporting members, lighting fixtures, other conduits, cable tray, boxes, piping, or ducts to support conduits and conduit runs.
8. Support within 300 mm (12 inches) of changes of direction, and within 300 mm (12 inches) of each enclosure to which connected.
9. Close ends of empty conduits with plugs or caps at the rough-in stage until wires are pulled in, to prevent entry of debris.
10. Conduit installations under fume and vent hoods are prohibited.
11. Secure conduits to cabinets, junction boxes, pull-boxes, and outlet boxes with bonding type locknuts. For rigid steel and IMC conduit installations, provide a locknut on the inside of the enclosure, made up wrench tight. Do not make conduit connections to junction box covers.
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 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 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.

3.6 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.

3.7 MOTORS AND VIBRATING EQUIPMENT

A. Use flexible metal conduit for connections to motors and other electrical equipment subject to movement, vibration, misalignment, cramped quarters, or noise transmission.

B. Use liquid-tight flexible metal conduit for installation in exterior locations, moisture or humidity laden atmosphere, corrosive atmosphere, water or spray wash-down operations, inside airstream of HVAC units, and locations subject to seepage or dripping of oil, grease, or water.

C. Provide a green equipment grounding conductor with flexible and liquid-tight flexible metal conduit.

3.8 EXPANSION JOINTS

A. Conduits 75 mm (3 inch) and larger that are secured to the building structure on opposite sides of a building expansion joint require expansion and deflection couplings. Install the couplings in accordance with the manufacturer's recommendations.

B. Provide conduits smaller than 75 mm (3 inch) with junction boxes on both sides of the expansion joint. Connect flexible metal conduits to junction boxes with sufficient slack to produce a 125 mm (5 inch) vertical drop midway between the ends of the flexible metal conduit. Flexible metal conduit shall have a green insulated copper bonding jumper installed. In lieu of this flexible metal conduit, expansion and deflection couplings as specified above are acceptable.

C. Install expansion and deflection couplings where shown.

D. Seismic Areas: In seismic areas, provide conduits rigidly secured to the building structure on opposite sides of a building expansion joint with junction boxes on both sides of the joint. Connect conduits to

junction boxes with 375 mm (15 inches) of slack flexible conduit. Flexible conduit shall have a copper bonding jumper installed.

3.9 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.

3.10 BOX INSTALLATION

A. Boxes for Concealed Conduits:
   1. Flush-mounted.
   2. Provide raised covers for boxes to suit the wall or ceiling, construction, and finish.

B. In addition to boxes shown, install additional boxes where needed to prevent damage to cables and wires during pulling-in operations or where more than the equivalent of 4-90 degree bends are necessary.

C. Locate pullboxes so that covers are accessible and easily removed. Coordinate locations with piping and ductwork where installed above ceilings.

D. Remove only knockouts as required. Plug unused openings. Use threaded plugs for cast metal boxes and snap-in metal covers for sheet metal boxes.

E. Outlet boxes mounted back-to-back in the same wall are prohibited. A minimum 600 mm (24 inch) center-to-center lateral spacing shall be maintained between boxes.

F. Flush-mounted wall or ceiling boxes shall be installed with raised covers so that the front face of raised cover is flush with the wall. Surface-mounted wall or ceiling boxes shall be installed with surface-style flat or raised covers.

G. Minimum size of outlet boxes for ground fault circuit interrupter (GFCI) receptacles is 100 mm (4 inches) square x 55 mm (2.125 inches) deep, with device covers for the wall material and thickness involved.

H. Stencil or install phenolic nameplates on covers of the boxes identified on riser diagrams; for example "ELECTRICAL PB No. 1."

I. On all branch circuit junction box covers, identify the circuits with black marker.

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11-1-16

SECTION 26 08 00

COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. The requirements of this Section apply to all sections of Division 26.

B. This project will have selected building systems commissioned. The complete list of equipment and systems to be commissioned is specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. The commissioning process, which the Contractor is responsible to execute, is defined in Section 01 91 00 GENERAL COMMISSIONING REQUIRMENTS. A Commissioning Agent (CxA) appointed by the VA will manage the commissioning process.

1.2 RELATED WORK

A. Section 01 00 00 GENERAL REQUIREMENTS.

B. Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

C. Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

1.3 SUMMARY

A. This Section includes requirements for commissioning the Facility electrical systems, related subsystems and related equipment. This Section supplements the general requirements specified in Section 01 91 00 General Commissioning Requirements.

B. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for more details regarding processes and procedures as well as roles and responsibilities for all Commissioning Team members.

1.4 DEFINITIONS

A. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for definitions.

1.5 COMMISSIONED SYSTEMS

A. Commissioning of a system or systems specified in Division 26 is part of the construction process. Documentation and testing of these systems, as well as training of the VA’s Operation and Maintenance personnel in accordance with the requirements of Section 01 91 00 and of Division 26, is required in cooperation with the VA and the Commissioning Agent.

B. The Facility electrical systems commissioning will include the systems listed in Section 01 91 00 General Commissioning Requirements:

1.6 SUBMITTALS

A. The commissioning process requires review of selected Submittals that pertain to the systems to be commissioned. The Commissioning Agent will provide a list of submittals that will be reviewed by the Commissioning Agent. This list will be reviewed and approved by the VA prior to forwarding to the Contractor. Refer to Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, and SAMPLES for further details.

B. The commissioning process requires Submittal review simultaneously with engineering review. Specific submittal requirements related to the commissioning process are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 CONSTRUCTION INSPECTIONS

A. Commissioning of Electrical systems will require inspection of individual elements of the electrical systems construction throughout the construction period. The Contractor shall coordinate with the Commissioning Agent in accordance with Section 01 91 00 and the Commissioning plan to schedule electrical systems inspections as required to support the Commissioning Process.

3.2 PRE-FUNCTIONAL CHECKLISTS

A. The Contractor shall complete Pre-Functional Checklists to verify systems, subsystems, and equipment installation is complete and systems are ready for Systems Functional Performance Testing. The Commissioning Agent will prepare Pre-Functional Checklists to be used to document equipment installation. The Contractor shall complete the checklists. Completed checklists shall be submitted to the VA and to the Commissioning Agent for review. The Commissioning Agent may spot check a sample of completed checklists. If the Commissioning Agent determines that the information provided on the checklist is not accurate, the Commissioning Agent will return the marked-up checklist to the Contractor for correction and resubmission. If the Commissioning Agent determines that a significant number of completed checklists for similar equipment are not accurate, the Commissioning

Agent will select a broader sample of checklists for review. If the Commissioning Agent determines that a significant number of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and resubmission. Refer to SECTION 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for Pre-Functional Checklists, Equipment Startup Reports, and other commissioning documents.

3.3 CONTRACTORS TESTS

A. Contractor tests as required by other sections of Division 26 shall be scheduled and documented in accordance with Section 01 00 00 GENERAL REQUIREMENTS. All testing shall be incorporated into the project schedule. Contractor shall provide no less than 7 calendar days' notice of testing. The Commissioning Agent will witness selected Contractor tests at the sole discretion of the Commissioning Agent. Contractor tests shall be completed prior to scheduling Systems Functional Performance Testing.

3.4 SYSTEMS FUNCTIONAL PERFORMANCE TESTING

A. The Commissioning Process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions. The Commissioning Agent will prepare detailed Systems Functional Performance Test procedures for review and approval by the 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 VA COR after submission and approval of formal training plans. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS and Division 26 Sections for additional Contractor training requirements.

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11-01-22

SECTION 26 09 23
LIGHTING CONTROLS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation and connection of the lighting controls.

1.2 RELATED WORK

A. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC: Interface of lighting controls with HVAC control systems.

B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General requirements that are common to more than one section of Division 26.

C. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Cables and wiring.

D. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents.

E. Section 26 27 26, WIRING DEVICES: Wiring devices used for control of the lighting systems.

F. Section 26 51 00, INTERIOR LIGHTING: Luminaire ballast and drivers used in control of lighting systems.

1.3 QUALITY ASSURANCE

A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:

1. Shop Drawings:
   a. Submit the following information for each type of lighting controls.
   b. Material and construction details.
   c. Physical dimensions and description.
   d. Wiring schematic and connection diagram.
   e. Installation details.

2. Manuals:
   a. Submit, simultaneously with the shop drawings, complete maintenance and operating manuals, including technical data sheets, wiring diagrams, and information for ordering replacement parts.
   b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
3. Certifications: Two weeks prior to final inspection, submit the following.
   a. Certification by the Contractor that the lighting control systems have been properly installed and tested.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

B. National Electrical Manufacturer's Association (NEMA):

C136.10-17.....American National Standard for Roadway and Area Lighting Equipment—Locking-Type Photocontrol Devices and Mating Receptacles—Physical and Electrical Interchangeability and Testing

ICS-1-00(R2015).....Standard for Industrial Control and Systems General Requirements

ICS-2-00(R2020).....Standard for Industrial Control and Systems Controllers, Contractors, and Overload Relays Rated 600 Volts

ICS-6-93(R2016).....Standard for Industrial Controls and Systems Enclosures

C. National Fire Protection Association (NFPA):

70-23.....National Electrical Code (NEC)

D. Underwriters Laboratories, Inc. (UL):

20-18.....Standard for General-Use Snap Switches

98-16.....Enclosed and Dead-Front Switches

773-16.....Standard for Plug-In Locking Type Photocontrols for Use with Area Lighting

773A-16.....Nonindustrial Photoelectric Switches for Lighting Control

916-15.....Standard for Energy Management Equipment

917-06.....Clock Operated Switches

924-16.....Emergency Lighting and Power Equipment

PART 2 - PRODUCTS

2.1 ELECTRONIC TIME SWITCHES

A. Electronic, solid-state programmable units with alphanumeric display; complying with UL 916 and or 917.

1. Contact Configuration: SPST DPST DPDT.
2. Contact Rating: 30-A inductive or resistive 120-277 volt 20-A ballast load, 120-277 volt.
3. Astronomical Clock: Capable of switching a load on at sunset and off at sunrise, and automatically changing the settings each day in accordance with seasonal changes of sunset and sunrise. Additionally, it shall be programmable to a fixed on/off weekly schedule.
4. Power Backup: Battery or capacitor for schedules and time clock.

2.2 ELECTROMECHANICAL-DIAL TIME SWITCHES

A. Electromechanical-dial time switches; complying with UL 917.

1. Contact Configuration: SPST DPST DPDT.
2. Contact Rating: 30-A inductive or resistive, 120-277 volt 20-A ballast load, 120-277 volt.
3. Wound-spring reserve carryover mechanism to keep time during power failures.

2.3 OUTDOOR PHOTOELECTRIC SWITCHES

A. Solid state, with SPST DPST dry contacts rated for 1800 VA tungsten or 1000 VA inductive, complying with UL 773A.

1. Light-Level Monitoring Range: 16.14 to 108 lx (1.5 to 10 fc), with adjustable turn-on and turn-off levels.
2. Time Delay: 15-second minimum.
3. Surge Protection: Metal-oxide varistor.
4. Mounting: Twist lock, with base-and-stem mounting or stem-and-swivel mounting accessories as required.

2.4 TIMER SWITCHES

A. Digital switches with backlit LCD display, 120/277 volt rated, fitting as a replacement for standard wall switches.

1. Compatibility: Compatible with all ballasts.
2. Warning: Audible warning to sound during the last minute of "on" operation.
3. Time-out: Adjustable from 5 minutes to 12 hours.
4. Faceplate: Refer to wall plate material and color requirements for toggle switches, as specified in Section 26 27 26, WIRING DEVICES.

2.5 CEILING-MOUNTED PHOTOELECTRIC SWITCHES

A. Solid-state, light-level sensor unit, with separate relay unit.

1. Sensor Output: Contacts rated to operate the associated relay. Sensor shall be powered from the relay unit.
2. Relay Unit: Dry contacts rated for 20A ballast load at 120 volt and 277 volt, for 13A tungsten at 120 volt, and for 1 hp at 120 volt.
3. Monitoring Range: 108 to 2152 lx (10 to 200 fc) 1080 to 10 800 lx (100 to 1000 fc), with an adjustment for turn-on and turn-off levels.
4. Time Delay: Adjustable from 5 to 300 seconds, with deadband adjustment.
5. Indicator: Two LEDs to indicate the beginning of on-off cycles.

2.6 SKYLIGHT PHOTOELECTRIC SENSORS

A. Solid-state, light-level sensor; housed in a threaded, plastic fitting for mounting under skylight; with separate relay unit.

1. Sensor Output: Contacts rated to operate the associated relay, complying with UL 773A. Sensor shall be powered from the relay unit.
2. Relay Unit: Dry contacts rated for 20A ballast load at 120 volt and 277 volt, for 13A tungsten at 120 volt, and for 1 hp at 120 volt.
3. Monitoring Range: 10,800 to 108,000 lx (1000 to 10,000 fc), with an adjustment for turn-on and turn-off levels.
4. Time Delay: Adjustable from 5 to 300 seconds, with deadband adjustment.
5. Indicator: Two LEDs to indicate the beginning of on-off cycles.

2.7 INDOOR OCCUPANCY SENSORS

A. Wall- or ceiling-mounting, solid-state units with a power supply and relay unit, suitable for the environmental conditions in which installed.

1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a 1 to 15 minute adjustable time delay for turning lights off.
2. Sensor Output: Contacts rated to operate the connected relay. Sensor shall be powered from the relay unit.
3. Relay Unit: Dry contacts rated for 20A ballast load at 120 volt and 277 volt, for 13A tungsten at 120 volt, and for 1 hp at 120 volt.
4. Mounting:
   a. Sensor: Suitable for mounting in any position on a standard outlet box.
   b. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
6. Bypass Switch: Override the on function in case of sensor failure.
7. Manual/automatic selector switch.
8. Automatic Light-Level Sensor: Adjustable from 21.5 to 2152 lx (2 to 200 fc); keep lighting off when selected lighting level is present.
9. Faceplate for Wall-Switch Replacement Type: Refer to wall plate material and color requirements for toggle switches, as specified in Section 26 27 26, WIRING DEVICES.

B. Dual-technology Type: Ceiling mounting; combination PIR and ultrasonic detection methods, field-selectable.

1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 150 mm (6-inch) minimum movement of any portion of a human body that presents a target of not less than 232 sq. cm (36 sq. in), and detect a person of average size and weight moving not less than 305 mm (12 inches) in either a horizontal or a vertical manner at an approximate speed of 305 mm/s (12 inches/s).

C. Detection Coverage: Shall be sufficient to provide coverage as required by sensor locations shown on drawing.

2.8 INDOOR VACANCY SENSOR SWITCH

A. Wall mounting, solid-state units with integral sensor and switch.
   1. Operation: Manually turn lights on with switch and sensor detects vacancy to turn lights off.
   2. Switch Rating: 120/277 volt, 1200 watts at 277 volt, 800 watts at 120 volt unit.
   3. Mounting:
      a. Sensor: Suitable for mounting in a standard switch box.
      b. Time-Delay and Sensitivity Adjustments: Integral with switch and accessible for reprogramming without removing switch.
   4. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
   5. Switch: Manual operation to turn lights on and override lights off.
   6. Faceplate: Refer to wall plate material and color requirements for toggle switches, as specified in Section 26 27 26, WIRING DEVICES.

2.9 OUTDOOR MOTION SENSOR (PIR)

A. Suitable for operation in ambient temperatures ranging from minus 40 to plus 130 degrees F (minus 40 to plus 54 degrees C).
   1. Operation: Turn lights on when sensing infrared energy changes between background and moving body in area of coverage; with a 1 to 15 minute adjustable time delay for turning lights off.
   2. Mounting:
      a. Sensor: Suitable for mounting in any position on a standard outdoor junction box.
      b. Relay: Internally mounted in a standard weatherproof electrical enclosure.
      c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
   3. Bypass Switch: Override the on function in case of sensor failure.
   4. Automatic Light-Level Sensor: Adjustable from 11 to 215 lx (1 to 20 fc); keep lighting off during daylight hours.

B. Detector Sensitivity: Detect occurrences of 150 mm (6-inch) minimum movement of any portion of a human body that presents a target of not less than 232 sq. cm (36 sq. in).

C. Detection Coverage: Shall be sufficient to provide coverage as required by sensor locations shown on drawing.

D. Individually Mounted Sensor: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
   1. Relay Unit: Dry contacts rated for 20A ballast load at 120 volt and 277 volt, for 13A tungsten at 120 volt, and for 1 hp at 120 volt.
   2. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.

2.10 LIGHTING CONTROL SYSTEM - RELAY PANEL TYPE (NETWORK)

A. System Description:
   1. The lighting control system shall be a network of lighting relay panels connected to a digital network and controlled through a system server / central station. Lighting control devices connect to the relay panels and communicate via the panel controller with the system server. System includes all associated network interfaces and wiring, relay panels, control modules, input modules, panel processors, relays, photocells, switches, dimmers, time clock, and occupancy sensors.
   2. System shall include server / central station with operating software, data network, and BACnet IP communication with other systems as described. System communication protocol shall be compatible with the building automation system specified in Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.
   3. System server / central station shall provide programmable operation of lights connected via system relays and controlled with system devices. System software shall provide control of relays and control devices, time and sequence scheduling, timed out and blink light operation and monitoring and reporting of system events and components. Initial programming shall be as shown on plans and schedules.

B. Server / Central Control Station: Lighting control system manufacturer shall be responsible to assure coordination between system devices, network and control system server/ central station such that system performs as described. Server / central control station shall have a minimum 80 GB hard drive, 2 4 8 GB RAM, 3 GHz speed minimum, three Ethernet ports, 1024 x 768 resolution graphic card, and 3 USB 2.0 ports. Server shall be provided with monitor, keyboard and mouse, and

plugged into a receptacle connected to an equipment emergency circuit as a minimum.

C. Cabinet: Steel with hinged, locking door. Barriers separate low-voltage and line-voltage components.

D. Directory: Identifies each relay as to load controlled.

E. System Power Supply: Transformer and full-wave rectifier with filtered dc output for panel, controllers and control devices. Feed from an equipment emergency circuit at a minimum.

F. Single-Pole Relays: Mechanically held unless otherwise indicated; split-coil, momentary-pulsed type, rated 20 A, 125 volt AC for tungsten filaments and 20 A, 277 volt AC for electronic ballasts, 50,000 cycles at rated capacity.

G. Control Devices: All occupancy sensors (Ultrasonic, IR and Dual Technology type), photocells, switches and timers shall be provided with system and designed to operate on system network. Supplemental power packs shall be provided as required for multiple control devices. This equipment shall be identified in shop drawing submission.

2.11 LIGHTING CONTROL SYSTEM - RELAY PANEL TYPE (STAND ALONE)

A. System Description:

1. The lighting control system shall be with lighting relay panels. Lighting control devices connect to the relay panels and communicate via the panel controller. System includes all interfaces and wiring, relay panels, control modules, input modules, panel processors, relays, photocells, switches, dimmers, time clock, and occupancy sensors.
2. System shall include the capability of BACnet IP communication with other systems as described. System communication protocol shall be compatible with the building automation system specified in Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.
3. Panel Controller shall provide programmable operation of lights connected via system relays and controlled with system devices. System software shall provide control of relays and control devices, time and sequence scheduling, timed out and blink light operation and monitoring and reporting of system events and components. Initial programming shall be as shown on plans and schedules.

B. Panel Controller: Comply with UL 508; programmable, solid-state, astronomic 365-day control unit with non-volatile memory, mounted in preassembled relay panel with low-voltage-controlled, latching-type, single-pole lighting circuit relays. Controller shall be capable of receiving inputs from control devices and other sources. Where indicated, a limited number of digital or analog, low-voltage control-circuit outputs shall be supported by control unit and circuit boards associated with relays.

C. Cabinet: Steel with hinged, locking door. Barriers separate low-voltage and line-voltage components.

D. Directory: Identifies each relay as to load controlled.

E. System Power Supply: Transformer and full-wave rectifier with filtered dc output for panel, controllers and control devices. Feed from an equipment emergency circuit at a minimum.

F. Single-Pole Relays: Mechanically held unless otherwise indicated; split-coil, momentary-pulsed type, rated 20 A, 125 volt AC for tungsten filaments and 20 A, 277 volt AC for electronic ballasts, 50,000 cycles at rated capacity.

G. Control Devices: All occupancy sensors (Ultrasonic, IR and Dual Technology type), photocells, switches and timers shall be provided with system and designed to operate on system network. Supplemental power packs shall be provided as required for multiple control devices. This equipment shall be identified in shop drawing submission.

2.12 LIGHTING CONTROL SYSTEM – DISTIBUTIVE RELAY TYPE

A. System Description:

1. The lighting control system shall be a network of remote relay modules connected to a digital network via network hubs and controlled through a system server / central station. Lighting control devices connect to the relay modules and communicate via the digital network with the system server. System includes all associated network interfaces and wiring, hubs, relay modules, relays, photocells, switches, dimmers, time clock, and occupancy sensors. System shall utilize distributed relays modules, allowing these relay modules to be located above accessible ceilings in or adjacent to rooms they are controlling.

2. System shall include server / central station with operating software, data network, and BACnet IP communication with other systems as described. System communication protocol shall be compatible with the building automation system specified in Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.
3. System server / central station shall provide programmable operation of lights connected via system relays and controlled with system devices. System software shall provide control of relays and control devices, time and sequence scheduling, timed out and blink light operation and monitoring and reporting of system events and components. Initial programming shall be as shown on plans and schedules.

B. Server / Central Control Station: Lighting control system manufacturer shall be responsible to assure coordination between relay modules, network hubs and control system server/ central station such that system performs as described. Server / central control station shall have a minimum 80 GB hard drive, 2 4 8 GB RAM, 3 GHz speed minimum, three Ethernet ports, 1024 x 768 resolution graphic card, and 3 USB 2.0 ports. Server shall be provided with monitor, keyboard and mouse, and plugged into a receptacle connected to an equipment emergency circuit as a minimum.

C. Network Hub: Network Hub shall contain processor and astronomic time clock for control and monitoring of lighting. Network Hub shall be fed from an equipment emergency circuit at a minimum.

D. Relay Modules: Mounted in NEMA enclosure with physically separate 120/277 volt wiring compartment from low voltage control wiring. Provide low voltage digital communication to control devices as shown on drawings and schedules. Supplemental power packs shall be provided as required for multiple control devices. This equipment shall be identified in shop drawing submission. Dimmable relay modules shall be provided where indicated. Relay modules shall contain up to 4 relays. Relay modules shall be labeled with room number that relays control lighting within.

E. Single-Pole Relays: Mechanically held unless otherwise indicated; split-coil, momentary-pulsed type, rated 20 A, 125 volt AC for tungsten

filaments and 20 A, 277 volt AC for electronic ballasts, 50,000 cycles at rated capacity.

F. Control Devices: All occupancy sensors (Ultrasonic, IR and Dual Technology type), photocells, switches and timers shall be provided with system and designed to operate on system network. Supplemental power packs shall be provided as required for multiple control devices. This equipment shall be identified in shop drawing submission.

2.13 LIGHTING CONTROL SYSTEML – CIRCUIT BREAKER PANEL TYPE

A. Controller: Panelboard mounted in compliance with UL 916, programmable, solid-state, astronomic 365-day timing and control unit with non-volatile memory. Controller shall be integral to panelboard as specified in Section 26 24 16, PANELBOARDS. Controller shall be capable of receiving inputs from sensors and other sources, and capable of timed overrides and/or blink-warning on a per-circuit basis. Controller communication protocol shall be compatible with the building automation system specified in Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC. Panelboard shall use low-voltage-controlled, electrically operated molded-case branch circuit breakers or molded-case branch circuit breakers with switching accessories. Circuit breakers and a limited number of digital or analog, low-voltage control-circuit outputs shall be individually controlled by control module. Panelboard shall also comply with Section 24 26 16, PANELBOARDS.

B. Electrically Operated, Molded-Case Circuit-Breaker Panelboard: Per Section 26 24 16, PANELBOARDS.

C. Electrically Operated, Molded-Case Circuit Breakers: Per Section 26 24 16, PANELBOARDS.

D. Switching Endurance Ratings: Rated at least 20,000 open and close operations under rated load at 0.8 power factor.

2.14 LIGHTING CONTROL SYSTEM – DIGITAL ADDRESSABLE LIGHTING INTERFACE (DALI)

A. System Description:

1. The lighting control system shall consist of digital lighting control network connecting DALI compliant digital addressable ballasts, control modules and lighting control devices directly with a system server / central control station. Individually addressable electronic ballasts, control modules, and control devices are

operated from signals received through DALI-compliant bus from variety of DALI compliant digital controllers and interfaces and programmed through the system server / central control station. System includes all associated network bus and wiring, DALI controllers and interfaces, panels, photocells, switches, dimmers, time clock, and occupancy sensors. System shall utilize DALI compliant ballast and dimming modules provided with light fixtures.

2. System shall include server / central station with DALI operating software, data network, and BACnet IP communication with other systems as described. System communication protocol shall be compatible with the building automation system specified in Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.
3. System server / central station shall provide programmable operation of lights connected via system bus and controlled with system devices. System software shall provide control of DALI ballast, control modules and control devices, time and sequence scheduling, timed out and blink light operation and monitoring and reporting of system events and components. Initial programming shall be as shown on plans and schedules.

B. Server / Central Control Station: Lighting control system manufacturer shall be responsible to assure coordination between relay modules, network hubs and control system server/ central station such that system performs as described. Server / central control station shall have a minimum 80 GB hard drive, 2 4 8 GB RAM, 3 GHz speed minimum, three Ethernet ports, 1024 x 768 resolution graphic card, and 3 USB 2.0 ports. Server shall be provided with monitor, keyboard and mouse, and plugged into a receptacle connected to an equipment emergency circuit as a minimum.

C. Control Devices: All occupancy sensors (Ultrasonic, IR and Dual Technology type), photocells, switches and timers shall be provided with system and be DALI compliant. Devices shall be designed to operate on system network. Supplemental DALI compliant signal repeaters and controllers shall be provided as required. This equipment shall be identified in shop drawing submission.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be in accordance with the NEC, manufacturer's instructions, as shown on the drawings, and as specified.

B. Aim outdoor photoelectric sensor according to manufacturer's recommendations. Set adjustable window slide for 1 footcandle turn-on.

C. Aiming for wall-mounted and ceiling-mounted motion sensor switches shall be per manufacturer’s recommendations.

D. Set occupancy sensor "on" duration to 5 10 15 minutes.

E. Locate photoelectric sensors as indicated and in accordance with the manufacturer's recommendations. Adjust sensor for the available light level at the typical work plane for that area.

F. Label time switches and contactors with a unique designation.

G. Program lighting control panels per schedule on drawings.

3.2 ACCEPTANCE CHECKS AND TESTS

A. Perform in accordance with the manufacturer's recommendations.

B. Upon completion of installation, conduct an operating test to show that equipment operates in accordance with requirements of this section.

C. Test for full range of dimming ballast and dimming controls capability. Observe for visually detectable flicker over full dimming range.

D. Test occupancy sensors for proper operation. Observe for light control over entire area being covered.

E. Upon completion of the installation, the system shall be commissioned by the manufacturer’s factory-authorized technician who will verify all adjustments and sensor placements.

3.3 FOLLOW-UP VERIFICATION

A. Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that the lighting control devices are in good operating condition and properly performing the intended function in the presence of COR.

3.4 INSTRUCTION

A. Furnish the services of a factory-trained technician for one 8-hour training period for instructing personnel in the maintenance and operation of the lighting control system on the dates requested by the COR.

B. Contractor shall submit written instructions on training and maintenance as reviewed in training session.

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11-01-22

SECTION 26 27 26
WIRING DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, connection, and testing of wiring devices.

1.2 RELATED WORK

A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements that are common to more than one section of Division 26.

B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Cables and wiring.

C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents.

D. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduit and boxes.

E. Section 26 51 00, INTERIOR LIGHTING: Fluorescent ballasts and LED drivers for use with manual dimming controls.

1.3 QUALITY ASSURANCE

A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:

1. Shop Drawings:
   a. Submit sufficient information to demonstrate compliance with drawings and specifications.
   b. Include electrical ratings, dimensions, mounting details, construction materials, grade, and termination information.
2. Manuals:
   a. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals, including

technical data sheets and information for ordering replacement parts.

b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.

3. Certifications: Two weeks prior to final inspection, submit the following.

a. Certification by the manufacturer that the wiring devices conform to the requirements of the drawings and specifications.

b. Certification by the Contractor that the wiring devices have been properly installed and adjusted.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by basic designation only.

B. National Electrical Manufacturers Association (NEMA):
WD 1-99(R2020).....General Color Requirements for Wiring Devices
WD 6-16 .....Wiring Devices – Dimensional Specifications

C. National Fire Protection Association (NFPA):
70-23.....National Electrical Code (NEC)
99-21.....Health Care Facilities

D. Underwriter’s Laboratories, Inc. (UL):
5-16.....Surface Metal Raceways and Fittings
20-18.....General-Use Snap Switches
231-16.....Power Outlets
467-13.....Grounding and Bonding Equipment
498-17.....Attachment Plugs and Receptacles
943-16.....Ground-Fault Circuit-Interrupters
1449-21.....Surge Protective Devices
1472-15.....Solid State Dimming Controls

PART 2 - PRODUCTS

2.1 RECEPTACLES

A. General: All receptacles shall comply with NEMA, NFPA, UL, and as shown on the drawings.

1. Mounting straps shall be nickel plated brass, brass, nickel plated steel or galvanize steel with break-off plaster ears, and shall include a self-grounding feature. Terminal screws shall be brass, brass plated or a copper alloy metal.
2. Receptacles shall have provisions for back wiring with separate metal clamp type terminals (four minimum) and side wiring from four captively held binding screws.

B. Duplex Receptacles - Hospital-grade: shall be listed for hospital grade, single phase, 20 ampere, 120 volts, 2-pole, 3-wire, NEMA 5-20R, with break-off feature for two-circuit operation.
1. Bodies shall be ivory in color.
2. Switched duplex receptacles shall be wired so that only the top receptacle is switched. The lower receptacle shall be unswitched.
3. Duplex Receptacles on Emergency Circuit:
   a. In rooms without emergency powered general lighting, the emergency receptacles shall be of the self-illuminated type.
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 gray 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.
   1. Bodies shall be brown nylon.

D. Receptacles - 20, 30, and 50 ampere, 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 hospital grade attachment plug caps are inserted. Cover plates on outlet boxes mounted flush in the wall shall be gasketed to the wall in a watertight manner.

F. Surge Protective Receptacles shall have integral surge suppression in line to ground, line to neutral, and neutral to ground modes.
   1. Surge Protective 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 Surge Protective Indication: LED, visible in face of device to indicate device is active or no longer in service.

G. Cable Reel Receptacles:
   1. Reel shall have a heavy-duty spring motor, with self-contained rewind power and non-sparking ratchet assembly, a 4-way roller and adjustable cable stop, and a safety chain. Reel shall lock when desired cable has been payed out, and unlock and retract when cable is pulled to release lock.
   2. Reel shall be provided with minimum 40 foot cable rated for 20 30 50 amperes with required phase conductors, neutral, and equipment grounding conductor. Provide device with NEMA configuration as shown two NEMA 5-20R GFCI receptacles.

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 plasters ears and provisions for back wiring with separate metal wiring clamps and side wiring with captively held binding screws.
3. Switches shall be rated 20 amperes at 120-277 Volts AC.

2.3 MANUAL DIMMING CONTROL

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 302 stainless steel or 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 also connected to the branch circuit equipment grounding conductor.

D. Outlet boxes for toggle switches and manual dimming controls shall be mounted on the strike side of doors.

E. Provide barriers in multi-gang outlet boxes to comply with the NEC.

F. Coordinate the electrical work with the work of other trades to ensure that wiring device flush outlets are positioned with box openings aligned with the face of the surrounding finish material. Pay special

attention to installations in cabinet work, and in connection with laboratory equipment.

G. Exact field locations of floors, walls, partitions, doors, windows, and equipment may vary from locations shown on the drawings. Prior to locating sleeves, boxes and chases for roughing-in of conduit and equipment, the Contractor shall coordinate exact field location of the above items with other trades.

H. Install wall switches 1.2 M (48 inches) above floor, with the toggle OFF position down.

I. Install wall dimmers 1.2 M (48 inches) above floor.

J. Install receptacles 450 mm (18 inches) above floor, and 152 mm (6 inches) above counter backsplash or workbenches. Install specific-use receptacles at heights shown on the drawings.

K. Install horizontally mounted receptacles with the ground pin to the right.

L. When required or recommended by the manufacturer, use a torque screwdriver. Tighten unused terminal screws.

M. Label device plates with a permanent adhesive label listing panel and circuit feeding the wiring device.

3.2 ACCEPTANCE CHECKS AND TESTS

A. Perform manufacturer’s required field checks in accordance with the manufacturer's recommendations, and the latest NFPA 99. In addition, include the following:

1. Visual Inspection and Tests:

a. Inspect physical and electrical conditions.

b. Vacuum-clean surface metal raceway interior. Clean metal raceway exterior.

c. Test wiring devices for damaged conductors, high circuit resistance, poor connections, inadequate fault current path, defective devices, or similar problems using a portable receptacle tester. Correct circuit conditions, remove malfunctioning units and replace with new, and retest as specified above.

d. Test GFCI receptacles.

2. Receptacle testing in the Patient Care Spaces, such as retention force of the grounding blade of each receptacle, shall comply with the latest NFPA 99.

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11-01-22

SECTION 26 29 21
ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, and connection of fused and unfused disconnect switches (indicated as switches in this section), and separately-enclosed circuit breakers for use in electrical systems rated 600 V and below.

1.2 RELATED WORK

A. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Requirements for seismic restraint of non-structural components.

B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.

C. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.

D. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground faults.

E. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits.

1.3 QUALITY ASSURANCE

A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:

1. Shop Drawings:
   a. Submit sufficient information to demonstrate compliance with drawings and specifications.
   b. Submit the following data for approval:
      1) Electrical ratings, dimensions, mounting details, materials, required clearances, terminations, weight, fuses, circuit

breakers, wiring and connection diagrams, accessories, and device nameplate data.

c. Certification from the manufacturer that representative enclosed switches and circuit breakers have been seismically tested to International Building Code requirements. Certification shall be based upon simulated seismic forces on a shake table or by analytical methods, but not by experience data or other methods.

2. Manuals:

a. Submit complete maintenance and operating manuals including technical data sheets, wiring diagrams, and information for ordering fuses, circuit breakers, and replacement parts.

1) Include schematic diagrams, with all terminals identified, matching terminal identification in the enclosed switches and circuit breakers.

2) Include information for testing, repair, troubleshooting, assembly, and disassembly.

b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.

3. Certifications: Two weeks prior to final inspection, submit the following.

a. Certification by the manufacturer that the enclosed switches and circuit breakers conform to the requirements of the drawings and specifications.

b. Certification by the Contractor that the enclosed switches and circuit breakers have been properly installed, adjusted, and tested.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

B. International Code Council (ICC):
IBC-21.....International Building Code

C. National Electrical Manufacturers Association (NEMA):
FU l-12.....Low Voltage Cartridge Fuses

KS 1-13.....Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum)

D. National Fire Protection Association (NFPA):

70-23.....National Electrical Code (NEC)

E. Underwriters Laboratories, Inc. (UL):

98-16.....Enclosed and Dead-Front Switches

248 1-11.....Low Voltage Fuses

489-16.....Molded Case Circuit Breakers and Circuit Breaker Enclosures

PART 2 - PRODUCTS

2.1 FUSED SWITCHES RATED 600 AMPERES AND LESS

A. Switches shall be in accordance with NEMA, NEC, UL, as specified, and as shown on the drawings.

B. Shall be NEMA classified General Duty (GD) for 240 V switches, and NEMA classified Heavy Duty (HD) for 480 V switches.

C. Shall be horsepower (HP) rated.

D. Shall have the following features:

1. Switch mechanism shall be the quick-make, quick-break type.
2. Copper blades, visible in the open position.
3. An arc chute for each pole.
4. External operating handle shall indicate open and closed positions, and have lock-open padlocking provisions.
5. Mechanical interlock shall permit opening of the door only when the switch is in the open position, defeatable to permit inspection.
6. Fuse holders for the sizes and types of fuses specified.
7. Solid neutral for each switch being installed in a circuit which includes a neutral conductor.
8. Ground lugs for each ground conductor.
9. Enclosures:
   a. Shall be the NEMA types shown on the drawings.
   b. Where the types of switch enclosures are not shown, they shall be the NEMA types most suitable for the ambient environmental conditions.
   c. Shall be finished with manufacturer’s standard gray baked enamel paint over pretreated steel.

10. Electrically operated switches shall only be installed where shown on the drawings.

2.2 UNFUSED SWITCHES RATED 600 AMPERES AND LESS

A. Shall be the same as fused switches, but without provisions for fuses.

2.3 FUSED SWITCHES RATED OVER 600 AMPERES TO 1200 AMPERES

A. Shall be the same as fused switches, and shall be NEMA classified Heavy Duty (HD).

2.4 MOTOR RATED TOGGLE SWITCHES

A. Type 1, general purpose for single-phase motors rated up to 1 horsepower.

B. Quick-make, quick-break toggle switch with external reset button and thermal overload protection matched to nameplate full-load current of actual protected motor.

2.5 CARTRIDGE FUSES

A. Shall be in accordance with NEMA FU 1.

B. Service Entrance: Class L, fast acting Class L, time delay Class RK1, fast acting Class RK1, time delay Class J, fast acting Class J, time delay Class T, fast acting.

C. Feeders: Class L, fast acting Class L, time delay Class RK1, fast acting Class RK1, time delay Class RK5, fast acting Class RK5, time delay Class J, fast acting Class J, time delay.

D. Motor Branch Circuits: Class RK1 Class RK5, time delay.

E. Other Branch Circuits: Class RK1, time delay Class RK5, time delay Class J, fast acting Class J, time delay.

F. Control Circuits: Class CC, fast acting time delay.

2.6 SEPARATELY-ENCLOSED CIRCUIT BREAKERS

A. Enclosures shall be the NEMA types shown on the drawings. Where the types are not shown, they shall be the NEMA type most suitable for the ambient environmental conditions.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be in accordance with the NEC, as shown on the drawings, and manufacturer’s instructions.

B. In seismic areas, enclosed switches and circuit breakers shall be adequately anchored and braced per details on structural contract

drawings to withstand the seismic forces at the location where installed.

C. Fused switches shall be furnished complete with fuses. Arrange fuses such that rating information is readable without removing the fuses.

3.2 ACCEPTANCE CHECKS AND TESTS

A. Perform in accordance with the manufacturer's recommendations. In addition, include the following:

1. Visual Inspection and Tests:

a. Compare equipment nameplate data with specifications and approved shop drawings.

b. Inspect physical, electrical, and mechanical condition.

c. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method.

d. Vacuum-clean enclosure interior. Clean enclosure exterior.

3.3 SPARE PARTS

A. Two weeks prior to the final inspection, furnish one complete set of spare fuses for each fused disconnect switch installed on the project. Deliver the spare fuses to the COR.

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11-01-22

SECTION 26 41 00
FACILITY LIGHTNING PROTECTION

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing and installation of a complete UL master labeled lightning protection system as an extension of an existing system. Contractor shall be required to submit a Certificate of Compliance for this work.

1.2 RELATED WORK

A. Section 07 60 00, FLASHING AND SHEET METAL: Penetrations through the roof.

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 to ground for possible ground faults.

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. Show locations of air terminals, connections to required metal surfaces, down conductors, and grounding means.
   c. Show the mounting hardware and materials used to attach air terminals and conductors to the structure.
2. Certifications: Two weeks prior to final inspection, submit the following.

a. Certification by the manufacturer that the lightning protection system conforms to the requirements of the drawings and specifications.
b. Certification by the Contractor that the lightning protection system has been properly installed and inspected.
c. Certification that the lightning protection system has been inspected by a UL representative and has been approved by UL without variation.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

B. National Fire Protection Association (NFPA):
70-23.....National Electrical Code (NEC)
780-23.....Standard for the Installation of Lightning Protection Systems

C. Underwriters Laboratories, Inc. (UL):
96-16.....Lightning Protection Components
96A-16.....Installation Requirements for Lightning Protection Systems
467-22.....Standard for Grounding and Bonding Equipment

PART 2 – PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Lightning protection components shall conform to NFPA 780 and UL 96, for use on Class I structures. Copper materials are required.
1. Class I conductors: Copper.
2. Class I air terminals: Solid copper, 460 mm (18 inches) long, not less than 9.5 mm (3/8 inch) diameter, with sharp bare copper points.
3. Ground plates: Solid copper, not less than 20 gauge.
4. Bonding plates: Bronze, 50 square cm (8 square inches).
5. Through roof connectors: Solid copper riser bar, length and type as required to accommodate roof structure and flashing requirements.
6. Down conductor guards: Stiff copper or brass.
7. Anchors and fasteners: Bronze bolt and clamp type shall be used for all applications except for membrane roof. Adhesive type are

allowed only for attachment to membrane roof materials, using adhesive that is compatible with the membrane material.

8. Connectors: Bronze clamp-type connectors shall be used for roof conductor splices, and the connection of the roof conductor to air terminals and bonding plates. Crimp-type connectors are not allowed.
9. Exothermic welds: Exothermic welds shall be used for splicing the roof conductor to the down conductors, splices of the down conductors, and for connection of the down conductors to ground rods, ground plates, and the ground ring.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be in accordance with the NEC, as shown on the drawings, and manufacturer’s instructions.
B. Coordinate installation with the roofing manufacturer and roofing installer.
C. Install the conductors as inconspicuously as practical.
D. Make connections of dissimilar metal with bimetallic type fittings to prevent electrolytic action.
E. Connect roof conductors to all metallic projections and equipment above the roof as indicated on the drawings.
F. Connect exterior metal surfaces, located within 900 mm (3 feet) of the conductors, to the conductors to prevent flashovers.
G. Maintain horizontal or downward coursing of main conductor and ensure that all bends have at least an 200 mm (8 inches) radius and do not exceed 90 degrees.
H. Conductors shall be rigidly fastened every 900 mm (3 feet) along the roof and down to the building to ground.
I. Air terminals shall be secured against overturning either by attachment to the object to be protected or by means of a substantial tripod or other braces permanently and rigidly attached to the building or structure.
J. Install air terminal bases, cable holders and other roof-system supporting means without piercing membrane or metal roofs.

K. Use through-roof connectors for penetration of the roof system. Flashing shall be provided by roofing contractor in accordance with Section 07 60 00, FLASHING AND SHEET METAL.

L. On construction utilizing post tensioning systems to secure precast concrete sections, the post tension rods shall not be used as a path for lightning to ground.

M. Where shown, use the structural steel framework or reinforcing steel as the down conductor.

1. Weld or bond the non-electrically-continuous sections together and make them electrically continuous.
2. Verify the electrical continuity by measuring the ground resistances to earth at the ground level, at the top of the building or stack, and at intermediate points with a sensitive ohmmeter. Compare the resistance readings.
3. Connect the air terminals together with an exterior conductor connected to the structural steel framework at not more than 18 M (60 feet) intervals.
4. Install ground connections to earth at not more than 18 M (60 feet) intervals around the perimeter of the building.
5. Weld or braze bonding plates to cleaned sections of the steel and connect the conductors to the plates.
6. Do not pierce the structural steel in any manner. Connections to the structural steel shall conform to UL 96A.

N. Where the drawings show the new lightning protection system connected to an existing lightning protection system with or without a UL master label, the new portion of the lightning protection system requires UL inspection, a Certificate of Compliance and a Letter of Findings.

3.2 ACCEPTANCE CHECKS AND TESTS

A. Test the ground resistance to earth by standard methods and conform to the ground resistance requirements specified in Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

B. A UL representative shall inspect the lightning protection system. Obtain and install a UL numbered master label for each of the lightning protection systems at the location directed by the UL representative and the COR.

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SECTION 26 51 00

INTERIOR LIGHTING

PART 1 - GENERAL

1.1 DESCRIPTION:

A. This section specifies the furnishing, installation, and connection of the interior lighting systems. The terms "lighting fixture," "fixture," and "luminaire" are used interchangeably.

1.2 RELATED WORK

A. Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT: Disposal of lamps.

B. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Requirement for seismic restraint for nonstructural components.

C. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.

D. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.

E. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents.

F. Section 26 27 26, WIRING DEVICES: Wiring devices used for control of the lighting systems.

1.3 QUALITY ASSURANCE

A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:

1. Shop Drawings:

a. Submit the following information for each type of lighting fixture designated on the LIGHTING FIXTURE SCHEDULE, arranged in order of lighting fixture designation.

b. Material and construction details, include information on housing and optics system.

c. Physical dimensions and description.

d. Wiring schematic and connection diagram.

e. Installation details.

f. Energy efficiency data.

g. Photometric data based on laboratory tests complying with IES Lighting Measurements testing and calculation guides.

h. Lamp data including lumen output (initial and mean), color rendition index (CRI), rated life (hours), and color temperature (degrees Kelvin).

i. Ballast data including ballast type, starting method, ambient temperature, ballast factor, sound rating, system watts, and total harmonic distortion (THD).

j. For LED lighting fixtures, submit US DOE LED Lighting Facts label, and IES L70 rated life.

2. Manuals:

a. Submit, simultaneously with the shop drawings, complete maintenance and operating manuals, including technical data sheets, wiring diagrams, and information for ordering replacement parts.

b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.

3. Certifications: Two weeks prior to final inspection, submit the following.

a. Certification by the Contractor that the interior lighting systems have been properly installed and tested.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

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

C635/C635M-22.....Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings

C. Environmental Protection Agency (EPA):

40 CFR 261-21.....Identification and Listing of Hazardous Waste

D. Federal Communications Commission (FCC):

CFR Title 47, Part 15...Radio Frequency Devices

CFR Title 47, Part 18...Industrial, Scientific, and Medical Equipment

E. Illuminating Engineering Society of North America (IESNA):

LM-79-19.....Electrical and Photometric Measurements of Solid-State Lighting Products

LM-80-21.....Measuring Lumen Maintenance of LED Light Sources

LM-82-19.....Characterization of LED Light Engines and LED Lamps for Electrical and Photometric Properties as a Function of Temperature

F. Institute of Electrical and Electronic Engineers (IEEE):

C62.41-91(R1995).....Surge Voltages in Low Voltage AC Power Circuits

G. International Code Council (ICC):

IBC-21.....International Building Code

H. National Electrical Manufacturer's Association (NEMA):

C78.376-14 (R2021).....Chromaticity of Fluorescent Lamps

C82.1-04(S2021).....Lamp Ballasts – Line Frequency Fluorescent Lamp Ballasts

C82.2-02(S2021).....Method of Measurement of Fluorescent Lamp Ballasts

C82.4-17.....Lamp Ballasts - Ballasts for High-Intensity Discharge and Low-Pressure Sodium (LPS) Lamps (Multiple-Supply Type)

C82.11-17.....Lamp Ballasts - High Frequency Fluorescent Lamp Ballasts

LL 9-11.....Dimming of T8 Fluorescent Lighting Systems

SSL 1-16.....Electronic Drivers for LED Devices, Arrays, or Systems

I. National Fire Protection Association (NFPA):

70-23.....National Electrical Code (NEC)

101-21.....Life Safety Code

J. Underwriters Laboratories, Inc. (UL):

496-17.....Lampholders

542-05.....Fluorescent Lamp Starters
844-12.....Luminaires for Use in Hazardous (Classified) Locations
924-16.....Emergency Lighting and Power Equipment
935-01.....Fluorescent-Lamp Ballasts
1029-94.....High-Intensity-Discharge Lamp Ballasts
1029A-06.....Outline of Investigation for Ignitors and Related Auxiliaries for HID Lamp Ballasts
1574-04.....Standard for Safety Track Lighting Systems
1598-21.....Standard for Safety Luminaires
2108-15.....Standard for Safety Low-Voltage Lighting Systems
8750-15.....Standard for Safety Light Emitting Diode (LED) Light Sources for Use in Lighting Products

PART 2 - PRODUCTS

2.1 LIGHTING FIXTURES

A. Shall be in accordance with NFPA, UL, as shown on drawings, and as specified.

B. Sheet Metal:

1. Shall be formed to prevent warping and sagging. Housing, trim and lens frame shall be true, straight (unless intentionally curved), and parallel to each other as designed.
2. Wireways and fittings shall be free of burrs and sharp edges, and shall accommodate internal and branch circuit wiring without damage to the wiring.
3. When installed, any exposed fixture housing surface, trim frame, door frame, and lens frame shall be free of light leaks.
4. Hinged door frames shall operate smoothly without binding. Latches shall function easily by finger action without the use of tools.

C. Ballasts and lamps shall be serviceable while the fixture is in its normally installed position. Ballasts shall not be mounted to removable reflectors or wireway covers unless so specified.

D. Lamp Sockets:

1. Fluorescent: Single slot entry type, requiring a one-quarter turn of the lamp after insertion. Lampholder contacts shall be the biting edge type.

2. Compact Fluorescent: 4-pin.
3. High Intensity Discharge (HID): Porcelain.

E. Recessed fixtures mounted in an insulated ceiling shall be listed for use in insulated ceilings.

F. Mechanical Safety: Lighting fixture closures (lens doors, trim frame, hinged housings, etc.) shall be retained in a secure manner by captive screws, chains, aircraft cable, captive hinges, or fasteners such that they cannot be accidentally dislodged during normal operation or routine maintenance.

G. Metal Finishes:
1. The manufacturer shall apply standard finish (unless otherwise specified) over a corrosion-resistant primer, after cleaning to free the metal surfaces of rust, grease, dirt and other deposits. Edges of pre-finished sheet metal exposed during forming, stamping or shearing processes shall be finished in a similar corrosion resistant manner to match the adjacent surface(s). Fixture finish shall be free of stains or evidence of rusting, blistering, or flaking, and shall be applied after fabrication.
2. Interior light reflecting finishes shall be white with not less than 85 percent reflectances, except where otherwise shown on the drawing.
3. Exterior finishes shall be as shown on the drawings.

H. Lighting fixtures shall have a specific means for grounding metallic wireways and housings to an equipment grounding conductor.

I. Light Transmitting Components for Fluorescent Fixtures:
1. Shall be 100 percent virgin acrylic.
2. Flat lens panels shall have not less than 3 mm (1/8 inch) of average thickness.
3. Unless otherwise specified, lenses, reflectors, diffusers, and louvers shall be retained firmly in a metal frame by clips or clamping ring in such a manner as to allow expansion and contraction without distortion or cracking.

J. Lighting fixtures in hazardous areas shall be suitable for installation in Class and Division areas as defined in NFPA 70.

K. Compact fluorescent fixtures shall be manufactured specifically for compact fluorescent lamps with ballast integral to the fixture.

Assemblies designed to retrofit incandescent fixtures are prohibited except when specifically indicated for renovation of existing fixtures.

2.2 EMERGENCY LIGHTING UNIT

A. Complete, self-contained unit with batteries, battery charger, one or more local or remote lamp heads with lamps, under-voltage relay, and test switch.

1. Enclosure: Shall be impact-resistant thermoplastic cast aluminum. Enclosure shall be suitable for the environmental conditions in which installed.
2. Lamp Heads: Horizontally and vertically adjustable, mounted on the face of the unit, except where otherwise indicated.
3. Lamps: Shall be sealed-beam MR-16 halogen, rated not less than 12 watts at the specified DC voltage.
4. Battery: Shall be maintenance-free nickel-cadmium. Minimum normal life shall be minimum of 10 years.
5. Battery Charger: Dry-type full-wave rectifier with charging rates to maintain the battery in fully-charged condition during normal operation, and to automatically recharge the battery within 12 hours following a 1-1/2 hour continuous discharge.
6. Integral Self-Test: Automatically initiates test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing LED.

2.3 LED EXIT LIGHT FIXTURES

A. Exit light fixtures shall meet applicable requirements of NFPA and UL.

B. Housing and door shall be die-cast aluminum.

C. For general purpose exit light fixtures, door frame shall be hinged, with latch. For vandal-resistant exit light fixtures, door frame shall be secured with tamper-resistant screws.

D. Finish shall be satin or fine-grain brushed aluminum.

E. There shall be no radioactive material used in the fixtures.

F. Fixtures:

1. Inscription panels shall be cast or stamped aluminum a minimum of 2.25 mm (0.090 inch) thick, stenciled with 150 mm (6 inch) high letters, baked with red color stable plastic or fiberglass. Lamps shall be luminous Light Emitting Diodes (LED) mounted in center of letters on red color stable plastic or fiberglass.

2. Double-Faced Fixtures: Provide double-faced fixtures where required or as shown on drawings.
3. Directional Arrows: Provide directional arrows as part of the inscription panel where required or as shown on drawings. Directional arrows shall be the "chevron-type" of similar size and width as the letters and meet the requirements of NFPA 101.

G. Voltage: Multi-voltage (120 – 277V).

2.4 LED LIGHT FIXTURES

A. General:
1. LED light fixtures shall be in accordance with IES, NFPA, UL, as shown on the drawings, and as specified.
2. LED light fixtures shall be Reduction of Hazardous Substances (RoHS)-compliant.
3. LED drivers shall include the following features unless otherwise indicated:
   a. Minimum efficiency: 85% at full load.
   b. Minimum Operating Ambient Temperature: -20˚ C. (-4˚ F.)
   c. Input Voltage: 120 - 277V (±10%) at 60 Hz.
   d. Integral short circuit, open circuit, and overload protection.
   e. Power Factor: ≥ 0.95.
   f. Total Harmonic Distortion: ≤ 20%.
   g. Comply with FCC 47 CFR Part 15.
4. LED modules shall include the following features unless otherwise indicated:
   a. Comply with IES LM-79 and LM-80 requirements.
   b. Minimum CRI: 80 or higher. Minimum Color Fidelity Index (IES Rf): 80 or higher.
   c. Color temperature between 3500° - 5000°K and as specified in the drawings' LIGHTING FIXTURE SCHEDULE.
   d. Minimum Rated Life: 50,000 hours per IES L70.
   e. Light output lumens as indicated in the LIGHTING FIXTURE SCHEDULE.

B. LED Downlights:
1. Housing, LED driver, and LED module shall be products of the same manufacturer.

C. LED Troffers:
   1. LED drivers, modules, and reflector shall be accessible, serviceable, and replaceable from below the ceiling.
   2. Housing, LED driver, and LED module shall be products of the same manufacturer.
D. LED Emergency Battery Driver:
   1. Input voltage: 120-277 Volt at 60Hz.
   2. Illumination time: 90 minutes.
   3. Operating temperature: 0˚C to 55˚C (32˚F to 131˚F).
   4. Battery: Lithium Ferro Phosphate (LIF)technology, maintenance-free, and high-temperature. Battery shall be integral with the LED Emergency Battery Driver unit.
   5. Test switch: IP65 rated to protect against dust and water.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be in accordance with the NEC, manufacturer's instructions, and as shown on the drawings or specified.
B. Align, mount, and level the lighting fixtures uniformly.
C. Wall-mounted fixtures shall be attached to the studs in the walls, or to a 20 gauge metal backing plate that is attached to the studs in the walls. Lighting fixtures shall not be attached directly to gypsum board.
D. Lighting Fixture Supports:
   1. Shall provide support for all of the fixtures. Supports may be anchored to channels of the ceiling construction, to the structural slab or to structural members within a partition, or above a suspended ceiling.
   2. Shall maintain the fixture positions after cleaning and relamping.
   3. Shall support the lighting fixtures without causing the ceiling or partition to deflect.
   4. Hardware for recessed lighting fixtures:
      a. All fixture mounting devices connecting fixtures to the ceiling system or building structure shall have a capacity for a horizontal force of 100 percent of the fixture weight and a vertical force of 400 percent of the fixture weight.

b. Mounting devices shall clamp the fixture to the ceiling system structure (main grid runners or fixture framing cross runners) at four points in such a manner as to resist spreading of these supporting members. Each support point device shall utilize a screw or approved hardware to "lock" the fixture housing to the ceiling system, restraining the fixture from movement in any direction relative to the ceiling. The screw (size No. 10 minimum) or approved hardware shall pass through the ceiling member (T-bar, channel or spline), or it may extend over the inside of the flange of the channel (or spline) that faces away from the fixture, in a manner that prevents any fixture movement.

c. In addition to the above, the following is required for fixtures exceeding 9 kg (20 pounds) in weight.

1) Where fixtures mounted in ASTM Standard C635 "Intermediate Duty" and "Heavy Duty" ceilings and weigh between 9 kg and 25 kg (20 pounds and 56 pounds), provide two 12 gauge safety hangers hung slack between diagonal corners of the fixture and the building structure.

2) Where fixtures weigh over 25 kg (56 pounds), they shall be independently supported from the building structure by approved hangers. Two-way angular bracing of hangers shall be provided to prevent lateral motion.

d. Where ceiling cross runners are installed for support of lighting fixtures, they must have a carrying capacity equal to that of the main ceiling runners and be rigidly secured to the main runners.

5. Surface mounted lighting fixtures:

a. Fixtures shall be bolted against the ceiling independent of the outlet box at four points spaced near the corners of each unit. The bolts (or stud-clips) shall be minimum 6 mm (1/4 inch) bolt, secured to main ceiling runners and/or secured to cross runners. Non-turning studs may be attached to the main ceiling runners and cross runners with special non-friction clip devices designed for the purpose, provided they bolt through the runner, or are also secured to the building structure by 12 gauge safety hangers. Studs or bolts securing fixtures weighing in excess of 25 kg (56 pounds) shall be supported directly from the building structure.

b. Where ceiling cross runners are installed for support of lighting fixtures, they must have a carrying capacity equal to that of the main ceiling runners and be rigidly secured to the main runners.

c. Fixtures less than 6.8 kg (15 pounds) in weight and occupying less than 3715 sq cm (two square feet) of ceiling area may, when designed for the purpose, be supported directly from the outlet box when all the following conditions are met.

1) Screws attaching the fixture to the outlet box pass through round holes (not key-hole slots) in the fixture body.

2) The outlet box is attached to a main ceiling runner (or cross runner) with approved hardware.

3) The outlet box is supported vertically from the building structure.

d. Fixtures mounted in open construction shall be secured directly to the building structure with approved bolting and clamping devices.

6. Single or double pendant-mounted lighting fixtures:

a. Each stem shall be supported by an approved outlet box mounted swivel joint and canopy which holds the stem captive and provides spring load (or approved equivalent) dampening of fixture oscillations. Outlet box shall be supported vertically from the building structure.

7. Outlet boxes for support of lighting fixtures (where permitted) shall be secured directly to the building structure with approved devices or supported vertically in a hung ceiling from the building structure with a nine gauge wire hanger, and be secured by an approved device to a main ceiling runner or cross runner to prevent any horizontal movement relative to the ceiling.

E. Furnish and install the new lamps as specified for all lighting fixtures installed under this project, and for all existing lighting fixtures reused under this project.

F. The electrical and ceiling trades shall coordinate to ascertain that approved lighting fixtures are furnished in the proper sizes and installed with the proper devices (hangers, clips, trim frames, flanges, etc.), to match the ceiling system being installed.

G. Bond lighting fixtures to the grounding system as specified in Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

H. At completion of project, replace all defective components of the lighting fixtures at no cost to the Government.

I. Dispose of lamps per requirements of Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT.

3.2 ACCEPTANCE CHECKS AND TESTS

A. Perform the following:

1. Visual Inspection:

a. Verify proper operation by operating the lighting controls.

b. Visually inspect for damage to fixtures, lenses, reflectors, diffusers, and louvers. Clean fixtures, lenses, reflectors, diffusers, and louvers that have accumulated dust, dirt, or fingerprints during construction.

2. Electrical tests:

a. Exercise dimming components of the lighting fixtures over full range of dimming capability by operating the control devices(s) in the presence of the COR. Observe for visually detectable flicker over full dimming range, and replace defective components at no cost to the Government.

b. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Government. Burn-in period to be 40 hours minimum, unless specifically recommended otherwise by the lamp manufacturer. Burn-in dimmed fluorescent and compact fluorescent lamps for at least 100 hours at full voltage, unless specifically recommended otherwise by the lamp manufacturer. Replace any lamps and ballasts which fail during burn-in.

3.3 FOLLOW-UP VERIFICATION

A. Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that the lighting systems are in good operating condition and properly performing the intended function.

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SECTION 27 05 11

REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section includes common requirements to communications installations and applies to all sections of Division 27 and Division 28.

B. Provide completely functioning communications systems.

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

1.2 REFERENCES

A. Abbreviations and Acronyms

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

2. Additional Abbreviations and Acronyms:

A	Ampere
AC	Alternating Current
AE	Architect and Engineer
AFF	Above Finished Floor
AHJ	Authority Having Jurisdiction
ANSI	American National Standards Institute
AWG	American Wire Gauge (refer to STP and UTP)
AWS	Advanced Wireless Services
BCT	Bonding Conductor for Telecommunications (also Telecommunications Bonding Conductor (TBC))
BDA	Bi-Directional Amplifier
BICSI	Building Industry Consulting Service International
BIM	Building Information Modeling
BOM	Bill of Materials
BTU	British Thermal Units
BUCR	Back-up Computer Room
BTS	Base Transceiver Station

CAD	AutoCAD
CBOPC	Community Based Out Patient Clinic
CBC	Coupled Bonding Conductor
CBOC	Community Based Out Patient Clinic (refer to CBOPC, OPC, VAMC)
CCS	TIP's Cross Connection System (refer to VCCS and HCCS)
CFE	Contractor Furnished Equipment
CFM	US Department of Veterans Affairs Office of Construction and Facilities Management
CFR	Consolidated Federal Regulations
CIO	Communication Information Officer (Facility, VISN or Region)
cm	Centimeters
CO	Central Office
COR	Contracting Officer Representative
CPU	Central Processing Unit
CSU	Customer Service Unit
CUP	Conditional Use Permit(s) - Federal/GSA for VA
dB	Decibel
dBm	Decibel Measured
dBmV	Decibel per milli-Volt
DC	Direct Current
DEA	United States Drug Enforcement Administration
DSU	Data Service Unit
EBC	Equipment Bonding Conductor
ECC	Engineering Control Center (refer to DCR, EMCR)
EDGE	Enhanced Data (Rates) for GSM Evolution
EDM	Electrical Design Manual
EMCR	Emergency Management Control Room (refer to DCR, ECC)
EMI	Electromagnetic Interference (refer to RFI)
EMS	Emergency Medical Service

EMT	Electrical Metallic Tubing or thin wall conduit
ENTR	Utilities Entrance Location (refer to DEMARC, POTS, LEC)
EPBX	Electronic Digital Private Branch Exchange
ESR	Vendor's Engineering Service Report
FA	Fire Alarm
FAR	Federal Acquisition Regulations in Chapter 1 of Title 48 of Code of Federal Regulations
FMS	VA's Headquarters or Medical Center Facility's Management Service
FR	Frequency (refer to RF)
FTS	Federal Telephone Service
GFE	Government Furnished Equipment
GPS	Global Positioning System
GRC	Galvanized Rigid Metal Conduit
GSM	Global System (Station) for Mobile
HCCS	TIP's Horizontal Cross Connection System (refer to CCS & VCCS)
HDPE	High Density Polyethylene Conduit
HDTV	Advanced Television Standards Committee High-Definition Digital Television
HEC	Head End Cabinets(refer to HEIC, PA)
HEIC	Head End Interface Cabinets(refer to HEC, PA)
HF	High Frequency (Radio Band; Re FR, RF, VHF & UHF)
HSPA	High Speed Packet Access
HZ	Hertz
IBT	Intersystem Bonding Termination (NEC 250.94)
IC	Intercom
ICRA	Infectious Control Risk Assessment
IDEN	Integrated Digital Enhanced Network
IDC	Insulation Displacement Contact
IDF	Intermediate Distribution Frame

ILSM	Interim Life Safety Measures
IMC	Rigid Intermediate Steel Conduit
IRM	Department of Veterans Affairs Office of Information Resources Management
ISDN	Integrated Services Digital Network
ISM	Industrial, Scientific, Medical
IWS	Intra-Building Wireless System
LAN	Local Area Network
LBS	Location Based Services, Leased Based Systems
LEC	Local Exchange Carrier (refer to DEMARC, PBX & POTS)
LED	Light Emitting Diode
LMR	Land Mobile Radio
LTE	Long Term Evolution, or 4G Standard for Wireless Data Communications Technology
M	Meter
MAS	Medical Administration Service
MATV	Master Antenna Television
MCR	Main Computer Room
MCOR	Main Computer Operators Room
MDF	Main Distribution Frame
MH	Manholes or Maintenance Holes
MHz	Megaherts (10^6 Hz)
mm	Millimeter
MOU	Memorandum of Understanding
MW	Microwave (RF Band, Equipment or Services)
NID	Network Interface Device (refer to DEMARC)
NEC	National Electric Code
NOR	Network Operations Room
NRTL	OSHA Nationally Recognized Testing Laboratory
NS	Nurse Stations
NTIA	U.S. Department of Commerce National Telecommunications and Information Administration

OEM	Original Equipment Manufacturer
OI&T	Office of Information and Technology
OPC	VA's Outpatient Clinic (refer to CBOC, VAMC)
OSH	Department of Veterans Affairs Office of Occupational Safety and Health
OSHA	United States Department of Labor Occupational Safety and Health Administration
OTDR	Optical Time-Domain Reflectometer
PA	Public Address System (refer to HE, HEIC, RPEC)
PBX	Private Branch Exchange (refer to DEMARC, LEC, POTS)
PCR	Police Control Room (refer to SPCC, could be designated SCC)
PCS	Personal Communications Service (refer to UPCS)
PE	Professional Engineer
PM	Project Manager
PoE	Power over Ethernet
POTS	Plain Old Telephone Service (refer to DEMARC, LEC, PBX)
PSTN	Public Switched Telephone Network
PSRAS	Public Safety Radio Amplification Systems
PTS	Pay Telephone Station
PVC	Poly-Vinyl Chloride
PWR	Power (in Watts)
RAN	Radio Access Network
RBB	Rack Bonding Busbar
RE	Resident Engineer or Senior Resident Engineer
RF	Radio Frequency (refer to FR)
RFI	Radio Frequency Interference (refer to EMI)
RFID	RF Identification (Equipment, System or Personnel)
RMC	Rigid Metal Conduit
RMU	Rack Mounting Unit

RPEC	Radio Paging Equipment Cabinets(refer to HEC, HEIC, PA)
RTLS	Real Time Location Service or System
RUS	Rural Utilities Service
SCC	Security Control Console (refer to PCR, SPCC)
SMCS	Spectrum Management and Communications Security (COMSEC)
SFO	Solicitation for Offers
SME	Subject Matter Experts (refer to AHJ)
SMR	Specialized Mobile Radio
SMS	Security Management System
SNMP	Simple Network Management Protocol
SPCC	Security Police Control Center (refer to PCR, SMS)
STP	Shielded Balanced Twisted Pair (refer to UTP)
STR	Stacked Telecommunications Room
TAC	VA’s Technology Acquisition Center, Austin, Texas
TCO	Telecommunications Outlet
TER	Telephone Equipment Room
TGB	Telecommunications Grounding Busbar (also Secondary Bonding Busbar (SBB))
TIP	Telecommunications Infrastructure Plant
TMGB	Telecommunications Main Grounding Busbar (also Primary Bonding Busbar (PBB))
TMS	Traffic Management System
TOR	Telephone Operators Room
TP	Balanced Twisted Pair (refer to STP and UTP)
TR	Telecommunications Room (refer to STR)
TWP	Twisted Pair
UHF	Ultra High Frequency (Radio)
UMTS	Universal Mobile Telecommunications System
UPCS	Unlicensed Personal Communications Service (refer to PCS)

UPS	Uninterruptible Power Supply
USC	United States Code
UTP	Unshielded Balanced Twisted Pair (refer to TP and STP)
UV	Ultraviolet
V	Volts
VAAR	Veterans Affairs Acquisition Regulation
VACO	Veterans Affairs Central Office
VAMC	VA Medical Center (refer to CBOC, OPC, VACO)
VCCS	TIP's Vertical Cross Connection System (refer to CCS and HCCS)
VHF	Very High Frequency (Radio)
VISN	Veterans Integrated Services Network (refers to geographical region)
VSWR	Voltage Standing Wave Radio
W	Watts
WEB	World Electronic Broadcast
WiMAX	Worldwide Interoperability (for MW Access)
WI-FI	Wireless Fidelity
WMTS	Wireless Medical Telemetry Service
WSP	Wireless Service Providers

B. Definitions:

1. Access Floor: Pathway system of removable floor panels supported on adjustable pedestals to allow cable placement in area below.
2. BNC Connector (BNC): United States Military Standard MIL-C-39012/21 bayonet-type coaxial connector with quick twist mating/unmating, and two lugs preventing accidental disconnection from pulling forces on cable.
3. Bond: Permanent joining of metallic parts to form an electrically conductive path to ensure electrical continuity and capacity to safely conduct any currents likely to be imposed to earth ground.
4. Bundled Microducts: All forms of jacketed microducts.

5. Conduit: Includes all raceway types specified.
6. Conveniently Accessible: Capable of being reached without use of ladders, or without climbing or crawling under or over obstacles such as, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.
7. Distributed (in house) Antenna System (DAS): An Emergency Radio Communications System installed for Emergency Responder (or first responders and Government personnel) use while inside facility to maintain contact with each respective control point; refer to Section 27 53 19, DISTRIBUTED RADIO ANTENNA (WITHIN BUILDING) EQUIPMENT AND SYSTEMS.
8. DEMARC, Extended DMARC or ENTR: Service provider's main point of demarcation owned by LEC or service provider and establishes a physical point where service provider's responsibilities for service and maintenance end. This point is called NID, in data networks.
9. Effectively Grounded: Intentionally bonded to earth through connections of low impedance having current carrying capacity to prevent buildup of currents and voltages resulting in hazard to equipment or persons.
10. Electrical Supervision: Analyzing a system’s function and components (i.e. cable breaks / shorts, inoperative stations, lights, LEDs and states of change, from primary to backup) on a 24/7/365 basis; provide aural and visual emergency notification signals to minimum two remote designated or accepted monitoring stations.
11. Electrostatic Interference (ESI) or Electrostatic Discharge Interference: Refer to EMI and RFI.
12. Emergency Call Systems: Wall units (in parking garages and stairwells) and pedestal mounts (in parking lots) typically provided with a strobe, camera and two-way audio communication functions. 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 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)

3. US Department of Commerce/National Institute of Standards Technology,(NIST):

FIPS PUB 1-1	Telecommunications Information Exchange
FIPS PUB 100/1	Interface between Data Terminal Equipment (DTE) Circuit Terminating Equipment for operation with Packet Switched Networks, or Between Two DTEs, by Dedicated Circuit
FIPS PUB 140/2	Telecommunications Information Security Algorithms
FIPS PUB 143	General Purpose 37 Position Interface between DTE and Data Circuit Terminating Equipment
FIPS 160/2	Electronic Data Interchange (EDI),
FIPS 175	Federal Building Standard for Telecommunications Pathway and Spaces
FIPS 191	Guideline for the Analysis of Local Area Network Security
FIPS 197	Advanced Encryption Standard (AES)

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

4. US Department of Defense, (DoD):

MIL-STD-188-110	Interoperability and Performance Standards for Data Modems
MIL-STD-188-114	Electrical Characteristics of Digital Interface Circuits
MIL-STD-188-115	Communications Timing and Synchronizations Subsystems
MIL-C-28883	Advanced Narrowband Digital Voice Terminals
MIL-C-39012/21	Connectors, Receptacle, Electrical, Coaxial, Radio Frequency, (Series BNC (Uncabled), Socket Contact, Jam Nut Mounted, Class 2)

5. US Department of Health and Human Services:
   The Health Insurance Portability and Accountability Act of 1996 (HIPAA) Privacy, Security and Breach Notification Rules
6. US Department of Justice:
   2010 Americans with Disabilities Act Standards for Accessible Design (ADAAD).
7. US Department of Labor, (DoL) - Public Law 426-62 – CFR, Title 29, Part 1910, Chapter XVII - Occupational Safety and Health Administration (OSHA), Occupational Safety and Health Standards):

Subpart 7	Approved NRTLs; obtain a copy at https:www.osha.gov/dts/otpca/nrtl/nrtllist.html
Subpart 35	Compliance with NFPA 101, Life Safety Code
Subpart 36	Design and Construction Requirements for Exit Routes
Subpart 268	Telecommunications
Subpart 305	Wiring Methods, Components, and Equipment for General Use
Subpart 508	Americans with Disabilities Act Accessibility Guidelines; technical requirement for accessibility to buildings and facilities by individuals with disabilities

8. US Department of Transportation, (DoT):

a. Public Law 85-625, CFR, Title 49, Part 1, Subpart C – Federal Aviation Administration (FAA):AC 110/460-ID & AC 707 / 460-2E – Advisory Circulars Standards for Construction of Antenna Towers, and 7450 and 7460-2 – Antenna Construction Registration Forms.

9. US Department of Veterans Affairs (VA): Office of Telecommunications (OI&T), MP-6, PART VIII, TELECOMMUNICATIONS, CHAPTER 5, AUDIO, RADIO AND TELEVISION (and COMSEC) COMMUNICATIONS SYSTEMS: Spectrum Management and COMSEC Service (SMCS), AHJ for:
   a. CoG, "Continuance of Government" communications guidelines and compliance.
   b. COMSEC,"VA wide coordination and control of security classified communication assets."
   c. COOP, "Continuance of Operations" emergency communications guidelines and compliance.
   d. FAA, FCC, and US Department of Commerce National Telecommunications and Information Administration, "VA wide RF Co-ordination, Compliance and Licensing."
   e. Handbook 6100 – Telecommunications: Cyber and Information Security Office of Cyber and Information Security, and Handbook 6500 – Information Security Program.
   f. Low Voltage Special Communications Systems "Design, Engineering, Construction Contract Specifications and Drawings Conformity, Proof of Performance Testing, VA Compliance and Life Safety Certifications for CFM and VA Facility Low Voltage Special Communications Projects (except Fire Alarm, Telephone and Data Systems)."
   g. SATCOM, "Satellite Communications" guidelines and compliance, and Security and Law Enforcement Systems – "Coordinates the Design, Engineering, Construction Contract Specifications and Drawings Conformity, Proof of Performance Testing, VA Compliance, DEA and Public Safety Certification(s) for CFM and VA Facility Security Low Voltage Special Communications and Physical Security Projects.
   h. VHA's National Center for Patient Safety – Veterans Health Administration (VHA) Warning System, Failure of Medical Alarm

Systems using Paging Technology to Notify Clinical Staff, July 2004.

i. VA's CEOSH, concurrence with warning identified in VA Directive 7700.

j. Wireless and Handheld Devices, "Guidelines and Compliance,"

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

C. NRTL Standards: Refer to https:www.osha.gov/laws-regs/regulations/standardnumber/1926

1. Canadian Standards Association (CSA); same tests as presented by UL
2. Communications Certifications Laboratory (CEL); same tests as presented by UL.
3. Intertek Testing Services NA, Inc., (ITSNA), formerly Edison Testing Laboratory (ETL) same tests as presented by UL).
4. Underwriters Laboratory (UL):

1-2005	Flexible Metal Conduit
5-2011	Surface Metal Raceway and Fittings
6-2007	Rigid Metal Conduit
44-010	Thermoset-Insulated Wires and Cables
50-1995	Enclosures for Electrical Equipment
65-2010	Wired Cabinets
83-2008	Thermoplastic-Insulated Wires and Cables
96-2005	Lightning Protection Components
96A-2007	Installation Requirements for Lightning Protection Systems
360-2013	Liquid-Tight Flexible Steel Conduit
444-2008	Communications Cables
467-2013	Grounding and Bonding Equipment
486A-486B-2013	Wire Connectors
486C-2013	Splicing Wire Connectors
486D-2005	Sealed Wire Connector Systems
486E-2009	Standard for Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors
493-2007	Thermoplastic-Insulated Underground Feeder and Branch Circuit Cable
497/497A/497B/497C	

497D/497E	Protectors for Paired Conductors/Communications Circuits/Data Communications and Fire Alarm Circuits/coaxial circuits/voltage protections/Antenna Lead In
510-2005	Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape
514A-2013	Metallic Outlet Boxes
514B-2012	Fittings for Cable and Conduit
514C-1996	Nonmetallic Outlet Boxes, Flush-Device Boxes and Covers
651-2011	Schedule 40 and 80 Rigid PVC Conduit
651A-2011	Type EB and A Rigid PVC Conduit and HDPE Conduit
797-2007	Electrical Metallic Tubing
884-2011	Underfloor Raceways and Fittings
1069-2007	Hospital Signaling and Nurse Call Equipment
1242-2006	Intermediate Metal Conduit
1449-2006	Standard for Transient Voltage Surge Suppressors
1479-2003	Fire Tests of Through-Penetration Fire Stops
1480-2003	Speaker Standards for Fire Alarm, Emergency, Commercial and Professional use
1666-2007	Standard for Wire/Cable Vertical (Riser) Tray Flame Tests
1685-2007	Vertical Tray Fire Protection and Smoke Release Test for Electrical and Fiber Optic Cables
1861-2012	Communication Circuit Accessories
1863-2013	Standard for Safety, communications Circuits Accessories
1865-2007	Standard for Safety for Vertical-Tray Fire Protection and Smoke-Release Test for Electrical and Optical-Fiber Cables
2024-2011	Standard for Optical Fiber Raceways
2024-2014	Standard for Cable Routing Assemblies and Communications Raceways
2196-2001	Standard for Test of Fire Resistive Cable

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

D. Industry Standards:

1. Advanced Television Systems Committee (ATSC):

A/53 Part 1: 2013	ATSC Digital Television Standard, Part 1, Digital Television System
A/53 Part 2: 2011	ATSC Digital Television Standard, Part 2, RF/Transmission System Characteristics
A/53 Part 3: 2013	ATSC Digital Television Standard, Part 3, Service Multiplex and Transport System Characteristics
A/53 Part 4: 2009	ATSC Digital Television Standard, Part 4, MPEG-2 Video System Characteristics
A/53 Part 5: 2014	ATSC Digital Television Standard, Part 5, AC-3 Audio System Characteristics
A/53 Part 6: 2014	ATSC digital Television Standard, Part 6, Enhanced AC-3 Audio System Characteristics

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

3. American Society of Mechanical Engineers (ASME):

A17.1 (2013)	Safety Code for Elevators and Escalators Includes Requirements for Elevators, Escalators, Dumbwaiters, Moving Walks, Material Lifts, and Dumbwaiters with Automatic Transfer Devices
17.3 (2011)	Safety Code for Existing Elevators and Escalators
17.4 (2009)	Guide for Emergency Personnel
17.5 (2011)	Elevator and Escalator Electrical Equipment

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

B1 (2001)	Standard Specification for Hard-Drawn Copper Wire
B8 (2004)	Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

D1557 (2012)	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort 56,000 ft-lbf/ft3 (2,700 kN-m/m3)
D2301 (2004)	Standard Specification for Vinyl Chloride Plastic Pressure Sensitive Electrical Insulating Tape
B258-02 (2008)	Standard Specification for Standard Nominal Diameters and Cross-Sectional Areas of AWG Sizes of Solid Round Wires Used as Electrical Conductors
D709-01(2007)	Standard Specification for Laminated Thermosetting Materials
D4566 (2008)	Standard Test Methods for Electrical Performance Properties of Insulations and Jackets for Telecommunications Wire and Cable

5. American Telephone and Telegraph Corporation (AT&T) - Obtain following AT&T Publications at https:ebiznet.sbc.com/sbcnebs/

ATT-TP-76200 (2013)	Network Equipment and Power Grounding, Environmental, and Physical Design Requirements
ATT-TP-76300(2012)	Merged AT&T Affiliate Companies Installation Requirements
ATT-TP-76305 (2013)	Common Systems Cable and Wire Installation and Removal Requirements - Cable Racks and Raceways
ATT-TP-76306 (2009)	Electrostatic Discharge Control
ATT-TP-76400 (2012)	Detail Engineering Requirements
ATT-TP-76402 (2013)	AT&T Raised Access Floor Engineering and Installation Requirements
ATT-TP-76405 (2011)	Technical Requirements for Supplemental Cooling Systems in Network Equipment Environments
ATT-TP-76416 (2011)	Grounding and Bonding Requirements for Network Facilities
ATT-TP-76440 (2005)	Ethernet Specification
ATT-TP-76450 (2013)	Common Systems Equipment Interconnection Standards for AT&T Network Equipment Spaces
ATT-TP-76461 (2008)	Fiber Optic Cleaning
ATT-TP-76900 (2010)	AT&T Installation Testing Requirement

ATT-TP-76911 (1999) AT&T LEC Technical Publication Notice

6. British Standards Institution (BSI):

BS EN 50109-2 Hand Crimping Tools - Tools for The Crimp Termination of Electric Cables and Wires for Low Frequency and Radio Frequency Applications – All Parts & Sections. October 1997

7. Building Industry Consulting Service International(BICSI):

ANSI/BICSI 002-2011 Data Center Design and Implementation Best Practices

ANSI/BICSI 004-2012 Information Technology Systems Design and Implementation Best Practices for Healthcare Institutions and Facilities

ANSI/NECA/BICSI 568-2006 Standard for Installing Commercial Building Telecommunications Cabling

NECA/BICSI 607-2011 Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings

ANSI/BICSI 005-2013 Electronic Safety and Security (ESS) System Design and Implementation Best Practices

8. Electronic Components Assemblies and Materials Association,(ECA).

ECA EIA/RS-270 (1973) Tools, Crimping, Solderless Wiring Devices – Recommended Procedures for User Certification

EIA/ECA 310-E (2005) Cabinets, and Associated Equipment

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

10. Insulated Cable Engineers Association (ICEA):

ANSI/ICEA S-80-576-2002 Category 1 & 2 Individually Unshielded Twisted-Pair Indoor Cables for Use in Communications Wiring Systems

ANSI/ICEA S-84-608-2010 Telecommunications Cable, Filled Polyolefin Insulated Copper Conductor, S-87-640(2011) Optical Fiber Outside Plant Communications Cable

ANSI/ICEA	
S-90-661-2012	Category 3, 5, & 5e Individually Unshielded Twisted-Pair Indoor Cable for Use in General Purpose and LAN Communication Wiring Systems
S-98-688 (2012)	Broadband Twisted Pair Cable Aircore, Polyolefin Insulated, Copper Conductors
S-99-689 (2012)	Broadband Twisted Pair Cable Filled, Polyolefin Insulated, Copper Conductors
ICEA S-102-700 (2004)	Category 6 Individually Unshielded Twisted Pair Indoor Cables (With or Without an Overall Shield) for use in Communications Wiring Systems Technical Requirements

11. Institute of Electrical and Electronics Engineers (IEEE):

ISSN 0739-5175	March-April 2008 Engineering in Medicine and Biology Magazine, IEEE (Volume: 27, Issue:2) Medical Grade-Mission Critical-Wireless Networks
IEEE C2-2012	National Electrical Safety Code (NESC)
C62.41.2-2002/ Cor 1-2012 IEEE	Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits 4)
C62.45-2002	IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits
81-2012 IEEE	Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System
100-1992	IEEE the New IEEE Standards Dictionary of Electrical and Electronics Terms
602-2007	IEEE Recommended Practice for Electric Systems in Health Care Facilities
1100-2005	IEEE Recommended Practice for Powering and Grounding Electronic Equipment

12. International Code Council:

AC193 (2014)	Mechanical Anchors in Concrete Elements

13. International Organization for Standardization (ISO):

ISO/TR 21730 (2007)	Use of Mobile Wireless Communication and Computing Technology in Healthcare Facilities - Recommendations for Electromagnetic Compatibility (Management of Unintentional Electromagnetic Interference) with Medical Devices

14. National Electrical Manufacturers Association (NEMA):

NEMA 250 (2008)	Enclosures for Electrical Equipment (1,000V Maximum)
ANSI C62.61 (1993)	American National Standard for Gas Tube Surge Arresters on Wire Line Telephone Circuits
ANSI/NEMA FB 1 (2012)	Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing EMT) and Cable
ANSI/NEMA OS 1 (2009)	Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
NEMA SB 19 (R2007)	NEMA Installation Guide for Nurse Call Systems
TC 3 (2004)	Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing
NEMA VE 2 (2006)	Cable Tray Installation Guidelines

15. National Fire Protection Association (NFPA):

70E-2015	Standard for Electrical Safety in the Workplace
70-2014	National Electrical Code (NEC)
72-2013	National Fire Alarm Code
75-2013	Standard for the Fire Protection of Information Technological Equipment
76-2012	Recommended Practice for the Fire Protection of Telecommunications Facilities
77-2014	Recommended Practice on Static Electricity
90A-2015	Standard for the Installation of Air Conditioning and Ventilating Systems
99-2015	Health Care Facilities Code
101-2015	Life Safety Code

241	Safeguarding construction, alternation and Demolition Operations
255-2006	Standard Method of Test of Surface Burning Characteristics of Building Materials
262 - 2011	Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces
780-2014	Standard for the Installation of Lightning Protection Systems
1221-2013	Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems
5000-2015	Building Construction and Safety Code

16. Society for Protective Coatings (SSPC):
    SSPC SP 6/NACE No.3 (2007) Commercial Blast Cleaning
17. Society of Cable Telecommunications Engineers (SCTE):

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

18. Telecommunications Industry Association (TIA):

TIA-120 Series	Telecommunications Land Mobile communications (APCO/Project 25) (January 2014)
TIA TSB-140	Additional Guidelines for Field-Testing Length, Loss and Polarity of Optical Fiber Cabling Systems (2004)
TIA-155	Guidelines for the Assessment and Mitigation of Installed Category 6 Cabling to Support 10GBASE-T (2010)
TIA TSB-162-A	Telecommunications Cabling Guidelines for Wireless Access Points (2013)
TIA-222-G	Structural Standard for Antenna Supporting Structures and Antennas (2014)
TIA/EIA-423-B	Electrical Characteristics of Unbalanced Voltage Digital Interface Circuits (2012)
TIA-455-C	General Requirements for Standard Test Procedures for Optical Fibers, Cables, Transducers, Sensors, Connecting and

	Terminating Devices, and other Fiber Optic Components (August 2014)
TIA-455-53-A	FOTP-53 Attenuation by Substitution Measurements for Multimode Graded-Index Optical Fibers in Fiber Assemblies (Long Length) (September 2001)
TIA-455-61-A	FOTP-61 Measurement of Fiber of Cable Attenuation Using an OTDR (July 2003)
TIA-472D000-B	Fiber Optic Communications Cable for Outside Plant Use (July 2007)
ANSI/TIA-492-B	62.5-µ Core Diameter/125-um Cladding Diameter Class 1a Graded-Index Multimode Optical Fibers (November 2009)
ANSI/TIA-492AAAB-A	50-um Core Diameter/125-um Cladding Diameter Class IA Graded-Index Multimode Optically Optimized American Standard Fibers (November 2009
TIA-492CAAA	Detail Specification for Class IVa Dispersion-Unshifted Single-Mode Optical Fibers (September 2002)
TIA-492E000	Sectional Specification for Class IVd Nonzero-Dispersion Single-Mode Optical Fibers for the 1,550 nm Window (September 2002)
TIA-526-7-B	Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant – OFSTP-7 (December 2008)
TIA-526.14-A	Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant – SFSTP-14 (August 1998)
TIA-568	Revision/Edition: C Commercial Building Telecommunications Cabling Standard Set: (TIA-568-C.0-2 Generic Telecommunications Cabling for Customer Premises (2012), TIA-568-C.1-1 Commercial Building Telecommunications Cabling Standard Part 1: General Requirements (2012), TIA-568-C.2 Commercial Building

	Telecommunications Cabling Standard—Part 2: Balanced Twisted Pair Cabling Components (2009), TIA-568-C.3-1 Optical Fiber Cabling Components Standard, (2011) AND TIA-568-C.4 Broadband Coaxial Cabling and Components Standard (2011) with addendums and erratas
TIA-569	Revision/Edition C Telecommunications Pathways and Spaces (March 2013)
TIA-574	Position Non-Synchronous Interface between Data Terminal equipment and Data Circuit Terminating Equipment Employing Serial Binary Interchange (May 2003)
TIA/EIA-590-A	Standard for Physical Location and Protection of Below Ground Fiber Optic Cable Plant (July 2001)
TIA-598-D	Optical Fiber Cable Color Coding (January 2005)
TIA-604-10-B	Fiber Optic Connector Intermateablility Standard (August 2008)
ANSI/TIA-606-B	Administration Standard for Telecommunications Infrastructure (2012)
TIA-607-B	Generic Telecommunications Bonding and Grounding (Earthing) For Customer Premises (January 2013)
TIA-613	High Speed Serial Interface for Data Terminal Equipment and Data Circuit Terminal Equipment (September 2005)
ANSI/TIA-758-B	Customer-owned Outside Plant Telecommunications Infrastructure Standard (April 2012)
ANSI/TIA-854	A Full Duplex Ethernet Specification for 1000 Mb/s (1000BASE-TX) Operating over Category 6 Balanced Twisted-Pair Cabling (2001)
ANSI/TIA-862-A	Building Automation Systems Cabling Standard (April 2011)
TIA-942-A	Telecommunications Infrastructure Standard for Data Centers (March 2014)

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

1.4 SINGULAR NUMBER

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

1.5 RELATED WORK

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

1. Field Cutting and Patching: Section 09 91 00, PAINTING.
2. Additional submittal requirements: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
3. Availability and source of references and standards specified in applicable publications: Section 01 42 19, REFERENCE STANDARDS.
4. Control of environmental pollution and damage for air, water, and land resources: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.
5. Requirements for non-hazardous building construction and demolition waste: Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT.
6. General requirements and procedures to comply with various federal mandates and U.S. Department of Veterans Affairs (VA) policies for sustainable design: Section 01 81 13,SUSTAINABLE DESIGN REQUIREMENTS.
7. Closures of openings in walls, floors, and roof decks against penetration of flame, heat, and smoke or gases in fire resistant rated construction: Section 07 84 00, FIRESTOPPING.
8. Sealant and caulking materials and their application: Section 07 92 00, JOINT SEALANTS.
9. General electrical requirements that are common to more than one section of Division 26: Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
10. 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.

11. Conduit and boxes: Section 26 05 33, RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS.
12. Wiring devices: Section 26 27 26, WIRING DEVICES.
13. Underground ducts, raceways, precast manholes and pull boxes: Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION.
14. General requirements common to more than one section in Division 28: Section 28 05 00, COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY.
15. Conductors and cables for electronic safety and security systems: Section 28 05 13, CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY.
16. Low impedance path to ground for electronic safety and security system ground fault currents: Section 28 05 26, GROUNDING AND BONDING FOR SECURITY SYSTEMS.
17. Conduits and partitioned telecommunications raceways for Electronic Safety and Security systems: Section 28 05 28.33, CONDUITS AND BACK BOXES FOR ELECTRONIC SAFETY AND SECURITY.
18. Physical Access Control System field-installed controllers connected by data transmission network: Section 28 13 00, PHYSICAL ACCESS DETECTION.
19. Video surveillance system cameras, data transmission wiring, and control stations with associated equipment: Section 28 23 00, VIDEO SURVEILLANCE EQUIPMENT AND SYSTEMS.
20. Duress-panic alarms, emergency phones or call boxes, intercom systems, data transmission wiring and associated equipment.
21. Alarm initiating devices, alarm notification appliances, control units, fire safety control devices, annunciators, power supplies, and wiring: Section 28 31 00, FIRE DETECTION AND ALARM.

1.6 ADMINISTRATIVE REQUIREMENTS

A. Assign a single communications project manager to serve as point of contact for Government, contractor, and design professional.

B. Be proactive in scheduling work.

1. Use of premises is restricted at times directed by COR.
2. Movement of materials: Unload materials and equipment delivered to site. Pay costs for rigging, hoisting, lowering and moving equipment on and around site, in building or on roof.

3. Coordinate installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
4. Sequence, coordinate, and integrate installations of materials and equipment for efficient flow of Work. Plan for large equipment requiring positioning prior to closing in building.
5. Coordinate connection of materials, equipment, and systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies; provide required connection for each service.
6. Initiate and maintain discussion regarding schedule for ceiling construction and install cables to meet that schedule.

C. Contact the Office of Telecommunications, Special Communications Team (005OP2H3) (202)461-5310 to have a Government-accepted Telecommunications COR assigned to project for telecommunications review, equipment and system approval and coordination with other VA personnel.

D. Communications Project Manager Responsibilities:
1. Assume responsibility for overall telecommunications system integration and coordination of work among trades, subcontractors, and authorized system installers.
2. Coordinate with related work indicated on drawings or specified.
3. Manage work related to telecommunications system installation in a manner approved by manufacturer.

1.7 SUBMITTALS

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

B. Provide parts list including quantity of spare parts.

C. Provide manufacturer product information. Government reserves the right to require a list of installations where products have been in operation.

D. Provide Source Quality Control Submittal:
1. Submit written certification from OEM indicating that proposed supervisor of installation and proposed provider of warranty maintenance are authorized representatives of OEM. Include

individual's legal name, contact information and OEM credentials in certification.

2. Submit written certification from OEM that wiring and connection diagrams meet Government Life Safety Guidelines, NFPA, NEC, NRTL, these specifications, and Joint Commission requirements and instructions, requirements, recommendations, and guidance set forth by OEM for the proper performance of system.
3. Pre-acceptance Certification: Certification in accordance with procedure outlined in Section 01 00 00, GENERAL REQUIREMENTS and specific Division 27 qualification documentation.

E. Installer Qualifications: Submit three installations of similar size and complexity furnished and installed by installer; include:
1. Installation location and name.
2. Owner’s name and contact information including, address, telephone and email.
3. Date of project start and date of final acceptance.
4. System project number.
5. Three paragraph description of each system related to this project; include function, operation, and installation.

F. Provide delegated design submittals (e.g. seismic support design).

G. Submittals are required for all equipment anchors and supports. Include weights, dimensions, center of gravity, standard connections, manufacturer's recommendations and behavior problems (e.g., vibration, thermal expansion,) associated with equipment or conduit. Anchors and supports to resist seismic load based on seismic design categories per section 4.0 of VA seismic design requirements H-18-8 dated August, 2013.

H. Test Equipment List:
1. Supply test equipment of accuracy better than parameters to be tested.
2. Submit test equipment list including make and model number:
   a. ANSI/TIA-1152 Level IIIe IV twisted pair cabling test instrument.
   b. Fiber optic insertion loss power meter with light source.
   c. Optical time domain reflectometer (OTDR).
   d. Volt-Ohm meter.

e. Digital camera.

f. Bit Error Test Set (BERT).

g. Signal level meter.

h. Time domain reflectometer (TDR) with strip chart recorder (Data and Optical Measuring).

i. Spectrum analyzer.

j. Color video monitor with audio capability.

k. Video waveform monitor.

l. Video vector scope.

m. 100 MHz oscilloscope with video adapters.

3. Supply only test equipment with a calibration tag from Government-accepted calibration service dated not more than 12 months prior to test.

4. Provide sample test and evaluation reports.

I. Submittal Drawings:

1. Telecommunications Space Plans/Elevations: Provide enlarged floor plans of telecommunication spaces indicating layout of equipment and devices, including receptacles and grounding provisions. Submit detailed plan views and elevations of telecommunication spaces showing racks, termination blocks, and cable paths. Include following rooms:

a. Telecommunications rooms.

b. Building Entrance Facility/Demarcation rooms.

c. Server rooms/Data Center.

d. Equipment rooms.

e. Antenna Head End rooms.

2. Logical Drawings: Provide logical riser or schematic drawings for all systems.

a. Provide riser diagrams systems and interconnection drawings for equipment assemblies; show termination points and identify wiring connections.

3. Access Panel Schedule on Submittal Drawings: Coordinate and prepare a location, size, and function schedule of access panels required to fully service equipment.

J. Provide sustainable design submittals.

K. Furnish electronic certified test reports to COR prior to final inspection and not more than 90 days after completion of tests.

1.8 CLOSEOUT SUBMITTALS

A. Provide following closeout submittals prior to project closeout date:
   1. Warranty certificate.
   2. Evidence of compliance with requirements such as low voltage certificate of inspection.
   3. Project record documents.
   4. Instruction manuals and software that are a part of system.

B. Maintenance and Operation Manuals: Submit in accordance with Section 01 00 00, GENERAL REQUIREMENTS.
   1. Prepare a manual for each system and equipment specified.
   2. Furnish on portable storage drive in PDF format or equivalent accepted by COR.
   3. Furnish complete manual as specified in specification section, fifteen days prior to performance of systems or equipment test.
   4. Furnish remaining manuals prior to final completion.
   5. Identify storage drive "MAINTENANCE AND OPERATION MANUAL" and system name.
   6. Include name, contact information and emergency service numbers of each subcontractor installing system or equipment and local representatives for system or equipment.
   7. Provide a Table of Contents and assemble files to conform to Table of Contents.
   8. Operation and Maintenance Data includes:
      a. Approved shop drawing for each item of equipment.
      b. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of equipment.
      c. A control sequence describing start-up, operation, and shutdown.
      d. Description of function of each principal item of equipment.
      e. Installation and maintenance instructions.
      f. Safety precautions.
      g. Diagrams and illustrations.
      h. Test Results and testing methods.
      i. Performance data.

j. Pictorial "exploded" parts list with part numbers. Emphasis to be placed on use of special tools and instruments. Indicate sources of supply, recommended spare parts, and name of servicing organization.

k. Warranty documentation indicating end date and equipment protected under warranty.

l. Appendix; list qualified permanent servicing organizations for support of equipment, including addresses and certified personnel qualifications.

C. Record Wiring Diagrams:

1. Red Line Drawings: Keep one E size 91.44 cm x 121.92 cm (36 inches x 48 inches) set of floor plans, on site during work hours, showing installation progress marked and backbone cable labels noted. Make these drawings available for examination during construction meetings or field inspections.

2. General Drawing Specifications: Detail and elevation drawings to be D size 61 cm x 91.44 cm (24 inches x 36 inches) with a minimum scale of 0.635 cm = 30.48 cm (1/4 inch = 12 inches). ER, TR and other enlarged detail floor plan drawings to be D size 61 cm x 91.44 cm (24” x 36”) with a minimum scale of 0.635 cm = 30.48 cm (1/4 inch = 12 inches). Building composite floor plan drawings to be D size 61 cm x 91.44 cm (24 inches x 36 inches) with a minimum scale of 3.175 mm = 30.48 cm (1/8 inch = 1’ 0 inch).

3. Building Composite Floor Plans: Provide building floor plans showing work area outlet locations and configuration, types of jacks, distance for each cable, and cable routing locations.

4. Floor plans to include:

a. Final room numbers and actual backbone cabling and pathway locations and labeling.

b. Inputs and outputs of equipment identified according to labels installed on cables and equipment

c. Device locations with labels.

d. Conduit.

e. Head-end equipment.

f. Wiring diagram.

g. Labeling and administration documentation.

5. Submit Record Wiring Diagrams within five business days after final cable testing.
6. Deliver Record Wiring Diagrams as CAD files in .dwg or .dgn .rvt formats as determined by COR.
7. Deliver four complete sets of electronic record wiring diagrams to COR on portable storage drive.

D. Service Qualifications: Submit name and contact information of service organizations providing service to this installation within four 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 005OP2H3, OEM, contractor, and local authorities.

2.2 EQUIPMENT IDENTIFICATION

A. Provide laminated black phenolic resin with a white core nameplates with minimum 6 mm (1/4 inch) high engraved lettering.

B. Nameplates furnished by manufacturer as standard catalog items, unless other method of identification is indicated.

2.3 UNDERGROUND WARNING TAPE

A. Underground Warning: Standard 4-Mil polyethylene 76 mm (3 inch) wide tape detectable type; red with black letters imprinted with “CAUTION BURIED ELECTRIC LINE BELOW”, orange with black letters imprinted with “CAUTION BURIED TELEPHONE LINE BELOW” or orange with black letters imprinted with “CAUTION BURIED FIBER OPTIC LINE BELOW”, as applicable.

2.4 WIRE LUBRICATING COMPOUND

A. Provide non-hardening or forming adhesive coating cable lubricants suitable for cable jacket material and raceway.

2.5 FIREPROOFING TAPE

A. Provide flexible, conformable fabric tape of organic composition and coated one side with flame-retardant elastomer.

B. Tape must be self-extinguishing and cannot support combustion; arc-proof and fireproof.

C. Tape cannot deteriorate when subjected to water, gases, salt water, sewage, or fungus; and tape must be resistant to sunlight and ultraviolet light.

D. Application must withstand a 200-ampere arc for minimum 30 seconds.

E. Securing Tape: Glass cloth electrical tape minimum 0.18 mm (7 mils) thick and 19 mm (3/4 inch) wide.

2.6 UNDERGROUND CABLES

A. Provide buried closure suitable for enclosing a straight, butt, and branch splice in a container into which can be poured an encapsulating compound.

B. Provide closure of adequate strength to protect splice and maintain cable shield electrical continuity in buried environment.

C. Provide re-enterable encapsulating compound maintaining chemical stability of closure.

D. Provide filled splice cases in accordance with RUS Bull 345-72.

E. Provide gel filled cable meeting requirements of ICEA S-99-689 and RUS 1755.390 RUS 1755.890.

F. In Vault or Manhole:

1. Provide underground closure suitable to house a straight, butt, and branch splice in a protective housing into which can be poured an encapsulating compound

2. Closure must be suitable thermoplastic, thermo-set, or stainless steel material supplying structural strength to pass mechanical and electrical requirements in a vault or maintenance hole (manhole) environment.

G. Re-Enterable Encapsulating Compound: Product maintaining chemical stability of closure.

H. Provide gel-filled splice cases in accordance with RUS Bull 345-72.

2.7 AERIAL (ABOVEGROUND) ENCLOSURES

A. Provide aboveground enclosures constructed of minimum 2.108 mm (14 gauge) steel ultraviolet resistant PVC and acceptable for pole stake mounting in accordance with RUS 1755.

B. Size enclosures and install marker.

C. Secure covers to prevent unauthorized entry.

D. Provide gel filled cable meeting requirements of ICEA S-99-689 ICEA S-98-688, and RUS 1755.390; except, Figure 8 distribution wire suitable for aerial installation with:

1. 26,700 N (6,000 pound); or

2. 6,000 pound Class A galvanized steel; or

3. 26,700 N (6,000 pound) aluminum-clad steel strand.

2.8 TEMPORARY _____ TIP PATHS (OVERHEAD TRACKS, ROAD/PATH BRIDGES, ETC.)

A. Provide for copper, fiber optic, RF, coaxial and designated electronic system cables to maintain facility communications service during construction and install so as to not present a pedestrian and traffic (including construction) safety hazard.

B. _____ TIP temporary cable installations are not required to meet industry standards; but each must be reviewed and accepted, in writing, by COR with concurrences from SMCS 005OP2H3, OI&T and facility safety officer, prior to installation.

1. Be responsible for work associated with each temporary _____ TIP path installation, required by system design and its removal when determined no longer necessary.
2. Survey outside _____ TIP locations usually encountered, including roads, driveways, marked paths, high traffic passage ways or personnel walkways, and provide COR with a plan for temporary paths.

2.9 ACCESS PANELS

A. Panels: 304 mm x 304 mm (12 inches by 12 inches) _____ , or size allowed by location to provide optimum access to equipment for maintenance and service.

B. Provide access panels and doors as required to allow service of materials and equipment that require inspection, replacement, repair or service.

C. Provide access panels where items installed require access and are concealed in floor, wall, furred space or above ceiling; ceilings consisting of lay-in or removable splined tiles do not require access panels.

D. Provide access panels with same fire rating classification as surface penetrated.

PART 3 - EXECUTION

3.1 PREPARATION

A. Penetrations and Sleeves:

1. Lay out penetration and sleeve openings in advance, to permit provision in work.
2. Set sleeves in forms before concrete is poured.

3. Set sleeves prior to installation of structure for passage of pipes, conduit, ducts, etc.
4. Provide sleeves and packing materials at penetrations of foundations, walls, slabs, partitions, and floors.
5. Make sleeves that penetrate outside walls, basement slabs, footings, and beams waterproof.
6. Fill slots, sleeves and other openings in floors or walls if not used.
   a. Fill spaces in openings after installation of conduit or cable.
   b. Provide fill for floor penetrations to prevent passage of water, smoke, fire, and fumes.
   c. Provide fire resistant fill in rated floors and walls, to prevent passage of air, smoke and fumes.
7. Install sleeves through floors watertight and extend minimum 50.8 mm (2 inches) above floor surface.
8. Match and set sleeves flush with adjoining floor, ceiling, and wall finishes where raceways passing through openings are exposed in finished rooms.
9. Annular space between conduit and sleeve must be minimum 6 mm (1/4 inch).
10. Do not provide sleeves for slabs-on-grade, unless specified or indicated otherwise.
11. Comply with requirements for firestopping, for sleeves through rated fire walls and smoke partitions.
12. Do not support piping risers or conduit on sleeves.
13. Identify unused sleeves and slots for future installation.
14. Provide core drilling if walls are poured or otherwise constructed without sleeves and wall penetration is required; do not penetrate structural members.

B. Core Drilling:
1. Avoid core drilling whenever possible.
2. Coordinate openings with other trades and utilities, and prevent damage to structural reinforcement.
3. Investigate existing conditions in vicinity of required opening prior to coring, including an x-ray of floor if determined necessary by competent person or COR.

4. Protect areas from damage.

C. Verification of In-Place Conditions:

1. Verify location, use and status of all material, equipment, and utilities that are specified, indicated, or determined necessary for removal.
   a. Verify materials, equipment, and utilities to be removed are inactive, not required, or in use after completion of project.
   b. Replace with equivalent any material, equipment and utilities that were removed by contractor that are required to be left in place.
2. Existing Utilities: Do not interrupt utilities serving facilities occupied by Government or others unless permitted under following conditions and then only after arranging to provide temporary utility services, according to requirements indicated:
   a. Notify COR in writing at least 14 days in advance of proposed utility interruptions.
   b. Do not proceed with utility interruptions without Government's written permission.

D. Provide suspended platforms, strap hangers, brackets, shelves, stands or legs for floor, wall and ceiling mounting of equipment as required.

E. Provide steel supports and hardware for installation of hangers, anchors, guides, and other support hardware.

F. Obtain and analyze catalog data, weights, and other pertinent data required for coordination of equipment support provisions and installation.

G. Verify site conditions and dimensions of equipment to ensure access for proper installation of equipment without disassembly that would void warranty.

3.2 INSTALLATION - GENERAL

A. Coordinate systems, equipment, and materials installation with other building components.

B. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings.

C. Conform to VAAR 852.236.91 arrangements indicated, recognizing that work may be shown in diagrammatic form or have been impracticable to

detail all items because of variances in manufacturers' methods of achieving specified results.

D. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed in both exposed and un-exposed spaces.

E. Install equipment according to manufacturers' written instructions.

F. Install wiring and cabling between equipment and related devices.

G. Install cabling, wiring, and equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with minimum interference of adjacent other installations.

H. Provide access panel or doors where units are concealed behind finished surfaces.

I. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for wiring, cabling, and equipment installations.

J. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide maximum headroom and access for service and maintenance as possible.

K. Install systems, materials, and equipment giving priority to systems required to be installed at a specified slope.

L. Avoid interference with structure and with work or other trades, preserving adequate headroom and clearing doors and passageways to satisfaction of COR and code requirements.

M. Install equipment and cabling to distribute equipment loads on building structural members provided for equipment support under other sections; install and support roof-mounted equipment on structural steel or roof curbs as appropriate.

N. Provide supplementary or miscellaneous items, appurtenances, devices and materials for a complete installation.

3.3 EQUIPMENT INSTALLATION

A. Locate equipment as close as practical to locations shown on drawings.

B. Note locations of equipment requiring access on record drawings.

C. Access and Access Panels: Verify access panel locations and construction with COR.

D. Inaccessible Equipment:

1. Where Government determines that contractor has installed equipment not conveniently accessible for operation and maintenance, equipment must be removed and reinstalled as directed and without additional cost to Government.

3.4 EQUIPMENT IDENTIFICATION

A. Install an identification sign which clearly indicates information required for use and maintenance of equipment.

B. Secure identification signs with screws.

3.5 CUTTING AND PATCHING

A. Perform cutting and patching according to contract general requirements and as follows:

1. Remove samples of installed work as specified for testing.
2. Perform cutting, fitting, and patching of equipment and materials required to uncover existing infrastructure in order to provide access for correction of improperly installed existing or new work.
3. Remove and replace defective work.
4. Remove and replace non-conforming work.

B. Cut, remove, and legally dispose of selected equipment, components, and materials, including removal of material, equipment, devices, and other items indicated to be removed and items made obsolete by new work.

C. Provide and maintain temporary partitions or dust barriers adequate to prevent spread of dust and dirt to adjacent areas.

D. Protect adjacent installations during cutting and patching operations.

E. Protect structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

F. Patch finished surfaces and building components using new materials specified for original installation and experienced installers.

3.6 FIELD QUALITY CONTROL

A. Provide work according to VAAR 852.236.91 and FAR clause 52.236-5.

B. Provide minimum clearances and work required for compliance with NFPA 70, National Electrical Code (NEC), and manufacturers' instructions; comply with additional requirements indicated for access and clearances.

C. Verify all field conditions and dimensions that affect selection and provision of materials and equipment, and provide any disassembly,

reassembly, relocation, demolition, cutting and patching required to provide work specified or indicated, including relocation and reinstallation of existing wiring and equipment.

1. Protect facility, equipment, and wiring from damage.

D. Submit written notice that:

1. Project has been inspected for compliance with documents.
2. Work has been completed in accordance with documents.

E. Non-Conforming Work: Conduct project acceptance inspections, final completion inspections, substantial completion inspections, and acceptance testing and demonstrations after verification of system operation and completeness by Contractor.

F. For project acceptance inspections, final completion inspections, substantial completion inspections, and testing/demonstrations that require more than one site visit by COR or design professional to verify project compliance for same material or equipment, Government reserves right to obtain compensation from contractor to defray cost of additional site visits that result from project construction or testing deficiencies and incompleteness, incorrect information, or non-compliance with project provisions.

1. COR will notify contractor, of hourly rates and travel expenses for additional site visits, and will issue an invoice to Contractor for additional site visits.
2. Contractor is not be eligible for extensions of project schedule or additional charges resulting from additional site visits that result from project construction or testing deficiencies/incompleteness, incorrect information, or non-compliance with Project provisions.

G. Tests:

1. Interim inspection is required at approximately 50 percent of installation.
2. Request inspection ten working days prior to interim inspection start date by notifying COR in writing; this inspection must verify equipment and system being provided adheres to installation, mechanical and technical requirements of construction documents.
3. Inspection to be conducted by OEM and factory-certified contractor representative, and witnessed by COR, facility and SMCS 0050P2H3 representatives.

4. Check each item of installed equipment to ensure appropriate NRTL listing labels and markings are fixed in place.
5. Verify cabling terminations in DEMARC, MCR, TER, SCC, ECC, TRs and head end rooms, workstation locations and TCO adhere to color code for T568B T568A pin assignments and cabling connections are in compliance with TIA standards.
6. Visually confirm minimum Category 5e Category 6 _____ cable marking at TCOs, CCSs locations, patch cords and origination locations.
7. Review entire communications circulating ground system, each TGB and grounding connection, grounding electrode and outside lightning protection system.
8. Review cable tray, conduit and path/wire way installation practice.
9. OEM and contractor to perform:
   a. Fiber optical cable field inspection tests via attenuation measurements on factory reels; provide results along with OEM certification for factory reel tests.
   b. Coaxial cable field inspection tests via attenuation measurements on factory reels; provide results along with OEM certification for factory reel tests.
   c. Baseband cable field inspection tests via attenuation measurements on factory reels and provide results along with OEM certification for factory reel tests.
10. Relocate failed cable reels to a secured location for inventory, as directed by COR, and then remove from project site within two working days; provide COR with written confirmation of defective cable reels removal from project site.
11. Provide results of interim inspections to COR.
12. If major or multiple deficiencies are discovered, additional interim inspections could be required until deficiencies are corrected, before permitting further system installation.
    a. Additional inspections are scheduled at direction of COR.
    b. Re-inspection of deficiencies noted during interim inspections, must be part of system’s Final Acceptance Proof of Performance Test.

c. The interim inspection cannot affect the system's completion date unless directed by COR.

13. Facility COR will ensure test documents become a part of system's official documentation package.

H. Pretesting: Re-align, re-balance, sweep, re-adjust and clean entire system and leave system working for a "break-in" period, upon completing installation of system and prior to Final Acceptance Proof of Performance Test. System RF transmitting equipment must not be connected to keying or control lines during "break-in" period.

1. Pretesting Procedure:

a. Verify systems are fully operational and meet performance requirements, utilizing accepted test equipment and spectrum analyzer.

b. Pretest and verify system functions and performance requirements conform to construction documents and, that no unwanted physical, aural and electronic effects, such as signal distortion, noise pulses, glitches, audio hum, poling noise are present.

2. 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 005OP2H3).

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 005OP2H3, (202)461-5310.
   d. VISN-CIO, Network Officer and VISN representatives.
   e. Facility:
      1) FMS Service Chief, Bio-Medical Engineering and facility representatives.
      2) OI&T Service Chief and OI&T representatives.
      3) Safety Officer, Police Chief and facility safety representatives.
   f. Local Community Safety Personnel:
      1) Fire Marshal representative.
      2) Disaster Coordinator representative.
      3) EMS Representatives: Police, Sherriff, City, County or State representatives.
4. Test system utilizing accepted test equipment to certify proof of performance and Life and Public Safety compliance, FCC, NRTL, NFPA and OSHA compliance.
   a. Rate system as acceptable or unacceptable at conclusion of test; make only minor adjustments and connections required to show proof of performance.

1) Demonstrate and verify that system complies with performance requirements under operating conditions.
2) Failure of any part of system that precludes completion of system testing, and which cannot be repaired within four hours, terminates acceptance test of that portion of system.
3) Repeated failures that result in a cumulative time of eight hours to affect repairs is cause for entire system to be declared unacceptable.
4) If system is declared unacceptable, retesting must be rescheduled at convenience of Government and costs borne by the contractor.

J. Acceptance Test Procedure:

1. Physical and Mechanical Inspection: The test team representatives must tour major areas to determine system and sub-systems are completely and properly installed and are ready for acceptance testing.
2. A system inventory including available spare parts must be taken at this time.
3. Each item of installed equipment must be re-checked to ensure appropriate NRTL (i.e. UL) certification listing labels are affixed.
4. Confirm that deficiencies reported during Interim Inspections and Pretesting are corrected prior to start of Acceptance Test.
5. Inventory system diagrams, record drawings, equipment manuals, pretest results.
6. Failure of system to meet installation requirements of specifications is grounds for terminating testing and to schedule re-testing.

K. Operational Test:

1. Individual Item Test: VACO AHJ representative (SMCS 005OP2H3) may select individual items of DAS _____ 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 005OP2H3) provides COR notice stating system processes to required operating standards and functions and is Government accepted for use by facility.
2. Validate items with COR needing to be provided to complete project contract (i.e. charts & diagrams, manuals, spare parts, system warranty documents executed, etc.). Once items have been provided, COR contacts FMS service chief to turn over system from CFM oversight for beneficial use by facility.
3. If system is declared unacceptable without conditions, rescheduled testing expenses are to be borne by contractor.

3.7 CLEANING

A. Remove debris, rubbish, waste material, tools, construction equipment, machinery and surplus materials from project site and clean work area, prior to final inspection and acceptance of work.

B. Put building and premises in neat and clean condition.

C. Remove debris on a daily basis.

D. Remove unused material, during progress of work.

E. Perform cleaning and washing required to provide acceptable appearance and operation of equipment to satisfaction of COR.

F. Clean exterior surface of all equipment, including concrete residue, dirt, and paint residue, after completion of project.

G. Perform final cleaning prior to project acceptance by COR.

H. Remove paint splatters and other spots, dirt, and debris; touch up scratches and mars of finish to match original finish.

I. Clean devices internally using methods and materials recommended by manufacturer.

J. Tighten wiring connectors, terminals, bus joints, and mountings, to include lugs, screws and bolts according to equipment manufacturer's published torque tightening values for equipment connectors. In absence of published connection or terminal torque values, comply with torque values specified in UL 486A-486B.

3.8 TRAINING

A. Provide training in accordance with subsection, INSTRUCTIONS, of Section 01 00 00, GENERAL REQUIREMENTS.

B. Provide training for equipment or system as required in each associated specification.

C. Develop and submit training schedule for approval by COR, at least 30 days prior to planned training.

3.9 PROTECTION

A. Protection of Fireproofing:

1. Install clips, hangers, clamps, supports and other attachments to surfaces to be fireproofed, if possible, prior to start of spray fireproofing work.
2. Install conduits and other items that would interfere with proper application of fireproofing after completion of spray fire proofing work.
3. Patch and repair fireproofing damaged due to cutting or course of work must be performed by installer of fireproofing and paid for by trade responsible for damage.

B. Maintain equipment and systems until final acceptance.

C. Ensure adequate protection of equipment and material during installation and shutdown and during delays pending final test of systems and equipment because of seasonal conditions.

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12-01-22

SECTION 27 05 26

GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies grounding and bonding requirements of communications installations based on the requirements of ANSI/TIA-607-D, Telecommunications Bonding and Grounding (Earthing) for Customer Premises. Work covered by this Section shall consist of furnishing supplies, labor, materials, equipment, labeling, and tools. Testing is required unless otherwise specified. An operable grounding and bonding infrastructure is required as described on the Drawings and/or required by these specifications. All materials shall be listed by a nationally recognized testing laboratory (NRTL).

1.2 SUMMARY

Section Includes:

A. Required Bonding Busbars.

B. Supplemental Bonding Networks.

C. Telecommunications Bonding Conductors.

D. Joining Requirements.

E. Overvoltage Surge Protectors.

1.3 REFERENCES

A. VA Infrastructure Standard for Telecommunications Spaces.

B. ANSI/TIA-607-D, Telecommunications Bonding and Grounding (Earthing) for Customer Premises.

C. NFPA 70, National Electrical Code (NEC).

D. International Annealed Copper Standard (IACS).

E. BICSI Information Technology Systems Installation Methods Manual (ITSIMM), Recommended Testing Procedures and Criteria.

F. UL 497 & UL 497A, UL Standards for Primary & Secondary Safety Protectors for Paired-Conductor Communications Circuits.

1.4 RELATED WORK

A. Facility grounding and bonding requirements: Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

B. Information Technology equipment enclosures: Section 27 11 16, COMMUNICATION CABINETS, RACKS, FRAMES, AND ENCLOSURES.

C. Cable trays: Section 27 05 36, CABLE TRAYS FOR COMMUNICATIONS SYSTEMS.

1.5 SUBMITTALS

A. Submit in accordance with Section 27 05 00, COMMON WORK RESULTS FOR COMMUNICATIONS SYSTEMS.

B. Provide riser diagram indicating location of communications grounding system connections indicating routing of grounding conductors.

C. Closeout Submittals: Provide test reports of ground resistance to each primary or secondary bonding busbar (PBB/SBB) located in each telecommunications space impacted by the work.

PART 2 - PRODUCTS

2.1 BONDING BUSBARS.

Bonding busbars are located in each telecommunications space and in each network rack/cabinet. Bonding busbars provide common locations in the telecommunications space for the connection of the telecommunications bonding conductors.

A. Common Requirements.

1. Provided with holes for use with correctly-matched UL Listed two-hole lugs and hardware.
2. Constructed of copper or copper alloy with a minimum of 95% conductivity when annealed.
3. Annealed as specified by the International Annealed Copper Standard (IACS).
4. Installation resulting in a maximum 4.0Ω to ground resistance measured from any point in the system.
5. Installation is insulated from the mounting surface through the use of appropriate insulators.
6. UL Listed.

B. Primary Bonding Busbar (PBB). The PBB is a dedicated extension of the building grounding electrode system for the telecommunications infrastructure. The PBB also serves as the central attachment point for Secondary Bonding Busbars (SBB) via Telecommunications Bonding Backbone (TBB).

1. Pre-drilled copper with holes to accommodate lug mounting holes.
2. Sized for current applications and future growth.
3. Insulated from its supports.
4. Electro-tin plated is acceptable.

5. Maintain a 2” min clearance between busbar and finished wall.
6. Size must be 0.25” thick by 4” wide by 20” 16” length.

C. Secondary Bonding Busbar (SBB). The SBB is a common point of connection for telecommunications system and equipment bonding to a ground located in each Telecommunications Room.
1. Pre-drilled holes to accommodate dual-lug mounting holes.
2. 0.25” thick x 2” wide with varying length to be sized for current applications and future growth.
3. Maintain a 2” min clearance between the finished wall and busbar.
4. Copper or tin annealed copper.

D. Rack Bonding Busbar (RBB). The RBB is a busbar located in a cabinet, rack, or frame.
1. Mounting. Horizontal mounting to an EIA-310-D 19” equipment rack is specified.
2. Capacity: 10 Double-hole lugs.
3. Size & material 0.75” wide x 19” length x 0.25” thick – Copper or tin annealed copper.

2.2 SUPPLEMENTAL BONDING NETWORKS.

A. Also known as Signal Reference Grids (SRGs), Mesh Bonding Networks (Mesh-BN), or Isolated Bonding Networks (IBNs), the requirements for supplemental bonding networks are not specified in this document. Supplemental bonding networks may not be used to replace a standards-compliant bonding infrastructure.

2.3 TELECOMMUNICATIONS BONDING BACKBONE (TBB).

The TBB bonds the facility Primary Bonding Busbar (PBB) to telecommunications space Secondary Bonding Busbars (SBBs).

A. Material. Stranded copper wire with a green jacket (or per NEC depending on size), run as a continuous conductor.

B. Size. The TBB shall be sized to meet the requirements of ANSI/TIA-607-D and will be as straight as practicable avoiding bends.

C. Bonding the TBB to the PBB and each SBB will require a UL Listed irreversible compression (crimp) dual-lug connector.

2.4 BONDING CONDUCTORS.

A. Telecommunications Equipment Bonding Conductor (TEBC). The TEBC connects the cabinets and racks in the telecommunications space to the space’s bonding busbar (PBB or SBB).

1. Material. Stranded copper wire with a green jacket (or per NEC depending on size), run as a continuous conductor.
2. Size. The TBB shall be sized to meet the requirements of ANSI/TIA-607-D. The minimum size for the TEBC shall be AWG 6.
3. Bonding. Bonded to the telecommunications space bonding busbar (PBB or SBB) via a UL Listed two-hole compression lug. Rack Bonding Conductors (RBCs) are connected to the TEBC using UL Listed irreversible compression (crimp) connectors.

B. Rack Bonding Conductor (RBC). The RBC is a bonding conductor from the cabinet or Rack Bonding Busbar (RBB) to the Telecommunications Equipment Bonding Conductor (TEBC).
1. Material. Stranded copper wire with a green jacket run as a continuous conductor.
2. Size. The minimum size for the RBC shall be AWG 6.
3. Bonding. Bonded to the Telecommunications Equipment Bonding Conductor (TEBC) using UL Listed irreversible compression (crimp) connectors.
a. Where connected to a server cabinet, the RBC extends to the bottom of the server cabinet allowing Equipment Bonding Conductors to be attached at any point in the cabinet.
b. Where connected to a network rack/cabinet, the Rack Bonding Conductor (RBC) is bonded to the Rack Bonding Busbar (RBB) via a UL Listed two-hole compression lug.

C. Equipment/Unit Bonding Conductor (EBC/UBC). The Equipment/Unit Bonding Conductor connects individual equipment in a cabinet or rack to the Rack Bonding Conductor (RBC) or Rack Bonding Busbar (RBB). Equipment Bonding conductors are also used as cable tray bonding conductors to bond cable tray sections to the Telecommunications Equipment Bonding Conductor (TEBC).
1. Material. Stranded copper wire with a green jacket run as a continuous conductor.
2. Size. The minimum size for the RBC shall be AWG 6.
3. Bonding.
a. Where used in a server cabinet, bonded to the Rack Bonding Connector (RBC) using UL Listed irreversible compression (crimp)

connectors and to IT equipment via a UL Listed two-hole compression lug. (Some IT equipment may require one-hole lugs.)

b. Where used in a network cabinet/rack, bonded to the Rack Bonding Busbar (RBB) via a UL Listed two-hole compression lug and to IT equipment via a UL Listed two-hole compression lug. (Some IT equipment may require one-hole lugs.)

c. Where used as a cable tray bonding conductor connecting cable tray sections, bonded to each adjoining section of the cable tray using UL Listed two-hole compression lugs.

d. Where used as a cable tray bonding conductor connecting cable tray sections to the Telecommunications Equipment Bonding Conductor (TEBC), bonded to the TEBC using UL Listed irreversible compression (crimp) connectors and to the cable tray via a UL Listed two-hole compression lug.

4. Contractor shall furnish a minimum of ten (10) EBCs for each RBB. Five (5) EBCs shall be outfitted as described here and shall be six (6) feet in length. Five (5) EBCs shall be outfitted as decried here and shall be nine (9) feet in length. Contractor shall use field measurements to determine EBC cable length when directed by VA project managers.

2.5 OVERVOLTAGE SURGE PROTECTORS.

A. Protectors are voltage-limiting devices intended to protect equipment, wiring, and personnel against the effects of excessive potentials and currents in communications lines caused by lightning, contacts with power conductors, power induction, and rises in ground potential.

1. Compliance. Protectors shall be compliant with UL 497 and/or UL 497A, as applicable.
2. Performance. Protectors shall be rated to support copper UTP performance Category 5e at 100MHz.
3. Protection. Voltage suppression shall be via low capacitance solid state protectors only, rated at 18V for copper backbone applications or 65V for VOIP or PoE applications.
4. Construction. Provide protection for each pair.
5. Termination shall be insulation-displacement contact.
6. Mounting. Protectors shall be wall-mounted.

PART 3 - EXECUTION

3.1 IMPLEMENTATION

A. Components of the telecommunications bonding system will be installed and connected using materials and techniques required by ANSI/TIA-607-D. The use of antioxidant joint compound is required for all connections excluding protector 110 block connections.

B. Testing.

1. Perform tests per BICSI Information Technology Systems Installation Methods Manual (ITSIMM), Recommended Testing Procedures and Criteria.
2. Perform two-point bond test using trained installers qualified to use test equipment.
3. Conduct continuity tests to verify that metallic pathways in telecommunications spaces are bonded to PBB or SBB.
4. Conduct electrical continuity test to verify that PBB is effectively bonded to the facility grounding electrode conductor.
5. Perform resistance tests to ensure rack and cabinet bonding connection resistance measures less than 4Ω to PBB or SBB.

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SECTION 27 05 33

CONDUITS AND BACKBOXES FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies conduit, fittings, and boxes to form raceway systems for communications cabling.

1.2 RELATED WORK

A. Sealing around penetrations to maintain integrity of fire rated construction: Section 07 84 00, FIRESTOPPING.

B. Fabrications for deflection of water away from building envelope at penetrations: Section 07 60 00, FLASHING AND SHEET METAL.

C. Sealing around conduit penetrations through building envelope to prevent moisture migration into building: Section 07 92 00, JOINT SEALANTS.

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

E. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.

1.3 SUBMITTALS

A. In accordance with Section 27 05 00, COMMON WORK RESULTS FOR COMMUNICATIONS SYSTEMS, submit the following:

1. Size and location of cabinets, splice boxes, and pull boxes.
2. Layout of required conduit penetrations through structural elements.
3. Catalog cuts marked with specific item proposed and area of application identified.

B. Certification: Provide letter prior to final inspection, certifying material is in accordance with construction documents and properly installed.

PART 2 - PRODUCTS

2.1 MATERIAL

A. Minimum Conduit Size: 19 mm (3/4 inch).

B. Conduit:

1. Rigid Galvanized Steel: Conform to UL 6, ANSI C80.1.
2. Rigid Aluminum: Conform to UL 6A, ANSI C80.5.

3. Rigid Intermediate Steel Conduit (IMC): Conform to UL 1242, ANSI C80.6.
4. Electrical Metallic Tubing (EMT):
   a. Maximum Size: 105 mm (4 inches).
   b. Install only for cable rated 600 volts or less.
   c. Conform to UL 797, ANSI C80.3.
5. Flexible Galvanized Steel Conduit: Conform to UL 1.
6. Liquid-tight Flexible Metal Conduit: Conform to UL 360.
7. Direct Burial Plastic Conduit: Conform to UL 651 and UL 651A, heavy wall PVC, or high density polyethylene (HDPE).
8. Surface Metal Raceway: Conform to UL 5.

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

a. Standard Threaded Couplings, Locknuts, Bushings, and Elbows: Malleable iron, steel or aluminum alloy materials; Zinc or cadmium plate iron or steel fittings. Aluminum fittings containing more than 0.4 percent copper are not permitted.
b. Locknuts and Bushings: As specified for rigid steel and IMC conduit.
c. Set Screw Fittings: Not permitted for use with aluminum conduit.

3. Electrical Metallic Tubing Fittings:
   a. Conform to UL 514B and ANSI/ NEMA FB1; only steel or malleable iron materials are acceptable.
   b. Couplings and Connectors: Concrete tight and rain tight, with connectors having insulated throats.
      1) Use gland and ring compression type couplings and connectors for conduit sizes 50 mm (2 inches) and smaller.
      2) Use set screw type couplings with four set screws each for conduit sizes over 50 mm (2 inches).
      3) Use set screws of case-hardened steel with hex head and cup point to seat in wall of conduit for positive grounding.
   c. Indent type connectors or couplings are not permitted.
   d. Die-cast or pressure-cast zinc-alloy fittings or fittings made of "pot metal" are not permitted.
   e. Provide OEM approved fittings.
4. Flexible Steel Conduit Fittings:
   a. Conform to UL 514B; only steel or malleable iron materials are acceptable.
   b. Provide clamp type, with insulated throat.
   c. Provide OEM approved fittings.
5. Liquid-tight Flexible Metal Conduit Fittings:
   a. Conform to UL 514B and ANSI/ NEMA FB1; only steel or malleable iron materials are acceptable.
   b. Fittings must incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening.
   c. Provide connectors with insulated throats to prevent damage to cable jacket.
   d. Provide OEM approved fittings.

6. Direct Burial Plastic Conduit Fittings: Provide fittings meeting requirements of UL 514C and NEMA TC3, and as recommended by conduit manufacturer.
7. Expansion and Deflection Couplings:
   a. Conform to UL 467 and UL 514B.
   b. Accommodate 19 mm (3/4 inch) deflection, expansion, or contraction in any direction, and allow 30-degree angular deflections.
   c. Include internal flexible metal braid sized to ensure conduit ground continuity and fault currents in accordance with UL 467, and NEC code tables for ground conductors.
   d. Jacket: Flexible, corrosion-resistant, watertight, moisture and heat resistant molded rubber material with stainless steel jacket clamps.
8. Rigid Aluminum Fittings:
   a. Provide malleable iron, steel or aluminum alloy materials; zinc or cadmium plate iron or steel fittings. Aluminum fittings containing more than 0.4 percent copper are prohibited.
   b. Locknuts and Bushings: As specified for rigid steel and IMC conduit.
   c. Set Screw Fittings: Not permitted for use with aluminum conduit.
   d. Indent type connectors or couplings are prohibited.
   e. Die-cast or pressure-cast zinc-alloy fittings or fittings made of “pot metal” are not permitted.
   f. Provide OEM approved fittings.

D. Conduit Supports:
1. Parts and Hardware: Provide zinc-coat or equivalent corrosion protection.
2. Individual Conduit Hangers: Designed for the purpose, having a pre-assembled closure bolt and nut, and provisions for receiving a hanger rod.
3. Multiple Conduit (Trapeze) Hangers: Minimum 38 mm by 38 mm (1-1/2 by 1-1/2 inch), 2.78 mm (12 gage) steel, cold formed, lipped channels; with minimum 9 mm (3/8 inch) diameter steel hanger rods.
4. Solid Masonry and Concrete Anchors: Self-drilling expansion shields, or machine bolt expansion.

E. Outlet, Splice, and Pull Boxes:
   1. Conform to UL-50 and UL-514A.
   2. Cast metal where required by NEC or shown, and equipped with rustproof boxes.
   3. Sheet Metal Boxes: Galvanized steel, except where otherwise shown.
   4. Install flush mounted wall or ceiling boxes with raised covers so that front face of raised cover is flush with wall.
   5. Install surface mounted wall or ceiling boxes with surface style flat or raised covers.

F. Warning Tape: Standard, 4-Mil polyethylene 76 mm (3 inch) wide tape detectable type, red with black letters, and imprinted with “CAUTION BURIED COMMUNICATIONS CABLE BELOW”.

G. Flexible Nonmetallic Communications Raceway (Innerduct) and Fittings:
   1. General: Provide UL 910 listed plenum, riser, and general purpose corrugated pliable communications raceway.
   2. Provide Communications Raceway with a factory installed 567 kg (1250 lb.) tensile pre-lubricated pull tape.
   3. Use only metallic straps, hangers and fittings to support raceway from building structure. Cable ties are not permitted for securing raceway to building structure.
   4. Provide fittings to be installed in spaces used for environmental air made of materials that do not exceed flammability, smoke generation, ignitibility, and toxicity requirements of environmental air space.
   5. Size: Metric Designator 53 (trade size 2) or smaller.
   6. Outside Plant: Plenum-rated where each innerduct is 75 mm (3 inches) and larger.
   7. Inside Plant: Listed and marked for installation in plenum airspaces and minimum 25 mm (1 inch) inside diameter.
   8. Plenum: Non-metallic communications raceway.
      a. Constructed of low smoke emission, flame retardant PVC with corrugated construction.
      b. UL 94 V-O rating for flame spreading limitation.
   9. Provide innerduct reel lengths as necessary to ensure ducts are continuous.

10. Provide pulling accessories used for innerduct including but not limited to, inner duct lubricants, spreaders, applicators, grips, swivels, harnesses, and line missiles (blown air) compatible with materials being pulled.

H. Outlet Boxes:

1. Flush wall mounted 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.

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

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION AND REQUIREMENTS

A. Penetrations:

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

2) Install only retrofittable, non-hardening, and reusable firestop material that can be removed and reinstalled to seal around cables inside conduits.

d. Waterproofing at Floor, Exterior Wall, and Roof Conduit Penetrations: Seal clearances around conduit and make watertight as specified in Section 07 92 00, JOINT SEALANTS or directed by waterproofing manufacturer.

B. Conduit Installation:

1. Minimum conduit size of 19 mm (3/4 inch), but not less than size required for 40 percent fill.
2. Install insulated bushings on all conduit ends.
3. Install pull boxes after every 180 degrees of bends (two 90-degree bends) or every 100ft. Size boxes per TIA 569.
4. Extend vertical conduits/sleeves through floors minimum 75 mm (3 inches) above floor and minimum 75 mm (3 inches) below ceiling of floor below.
5. Terminate conduit runs to and from a backboard in a TR or interstitial space at top or bottom of backboard. Install conduits to enter telecommunication rooms next to wall and flush with backboard.
6. Where drilling is necessary for vertical conduits, locate holes so as not to affect structural sections.
7. Seal empty conduits located in telecommunications rooms or on backboards to prevent entrance of moisture and gases and to meet fire resistance requirements.
8. Provide pull wire in all empty conduits; sleeves through floor are exceptions.
9. Complete each entire conduit run installation before pulling in cables.
10. Flattened, dented, or deformed conduit is not permitted.
11. Ensure conduit installation does not encroach into ceiling height head room, walkways, or doorways.
12. Cut conduit square with a hacksaw, ream, remove burrs, and draw tight.
13. Install conduit mechanically continuous.

14. Independently support conduit at 2.44 m (8 feet) on center; do not use other supports (i.e., suspended ceilings, suspended ceiling supporting members, luminaires, conduits, mechanical piping, or mechanical ducts).
15. Support conduit within 300 mm (1 foot) of changes of direction, and within 300 mm (1 foot) of each enclosure to which connected.
16. Close ends of empty conduit with plugs or caps to prevent entry of debris, until cables are pulled in.
17. Conduit installations under fume and vent hoods are prohibited.
18. Attach conduits to cabinets, splice cases, pull boxes and outlet boxes with bonding type locknuts. For rigid and IMC conduit installations, provide a locknut on inside of enclosure, made up wrench tight. Do not make conduit connections to box covers.
19. Do not use aluminum conduits in wet locations.
20. Unless otherwise indicated on drawings or specified herein, conceal conduits within finished walls, floors and ceilings.
21. Conduit Bends:
    a. Make bends with standard conduit bending machines; observe minimum bend radius for cable type and outside diameter.
    b. Conduit hickey is permitted only for slight offsets, and for straightening stubbed conduits.
    c. Bending of conduits with a pipe tee or vise is not permitted.
    d. Minimum radius of communication conduit bends:

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

22. Layout and Homeruns - Deviations: Make only where necessary to avoid interferences and only after drawings showing proposed deviations have been submitted and approved by COR.

C. 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.

D. Furred or Suspended Ceilings and in Walls:

1. Rigid steel, IMC or rigid aluminum. Different type conduits mixed indiscriminately in same system is not permitted.

2. Align and run conduit parallel or perpendicular to building lines.

3. Tightening set screws with pliers is not permitted.

E. Exposed Work Installation:

1. Unless otherwise indicated on drawings, exposed conduit is only permitted in telecommunications rooms.

a. Provide rigid steel, IMC or rigid aluminum.

b. Different type of conduits mixed indiscriminately in system is not permitted.

2. Align and run conduit parallel or perpendicular to building lines.
3. Install horizontal runs close to ceiling or beams and secure with conduit straps.
4. Support horizontal or vertical runs at not over 2400 mm (96 inches) intervals.
5. Painting:
   a. Paint exposed conduit as specified in Section 09 91 00, PAINTING.
   b. Refer to Section 09 91 00, PAINTING for preparation, paint type, and exact color.
   c. Provide labels where conduits pass through walls and floors and at maximum 6000 mm (20 foot) intervals in between.

F. Expansion Joints:
1. Conduits 75 mm (3 inches) and larger, that are secured to building structure on opposite sides of a building expansion joint, require expansion and deflection couplings. Install couplings in accordance with manufacturer's recommendations.
2. Provide conduits smaller than 75 mm (3 inches) with pull boxes on both sides of expansion joint. Connect conduits to expansion and deflection couplings as specified.
3. Install expansion and deflection couplings where shown.

G. Seismic Areas:
1. In seismic areas, follow H-18-8 Seismic Design Requirements.
2. Rigidly secure conduit to building structure on opposite sides of a building expansion joint with pull boxes on both sides of joint.
3. Connect conduits to pull boxes with 375 mm (15 inches) of slack flexible conduit.
4. Install green copper wire minimum #6 AWG in flexible conduit for bonding jumper.

H. Conduit Supports, Installation:
1. Select AC193 code listed mechanical anchors or fastening devices with safe working load not to exceed 1/4 of proof test load.
2. Use pipe straps or individual conduit hangers for supporting individual conduits. Maximum distance between supports is 2.5 m (8 foot) on center.

3. Support multiple conduit runs with trapeze hangers. Use trapeze hangers designed to support a load equal or greater than sum of the weights of the conduits, wires, hanger itself, and 90 kg (200 pounds). Attach each conduit with U-bolts or other accepted fasteners.
4. Support conduit independent of pull boxes, luminaires, suspended ceiling components, angle supports, duct work, and similar items.
5. Fastenings and Supports in Solid Masonry and Concrete:
   a. New Construction: Use steel or malleable iron concrete inserts set in place prior to placing concrete.
   b. Existing Construction:
      1) Code AC193 listed wedge type steel expansion anchors minimum 6 mm (1/4 inch) bolt size and minimum 28 mm (1-1/8 inch) embedment.
      2) Power set fasteners minimum 6 mm (1/4 inch) diameter with depth of penetration minimum 75 mm (3 inches).
      3) Use vibration and shock resistant anchors and fasteners for attaching to concrete ceilings.
6. Fastening to Hollow Masonry: Toggle bolts are permitted.
7. Fastening to Metal Structures: Use machine screw fasteners or other devices designed and accepted for application.
8. Bolts supported only by plaster or gypsum wallboard are not acceptable.
9. Attachment by wood plugs, rawl plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.
10. Do not support conduit from chain, wire, or perforated strap.
11. Spring steel type supports or fasteners are not permitted except horizontal and vertical supports/fasteners within walls.
12. Vertical Supports:
    a. Install riser clamps and supports for vertical conduit runs in accordance with NEC.
    b. Provide supports for cable and wire with fittings that include internal wedges and retaining collars.

I. Box Installation:
   1. Boxes for Concealed Conduits:

a. Flush mounted.

b. Provide raised covers for boxes to suit wall or ceiling, construction and finish. In spaces not controlled by VA (i.e., common hallways) covers must be lockable.

2. In addition to boxes shown, install additional boxes where needed to prevent damage to cables during pulling.

3. Remove only knockouts as required and plug unused openings. Use threaded plugs for cast metal boxes and snap-in metal covers for sheet metal boxes.

4. Stencil or install phenolic nameplates on covers of boxes identified on riser diagrams; for example "SIG-FA JB No. 1".

5. Outlet boxes mounted back-to-back in same wall are not permitted. A minimum 600 mm (24 inches) center-to-center lateral spacing must be maintained between boxes.

J. Flexible Nonmetallic Communications Raceway (Innerduct), Installation:

1. Install Innerduct in cable tray. Innerduct may not be free-hung.

2. Install only in accessible spaces not subject to physical damage or corrosive influences.

3. Make bends manually to assure internal diameter of tubing is not effectively reduced.

4. Extend each segment of innerduct minimum 300 mm (12 inches) beyond end of service conduit tie or cable tray. Restrain innerduct ends with wall mount clamps and seal when cable is installed.

3.2 TESTING

A. Examine fittings and locknuts for secureness.

B. Test RMC, IMC and EMT systems for electrical continuity and resistance to ground.

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11-1-16

SECTION 27 08 00

COMMISSIONING OF COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 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 and 28 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 REQUIRMENTS and 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.

1.2 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.

1.3 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.

1.4 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 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 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.

3.2 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.

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SECTION 27 10 00

CONTROL, COMMUNICATION AND SIGNAL WIRING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section includes control, communication and signal wiring for a comprehensive systems infrastructure.

B. This section applies to all sections of Divisions 27 and 28.

1.2 RELATED WORK

A. Sealing around penetrations to maintain integrity of time rated construction: Section 07 84 00, FIRESTOPPING.

B. General electrical requirements that are common to more than one section in Division 27: Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.

C. Conduits for cables and wiring: Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS.

D. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.

1.3 SUBMITTALS

A. Submit in accordance with Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.

B. Submit written certification from OEM:

1. Indicate wiring and connection diagrams meet National and Government Life Safety Guidelines, NFPA, NEC, NRTL, Joint Commission, OEM, this section and Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
2. Include instructions, requirements, recommendations, and guidance for proper performance of system as described herein.
3. Government will not approve any submittal without this certification.

C. Identify environmental specifications on technical submittals; identify requirements for installation.

1. Minimum floor space and ceiling heights.
2. Minimum size of doors for cable reel passage.

D. Power: Provide specific voltage, amperage, phases, and quantities of circuits.

E. Provide conduit size requirements.

F. Closeout Submittals:

1. Provide contact information for maintenance personnel to contact contractor for emergency maintenance and logistic assistance, and assistance in resolving technical problems at any time during warranty period.
2. Provide certified OEM sweep test tags from each cable reel to COR.
3. Furnish spare or unused wire and cable with appropriate connectors (female types) for installation in appropriate punch blocks, barrier strips, patch, or bulkhead connector panels.
4. Turn over unused and opened installation kit boxes, coaxial, fiber optic, and twisted pair cable reels, conduit, cable tray, cable duct bundles, wire rolls, physical installation hardware to COR.
5. Documentation: Include any item or quantity of items, as installed drawings, equipment, maintenance, and operation manuals, and OEM materials needed to completely and correctly provide system documentation required herein.

PART 2 - PRODUCTS

2.1 CONTROL WIRING

A. Provide control wiring large enough so voltage drop under in-rush conditions does not adversely affect operation of controls.

B. Provide cable meeting specifications for type of cable.

C. Outside Location (i.e. above ground, underground in conduit, ducts, pathways, etc.): Provide cables filled with a waterproofing compound between outside jacket (not touching any provided armor) and inter conductors to seal punctures in jacket and protect conductors from moisture.

D. Remote Control Cable:

1. Multi-conductor with stranded conductors able to handle power and voltage required to control specified system equipment, from a remote location.
2. NRTL listed and pass VW-1 vertical wire flame test (UL 83) (formerly FR-1).
3. Color-coded Conductors: Combined multi-conductor and coaxial cables are acceptable for this installation, on condition system performance standards are met.
4. Technical Characteristics:

a. Length: As required, in 1K (3,000 ft.) reels minimum.

b. Connectors: As required by system design.

c. Size:

1) 18 AWG, minimum, Outside.

2) 20 AWG, minimum, Inside.

d. Color Coding: Required, EIA industry standard.

e. Bend Radius: 10 times cable outside diameter.

f. Impedance: As required.

g. Shield Coverage: As required by OEM specification.

h. Attenuation:

Frequency in MHz	dB per 305 Meter (1,000 feet), maximum
0.7	5.2
1.0	6.5
4.0	14.0
8.0	19.0
16.0	26.0
20.0	29.0
25.0	33.0
31.0	36.0
50.0	52.0

E. Distribution System Signal Wires and Cables:

1. Provide in same manner, and use construction practices, as Fire Protective and other Emergency Systems identified and defined in NFPA 101, Life Safety Code, Chapters 7, 12, and 13, NFPA 70, National Electrical Code, Chapter 7, Special Conditions.
2. Provide system able to withstand adverse environmental conditions without deterioration, in their respective location.
3. Provide entering of each equipment enclosure, console, cabinet or rack in such a manner that all doors or access panels can be opened and closed without removal or disruption of cables.
4. Terminate on an item of equipment by direct connection.

2.2 COMMUNICATION AND SIGNAL WIRING

A. Provide communications and signal wiring conforming to recommendations of manufacturers of systems; provide not less than TIA Performance Category 6.

B. Wiring shown is for typical systems; provide wiring as required for systems being provided.

C. Provide color-coded conductor insulation for multi-conductor cables.

D. Connectors:

1. Provide connectors for transmission lines, and signal extensions to maintain uninterupted continuity, ensure effective connection, and preserve uniform polarity between all points in system.
   a. Provide AC barrier strips with a protective cover to prevent accidental contact with wires carrying live AC current.
   b. Provide punch blocks for signal connection, not AC power. AC power twist-on wire connectors are not permitted for signal wire terminations.
2. Cables: Provide connectors designed for specific size cable and conductors being installed with OEM's approved installation tool. Typical system cable connectors include:
   a. Audio spade lug.
   b. Punch block.
   c. Wirewrap.

2.3 INSTALLATION KIT

A. Include connectors and terminals, labeling systems, audio spade lugs, barrier strips, punch blocks or wire wrap terminals, heat shrink tubing, cable ties, solder, hangers, clamps, bolts, conduit, cable duct, cable tray, etc., required to accomplish a neat and secure installation.

B. Terminate conductors in a spade lug and barrier strip, wire wrap terminal or punch block, so there are no unfinished or unlabeled wire connections.

C. Minimum required installation sub-kits:

1. System Grounding:
   a. Provide required cable and installation hardware for effective ground path, including the following:
      1) Control Cable Shields.
      2) Data Cable Shields.
      3) Equipment Racks.
      4) Equipment Cabinets.
      5) Conduits.
      6) Ducts.
      7) Cable Trays.
      8) Power Panels.

9) Connector Panels.

10) Grounding Blocks.

b. Bond radio equipment to earth ground via internal building wiring, according to NEC.

2. Wire and Cable: Provide connectors and terminals, punch blocks, tie wraps, hangers, clamps, labels, etc. required to accomplish termination in an orderly installation.

3. Conduit, Cable Duct, and Cable Tray: Provide conduit, duct, trays, junction boxes, back boxes, cover plates, feed through nipples, hangers, clamps, other hardware required to accomplish a neat and secure conduit, cable duct, cable tray installation in accordance with NEC and documents.

4. Equipment Interface: Provide any items or quantity of equipment, cable, mounting hardware and materials to interface systems with identified sub-systems, according to OEM requirements and construction documents.

5. Labels: Provide any item or quantity of labels, tools, stencils, and materials to label each subsystem according to OEM requirements, as-installed drawings, and construction documents.

D. Cross-Connection System (CCS) Equipment Breakout, Termination Connector (or Bulkhead), and Patch Panels:

1. Connector Panels: Flat smooth 3.175 mm (1/8 inch) thick solid aluminum, custom designed, fitted and installed in cabinet. Install bulkhead equipment connectors on panel to enable cabinet equipment’s signal, control, and coaxial cables to be connected through panel. Match panel color to cabinet installed.

a. Voice (or Telephone):

1) Provide industry standard Type 110 (minimum) punch blocks for voice or telephone, and control wiring instead of patch panels, each being certified for category 6.

2) IDC punch blocks (with internal RJ45 jacks) are acceptable for use in CCS when designed for Category 6 and the size and type of cable used.

3) Secure punch block strips to OEM designed physical anchoring unit on a wall location in TRS; console, cabinet, rail, panel, etc. mounting is permitted at OEM recommendation and as

accepted by COR. Punch blocks are not permitted for Class II or 120 VAC power wiring.

4) Technical Characteristics:
   a) Number of Horizontal Rows: Minimum 100.
   b) Number of Terminals per Row: Minimum 4.
   c) Terminal Protector: Required for each used or unused terminal.
   d) Insulation Splicing: Required between each row of terminals.

b. Digital or High Speed Data:
   1) Provide 480 mm (19 inches) horizontal EIA/ECA 310 rack mountable patch panel with EIA/ECA 310 standard spaced vertical mounting holes for digital or high-speed data service CSS, with modular female Category 5E (or on a case by case basis Category 6A for specialized powered systems accepted by SMCS 005OP2H3, (202) 461-5310, OI&T and FMS Services, and COR) RJ45 jacks designed for size and type of UTP or F/UTP cable installed in rows.
   2) Technical Characteristics:
      a) Number of Horizontal Rows: Minimum 2.
      b) Number of Jacks Per Row: Minimum 24.
      c) Type of Jacks: RJ45.
      d) Terminal Protector: Required for each used or unused jack.
      e) Insulation: Required between each row of jacks.

2.4 EXISTING WIRING

A. Reuse existing wiring only where indicated on plans and accepted by SMCS 005OP2H3.

B. Only existing wiring that conforms to specifications and applicable codes can be reused; existing wiring that does not meet these requirements cannot be reused and must be removed by contractor.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
   1. Install wiring in cable tray or raceway.
   2. Seal cable entering a building from underground, between wire and conduit where cable exits conduit, with non-hardening approved compound.

3. Wire Pulling:
   a. Provide installation equipment that prevents cutting or abrasion of insulation during pulling of cables.
   b. Use ropes made of nonmetallic material for pulling feeders.
   c. Attach pulling lines for feeders by means of either woven basket grips or pulling eyes attached to conductors, as accepted by COR.
   d. Pull multiple cables into a single conduit together.

B. Installation in Maintenance or Man holes:
1. Install and support cables in maintenance holes on steel racks with porcelain or equal insulators.
2. Train cables around maintenance hole walls, but do not bend to a radius less than six times overall cable diameter.
3. Fireproofing:
   a. Install fireproofing where low voltage cables are installed in same maintenance holes with high voltage cables; also cover low voltage cables with arc proof and fireproof tape.
   b. Use tape of same type used for high voltage cables, and apply tape in a single layer, one-half lapped or as recommended by manufacturer. Install tape with coated side towards the cable and extend minimum 25 mm (1 inch) into each duct.
   c. Secure tape in place by a random wrap of glass cloth tape.

C. Control, Communication and Signal Wiring Installation:
1. Unless otherwise specified in other sections, provide wiring and connect to equipment/devices to perform required functions as indicated.
2. Install separate cables for each system so that malfunctions in any system does not affect other systems, except where otherwise required.
3. Group wires and cables according to service (i.e. AC, grounds, signal, DC, control, etc.); DC, control and signal cables can be included with any group.
4. Form wires and cables to not change position in group throughout the conduit run. Bundle wires and cables in accepted signal duct, conduit, cable ducts, or cable trays neatly formed, tied off in 600 mm to 900 mm (24 inch to 36 inch) lengths to not change position in group throughout run.
5. Concealed splices are not allowed.

6. Separate, organize, bundle, and route wires or cables to restrict EMI, channel crosstalk, or feedback oscillation inside any enclosure.
7. Looking at any enclosure from the rear (wall mounted enclosures, junction, pull or interface boxes from the front), locate AC power, DC and speaker wires or cables on the left; coaxial, control, microphone and line level audio and data wires or cables, on the right.
8. Provide ties and fasteners that do not damage or distort wires or cables. Limit spacing between tied points to maximum 150 mm (6 inches).
9. Install wires or cables outside of buildings in conduit, secured to solid building structures.
10. Wires or cables must be specifically accepted, on a case by case basis, to be installed outside of conduit. Bundled wires or cables must be tied at minimum 460 mm (18 inches) intervals to a solid building structure; bundled wires or cables must have ultra violet protection and be waterproof (including all connections).
11. Laying wires or cables directly on roof tops, ladders, drooping down walls, walkways, floors, etc. is not permitted.
12. Wires or cables installed outside of conduit, cable trays, wireways, cable duct, etc.:
    a. Only when authorized, can wires or cables be identified and approved to be installed outside of conduit.
    b. Provide wire or cable rated plenum and OEM certified for use in air plenums.
    c. Provide wires and cables hidden, protected, fastened and tied at maximum 600 mm (24 inches) intervals, to building structure.
    d. Provide closer wire or cable fastening intervals to prevent sagging, maintain clearance above suspended ceilings.
    e. Remove unsightly wiring and cabling from view, and discourage tampering and vandalism.
    f. Sleeve and seal wire or cable runs, not installed in conduit, that penetrate outside building walls, supporting walls, and two hour fire barriers, with an approved fire retardant sealant.

D. AC Power:

1. Bond to ground contractor-installed equipment and identified Government-furnished equipment, to eliminate shock hazards and to minimize ground loops, common mode returns, noise pickup, crosstalk, etc. for total ground resistance of 0.1 Ohm or less.
2. Use of conduit, signal duct or cable trays as system or electrical ground is not permitted; use these items only for dissipation of internally generated static charges (not to be confused with externally generated lightning) that can be applied or generated outside mechanical and physical confines of system to earth ground. Discovery of improper system grounding is grounds to declare system unacceptable and termination of all system acceptance testing.
3. Cabinet Bus: Extend a common ground bus of at least #10 AWG solid copper wire throughout each equipment cabinet and bond to system ground. Provide a separate isolated ground connection from each equipment cabinet ground bus to system ground. Do not tie equipment ground busses together.
4. Equipment: Bond equipment to cabinet bus with copper braid equivalent to at least #12 AWG. Self-grounding equipment enclosures, racks or cabinets, that provide OEM certified functional ground connections through physical contact with installed equipment, are acceptable alternatives.

3.2 EQUIPMENT IDENTIFICATION

A. Control, Communication and Signal System Identification:
1. Install a permanent wire marker on each wire at each termination.
2. Identify cables with numbers and letters on the labels corresponding to those on wiring diagrams used for installing systems.
3. Install labels retaining their markings after cleaning.
4. In each maintenance hole (manhole) and handhole, install embossed brass tags to identify system served and function.

B. Labeling:
1. Industry Standard: ANSI/TIA-606-B.
2. Print lettering for voice and data circuits using laser printers thermal ink transfer process; handwritten labels are not acceptable.
3. Cable and Wires (hereinafter referred to as “cable”): Label cables at both ends in accordance with industry standard. Provide permanent labels in contrasting colors. Identify cables matching system Record Wiring Diagrams.

4. Equipment: Permanently labeled system equipment with contrasting plastic laminate or bakelite material. Label system equipment on face of unit corresponding to its source.
5. Conduit, Cable Duct, and Cable Tray: Label conduit, duct and tray, including utilized GFE, with permanent marking devices or spray painted stenciling a minimum of 3 meters (10 ft.) identifying system. Label each enclosure according to this standard.
6. Termination Hardware: Label workstation outlets and patch panel connections using color coded labels with identifiers in accordance with industry standard and Record Wiring Diagrams.

3.3 TESTING

A. Minimum test requirements are for impedance compliance, inductance, capacitance, signal level compliance, opens, shorts, cross talk, noise, and distortion, and split pairs on cables in frequency ranges specified.

B. Tests required for data cable must be made to confirm operation of this cable at minimum 10 Mega (M) Hertz (Hz) full bandwidth, fully channel loaded and a Bit Error Rate of a minimum of 10-6 at maximum rate of speed.

C. Provide cable installation and test records at acceptance testing to COR and thereafter maintain in facility’s telephone switch room.

D. Record changes (used pair, failed pair, etc.) in these records as change occurs.

E. Test cables after installation and replace any defective cables.

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06-01-15

SECTION 27 51 23
INTERCOMMUNICATIONS AND PROGRAM SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies a new and fully operating Intercom (IC) System.

B. Conform to VAAR 852.236.91 and intent of the construction documents, recognizing that it may be impracticable to detail all items because of variances in manufacturers to achieve indicated intent.

1.2 RELATED WORK

A. Connection to Electronic Access Control at doors: Section 28 13 00, PHYSICAL ACCESS CONTROL SYSTEM.

B. Door hardware and operation of doors: 08 71 00 DOOR HARDWARE

C. Conduit and boxes: Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS.

D. Electrical conductors and cables: Section 27 10 00, CONTROL, COMMUNICATION AND SIGNAL WIRING.

E. Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents: Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.

F. Requirements for interfacing with Facility’s SMS: Section 28 31 00, PHYSICAL ACCESS CONTROL SYSTEM.

1.3 SUBMITTALS

A. In addition to requirements of SECTION 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS, submit:

1. Written certification from OEM proposed provider of contract maintenance is an authorized representative of OEM. Include provider’s legal name, address, and OEM credentials.
2. Submit names, locations and point of contact for three installations employing proposed OEM IC Systems of comparable size and complexity performing for at least one year after final acceptance by user.

B. Certifications:

1. Submit documentation that supplier has been an authorized distributor and service organization for OEM for a minimum of three years and is authorized by OEM to pass thru OEM’s warranty of installed equipment to Government.

2. Submit certificate of successful completion of OEM's installation and training program for each installing technician of equipment being proposed. Provide current OEM certifications for installers to be approved by COR before being allowed to commence work on system.
3. Provide current OEM certification documenting maintenance and supervisory personnel are authorized by OEM to service installed equipment during warranty.
4. Furnish copies of applicable national, state and local licenses.

C. Warranty: Submit OEM warranty.

D. Needs Assessment Report: Provide a summary report of the needs assessment meeting conducted with nursing manager of each unit, as required by this section.

E. Maintenance Material Submission:

1. Provide one spare 304 m (1,000 foot) roll of accepted system (not microphone) cable.

1.4 QUALITY ASSURANCE

A. Assign only technicians trained, qualified, and certified by OEM on engineering, installation, operation and testing of system.

B. Provide system firmware from OEM with a proven history of product reliability and sole control over all source code.

1.5 WARRANTY

A. Comply with FAR clause 52.246-21, except that warranty must be as follows:

1. Manufacturer shall warranty their equipment and certified installation for a minimum of two years from date of installation and final acceptance by the Government.
2. Provide, free of charge, product firmware and software upgrades for a period of one year from date of final acceptance by Government for any product feature enhancements.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide voice communication between wall-mounted intercom stations and desk or wall-mounted master stations.

B. Provide accessories and miscellaneous appurtenances required for a complete and operating communications system and network.

C. Coordinate features and select components to form an integrated IC system. Match components and interconnections for optimum performance of specified functions.

D. Expansion Capability: Increase number of Room Speaker-Microphone stations in future by 25 percent above those indicated without adding any internal or external components or trunk cable conductors.

E. Equipment: Modular type, continuous duty rated.

F. Weather-Resistant Equipment: Listed by a National Recognized Testing Laboratory (NRTL) for operation in wet, damp or outdoor locations.

G. Install IC head end equipment in room _____ and connect rooms _____. Provide zoned, one-way voice paging through distributed, wall-mounted units. Interconnect so voice input into IC is by zone from main console at _____ .

2.2 PERFORMANCE CRITERIA

A. In addition to requirements of Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS, the minimum requirements for each system are:

1. Wired IC systems approved to connect to separate communications system (i.e. SMS, WAN, LAN includes: Telephone, Nurse Call, radio paging, wireless systems) minimum requirements:
   a. NIST FIPS Pub 140/2.
   b. UL 60950-1, edition 2.
2. IEC 62368-1 ed 2: 2014.
3. Code of Federal Regulations, Title 47, Part 15 (or FCC Part 15) Listed Radio Equipment is not permitted.

B. Provide system with configuration programming capable of being executed remotely via a remote connection (when specifically accepted by Spectrum Management and COMSEC Services (SMCS 0050P2H3) without any exchange of parts.

2.3 EQUIPMENT ITEMS

A. Manually Switched System:

1. Master Station Features:
   a. Communicate selectively with all other master and speaker-microphone stations by actuation of selector switches.
   b. Communicate simultaneously with other stations by actuation of a single all-call switch.

c. Communicate with individual stations in privacy.
d. Include other master-station connections in a multiple-station conference call.
e. Override any conversation by a designated master station.

2. Room Speaker-Microphone Station Features:
a. Privacy from remote monitoring with a warning tone signal and visual indication at monitored station.
b. Privacy switches at designated speaker-microphone stations to prevent another station from listening and to permit incoming calls.
c. Communicate hands free.
d. Call master station by actuating call switch.
e. Return busy signal to indicate that station is already in use.

3. Speakers: Free of noise and distortion during operation and when in standby mode.

B. Microprocessor-Switched System:

1. Master Station Features:
a. Communicate selectively with other master and speaker-microphone stations by dialing station's number on a 12-digit keypad.
b. Communicate simultaneously with all other stations by dialing a designated number on a 12-digit key-pad.
c. Communicate with individual stations in privacy.
d. Include other master-station connections in a multiple-station conference call.
e. Access separate paging speakers or groups of paging speakers by dialing designated numbers on a 12-digit keypad.
f. Override any conversation by a designated master station.
g. Display selected station.
h. Volume Control: Regulate incoming-call volume.
i. LED: Identify calling stations and stations in use. Remains illuminated until call is answered.
j. Momentary audible tone signal: Announce incoming calls.
k. Handset with Hook Switch: Telephone type with 61 cm (24-inch) long, permanently coiled cord. Hook switch to disconnect speaker when handset is lifted.
l. Reset Control: Cancels call and resets system for next call.

m. Equipment Cabinet:
1) Comply with EIA/ECA 310-E Cabinets, and Associated Equipment Standard.
2) Lockable.
3) Ventilated metal cabinet houses terminal strips, power supplies, amplifiers, system volume control, and other switching and control devices required for conversation channels and control functions.

n. Vertical Equipment Rack:
1) 28” (16RU) rack space.
a) Welded steel construction.
b) Minimum 198 cm (78 inches) usable height.
c) Adjustable front mounting rails.
2) Install the following appurtenances provided by same manufacturer or as specified:
a) Security screws w/ nylon isolation bushings.
b) Textured blank panels.
c) Custom mounts for components without rack mount kits.
d) Security covers.
e) Copper Bus Bar.
f) Power Sequencer- rack-mounted power conditioner and delayed sequencers with two unswitched outlets each and contact closure control inputs.

2. Room Speaker-Microphone Station Features:
a. Privacy from remote monitoring with a warning tone signal and visual indication at monitored station.
b. Privacy switches at designated speaker-microphone stations to prevent another station from listening and to permit incoming calls.
c. Communicate hands free.
d. Call master station by actuating call switch.
e. Return busy signal to indicate that station is already in use.
f. Free of noise and distortion during operation and when in standby mode.

C. Wireless:
1. Radio Systems:

a. Provide IC system with ability to operate only with VA certified and licensed radio system (FCC Part 15 listed pagers and transmitters are not allowed for "Safety of Life" functions or installed in those specific areas) and with the following features:
   1) Ability to pass-through location information (such as a room number) and call-type as well as other text messages simultaneously to shift supervisor identified staff members.
   2) Allow operator to select staff members by name or pager number and select system message consisting of room number and condition code (such as priority level) or type text to be read by holder of pager unit.
   3) While a patient station is connected to nurse's master station, allow operator to automatically page staff member assigned to that room.
      a) An alternate staff member can be selected for paging purposes in place of primary staff member.
      b) Allow alternate staff member to be paged when primary staff member is unable to respond to patient's needs within a specified period of time.
      c) Assign any bed to any pager or pager group.
      d) Assign an unlimited amount of pagers to any patient bed.
   4) Ability to send code calls to staff members by predetermined group automatically by pressing one "Code Blue" button.
      a) Indicate room number of code call.
      b) State "Code Blue" in plain English format on pagers
      c) FCC Part 15 listed pagers are not allowed to be used for these" functions or in those specific locations.

2. Personal Wireless Communicator:
   a. Connect to personal wireless communications system.
   b. Pass text data.
   c. Provides 2-way communication between Telephone or LAN/WAN Interface.
   d. Not FCC Part 15 listed device.
   e. Meets or exceeds UL 60950-1, edition 2.

f. Meets Office of Cyber and Information Security (OCIS) Guide Lines for NIST FIPS Pub 140/2 certification.

g. Includes training program with recertifications for staff.

3. Other Wireless Equipment/Systems: _____ .

2.4 HEAD END EQUIPMENT

A. Provide required power supplies, communications hubs, network switches, intelligent controllers and other devices necessary to form a complete system.

B. Head end components can be rack mounted or wall mounted in a metal enclosure.

C. Provide head end equipment in telecommunications room where IC system is installed.

D. Provide minimum 30 minute battery back-up (or UPS) to system components.

E. Provide complete IC System electronic supervision from Facility Police SMS Console in Police Control Room; and, interface Emergency (or Disaster Control Room) Console with alternate control capability.

2.5 SYSTEM CABLES

A. Comply with SECTION 27 10 00, CONTROL, COMMUNICATION AND SIGNAL WIRING for specific installation and testing requirements.

B. Conductors: Jacketed, twisted pair and twisted multipair, untinned solid copper; sizes as recommended by system manufacturer, but no smaller than No. 22 AWG.

C. Insulation: Thermoplastic; minimum 0.8 mm (1/32 inch) thick.

D. Shielding: For speaker-microphone leads and elsewhere where recommended by manufacturer; No. 34 AWG, tinned, soft-copper strands formed into a braid or equivalent foil.

E. Minimum Shielding Coverage on Conductors: 60 percent.

F. Cabling must be riser rated , plenum rated in designated spaces .

2.6 RACEWAYS

A. Raceways and Boxes: Comply with requirements in Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS.

B. Each open top raceway must be NRTL listed for telecommunications systems and partitioned with metal partitions in order to comply with NEC Parts 517 and 800 to “mechanically separate” telecommunications systems of different service, protect installed cables from falling out

when vertically mounted and allow junction boxes to be attached to the side to interface "drop" type conduit cable feeds.

C. IC System Cable Infrastructure: EMT and cable tray NRTL classified for suitability and NRTL listed for telecommunications.

D. Pull boxes must be minimum 63.5 mm (2-1/2 inches) deep and 152.4 mm (6 inches) wide by 152.4 (6 inches) long.

2.7 SYSTEM CONDUIT

A. Provide separate 25.4 mm (1 inch) minimum diameter ___ conduit, for system installation.

2.8 UNINTERRUPTIBLE POWER SUPPLY (UPS)

A. Provide UPS for system to allow normal operation and function (as if there was no AC power failure) in event of an AC power failure or during input power fluctuations for a minimum of 30 minutes.

B. As an alternative solution, telephone system UPS can be utilized to meet this requirement at head-end location, as long as this function is specifically accepted by telephone contractor and COR.

1. Do not make any attachments or connection to telephone system until specifically directed to do so, in writing, by COR.

C. Provide UPS for active system components including:

1. System Amplifiers.
2. Microphone Consoles.
3. System Interface Units.
4. Head End Equipment Racks.
5. Control Consoles.

2.9 FINISHES

A. Provide finishes for exposed work such as plates, racks, panels, speakers, etc. accepted by design professional, COR and 005OP3B.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Review and coordinate with telecommunications cabling installer for location of intercom equipment in Telecommunications Rooms.

B. Verification of Conditions: Before beginning work, verify location, quantity, size and access for the following:

1. Isolated ground AC power circuits provided for systems.
2. Pull boxes, wall boxes, wire troughs, conduit stubs and other related infrastructure for systems.

3. System components installed by others.
4. Overhead supports and rigging hardware installed by others.

C. Installer must immediately notify COR, general contractor and design professional in writing of any discrepancies.

D. Needs Assessment:
1. Provide a one-on-one meeting with nursing manager of each unit affected by installation of system.
2. Review floor plans and drawings, educate nursing manager on functions of the equipment and gather details specific to individual units; coverage and priorities of calls; staffing patterns; and other pertinent details that affect system programming and training.
3. Prepare a summary report of the assessment.

3.2 INSTALLATION

A. General:
1. Install work plumb and square and in a manner consistent with standard industry practice.
2. Protect work from dust, paint and moisture as dictated by site conditions. Contractor is responsible for protection of work until final acceptance by Government.
3. Install equipment according to OEM’s recommendations.
4. Provide any hardware, adaptors, brackets, rack mount kits or other accessories recommended by OEM for complete assembly and installation.
5. Secure equipment firmly in place, including IC stations, speakers, equipment racks, system cables, etc.:
   a. Supports, mounts, fasteners, attachments and attachment points must support loads with a safety factor of at least 5:1.
   b. Do not impose weight of equipment on supports provided for other trades or systems.
   c. Any suspended equipment or associated hardware must be certified by OEM for overhead suspension.
   d. Contractor is responsible for means and methods in design, fabrication, installation and certification of any supports, mounts, fasteners and attachments.
6. Coordinate cover plates with field conditions. Size and install cover plates to hide joints between back boxes and surrounding wall.

Do not allow cable to leave or enter boxes without cover plates installed.

7. Where cover plates are not fitted with connectors, provide grommeted holes in size and quantity required.

B. Equipment Racks:

1. Fill unused equipment mounting spaces with blank panels or vent panels; match color to equipment racks.
2. Provide security covers for devices not requiring routine operator control.
3. Provide vent panels and cooling fans as required for operation of equipment within OEM's specified temperature limits.
   a. Provide adequate ventilation space between equipment for cooling.
   b. Follow manufacturer’s recommendations regarding ventilation space between amplifiers.
4. Provide insulated connections of raceway to equipment racks.
5. Provide continuous conduit with no more than 40 percent fill between wire troughs and equipment racks for non-plenum-rated cable.
6. Ensure each system is mechanically separated from each other in wireway.

C. Wiring Practice: In addition to requirements in Section 27 10 00, STRUCTURED CABLING, adhere to the following additional practices:

1. Execute wiring in strict adherence to National Electrical Code, applicable local building codes and standard industry practices.
2. Where raceway and wire way are EMT (conduit), wiring of differing classifications must be run in separate conduit.
3. Where raceway and wire way are an enclosure (rack, tray, wire trough, utility box) wiring of differing classifications which share same enclosure must be mechanically partitioned and separated by 102 mm (four inches). Where wiring of differing classifications must cross, they must cross perpendicular to one another.
4. Do not splice wiring anywhere along entire length of run.
5. Make sure cables are insulated and shielded from each other and from raceway for entire length of run.
6. Do not pull wire through any enclosure where a change of raceway alignment or direction occurs.
7. Do not bend wires to less than radius recommended by manufacturer.

8. Replace entire length of run of any wire or cable that is damaged or abraded during installation. There are no acceptable methods of repairing damaged or abraded wiring.
9. Do not apply wire pulling lubricants unless specifically recommended by cable OEM.
10. Use grommets around cut-outs and knock-outs where conduit or chase nipples are not installed.
11. Do not use tape-based or glue-based cable anchors.
12. Bond shields and drain wires to ground.
13. Terminate field wiring entering equipment racks as follows:
    a. Provide service loops at harness break-outs, plates, panels and equipment to allow plates, panels and equipment to be removed for service and inspection.
    b. Line level and speaker level wiring can be terminated inside equipment rack using specified terminal blocks.
    c. Provide 15 percent spare terminals inside each rack.
    d. Microphone level wiring can only be terminated at equipment served.
    e. If specified terminal blocks are not designed for rack mounting, utilize 3/4 inch plywood or 1/8 inch thick aluminum plates/blank panels as a mounting surface.
    f. Do not mount terminal blocks on bottom of rack.
    g. Employ permanent strain relief for any cable with an outside diameter of 1 inch or greater.
14. Use only balanced audio circuits unless indicated otherwise.
15. Make connections as follows:
    a. Use rosin-core solder or mechanical connectors appropriate to application.
    b. For crimp-type connections, use only crimp tool specified by manufacturer for the application.
    c. Use only insulated spade lugs on screw terminals. Spade lugs must be sized to fit wire gauge; do not exceed two lugs per terminal.
    d. Twist on wire connectors and electrical tape are not permitted for any application.

D. Cable Installation: In addition to requirements in Section 27 10 00, STRUCTURED CABLING, comply to the following practices.

1. Acceptable means of cable support are cable tray, wire way, and conduit. Hook and loop wrap cable bundles loosely to cable tray with plenum rated Velcro straps. Plastic tie wraps are not permitted as a means to bundle or support cables.
2. Run cables parallel to walls.
3. Do not lay cables on top of luminaires, ceiling tiles, mechanical equipment, or ductwork.
4. Maintain minimum 61 cm (2’-0”) clearance from all shielded electrical apparatus.
5. Test cables after the total installation is complete. Document test results. Remedy any cabling problems or defects in order to pass or comply with testing. This includes re-pull of new cable as required.
6. Terminate both ends of cables per industry and OEM’s recommendations.
7. Provide proper temporary protection of cable after pulling is complete before final dressing and terminations are complete. Do not leave cable lying on floor. Bundle and tie wrap up off of the floor until ready to terminate.
8. Cover end of overall jacket with minimum 25.4 mm (1 inch) length of transparent heat-shrink tubing.
   a. Cut unused insulated conductors minimum 50.8 mm (2 inches) passed heat-shrink, fold back over jacket and secure with cable-tie.
   b. Cut unused shield/drain wires minimum 50.8 mm (2 inches) passed heat-shrink cover shield/drain wires with heat-shrink tubing extending to overall jacket. Extend tubing 6 mm (1/4 inch) passed end of unused wires, fold back over jacket and secure with cable tie.
9. For each solder-type connection, cover bare wire and solder connection with heat-shrink tubing.
10. Terminate conductors; no cable must contain unterminated elements. Make terminations only at outlets and terminals.
11. Terminations: Arrange on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Cables cannot be spliced.

12. Bundle, lace, and train conductors to terminal points without exceeding OEM's limitations on bending radii. Install lacing bars and distribution spools.
13. Cold-Weather Installation: Bring cable to room temperature before de-reeling. Heat lamps are not permitted.
14. Cable must not be run through structural members or be in contact with pipes, ducts, or other potentially damaging items.
15. Separation of Wires: (Refer to Raceway Installation)
    a. Separate speaker-microphone, line-level, speaker-level, and power wiring runs.
    b. Install in separate raceways or, where exposed or in same enclosure, separate conductors at minimum 30.5 cm (12 inches) apart for speaker microphones and adjacent parallel power and telephone wiring.
    c. Separate other intercommunication equipment conductors as recommended by equipment manufacturer.

E. System Conduit: Install manufactured conduit sweeps and long radius elbows according to wire and cable OEM instructions.

F. Labeling:
1. Permanently mark switches, connectors, jacks, relays, receptacles and electronic and other equipment.
2. Engrave and paint fill receptacle panels using minimum 3.17 mm (1/8 inch) high lettering and contrasting paint.
3. For rack-mounted equipment, use engraved Lamacoid labels with white minimum 3.17 mm (1/8 inch) high lettering on black background. Label front and back of rack-mounted equipment.
4. Where multiple pieces of equipment reside in same rack group, label each indicating to which room, channel, receptacle location, etc. they correspond.
5. Permanently label cables at each end, including intra-rack connections. Labels must be covered by same, transparent heat-shrink tubing covering end of overall jacket. Alternatively, provide computer generated labels of type which include a clear protective wrap.

6. Contractor's name cannot appear more than once on each continuous set of racks. Contractor's name cannot appear on wall plates or portable equipment.
7. Ensure each piece of OEM supplied equipment has appropriate NRTL labels for the service equipment is performing. Equipment installed not bearing NRTL label will not be permitted. Contractor is responsible to provide listed replacement equipment with approved NRTL label.

G. Protection during Installation:
1. Protect electronic devices during unpacking and installation by wearing electrostatic discharge (ESD) wrist straps tied to chassis ground.
2. Wrist straps must meet OSHA requirements for prevention of electrical shock, if technician comes in contact with high voltage.

H. Cutting and Patching:
1. Keep work area clear of debris and clean area daily at completion of work.
2. Patch and paint any wall or surface that has been disturbed by execution of this work.
3. Provide any additional cutting, drilling, fitting or patching required that is not indicated as provided by others to complete work or to make its parts fit together properly.
4. Do not damage or endanger fully or partially completed construction of Government or separate contractors by cutting, patching or otherwise altering such construction, or by excavation. Contractor cannot cut or otherwise alter such construction by facility or separate contractor except with written consent of Government or of such separate contractor; such consent cannot be unreasonably withheld. Contractor cannot unreasonably withhold consent to cutting or otherwise altering work, by facility or a separate contractor.
5. Where coring of in-place concrete is specified or required, including coring indicated under unit prices, location of such coring must be identified in the field and accepted by COR prior to commencement of coring work.

I. Fireproofing:

1. Fireproof openings where IC cables penetrate fire rated walls, floors and ceilings.
2. Provide conduit sleeves (if not already provided) for cables that penetrate fire rated walls and floors and ceilings. After cabling installation is complete, install fire proofing material in and around conduit sleeves and openings. Install fire proofing material thoroughly and neatly. Seal floor and ceiling penetrations.
3. Use only materials and methods that preserve integrity of fire stopping system and its rating.

J. Grounding:

1. Provide grounding system per Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.
2. Ground cable shields and equipment to eliminate shock hazard and to minimize ground loops, common mode returns, noise pickup, cross talk, and other impairments.
3. Signal Ground Terminal: Locate at main equipment cabinet. Isolate from power system and equipment grounding.
4. Install grounding electrodes as specified in Section 27 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
5. Do not use “3rd or 4th” wire internal electrical system conductors for ground.
6. Do not connect system ground to building’s external lightning protection system.
7. Do not “mix grounds” of different systems.

3.3 FIELD QUALITY CONTROL

A. Assign only technicians trained, qualified, and certified by OEM on engineering, installation, operation, and testing of system.

B. Performance Testing:

1. Intermediate Testing:
   a. After completion of 25 percent of installation of equipment, including one master station, and remote station, and prior to any further work, this portion of system must be pretested, inspected, and certified. Check each item of installed equipment to ensure appropriate NRTL labels are affixed, NFPA, Life Safety, and Joint Commission guidelines are followed, and proper

installation practices are followed. Include a full operational test.

b. Arrange for inspection and test conducted by a factory-certified representative to be witnessed by Government and SMCS 005OP2H3 at a minimum and COR. An identical inspection can be conducted between 65 and 75 percent of system construction phase, at direction of COR.

2. Pretesting:

a. Upon completing installation of system:

1) Align, balance, and completely pretest entire system under full operating conditions.

2) Verify (utilizing approved test equipment) system is operational and meets performance requirements of this standard.

3) Verify that system functions are operational, and no unwanted aural effects, (e.g. signal distortion, noise pulses, glitches, audio hum, poling noise, etc.) are present. At a minimum, pretest each of the following locations:

a) Networked locations.

b) System trouble reporting.

c) System electrical supervision.

d) UPS operation.

b. Provide recorded system pretest measurements and written certification that system is ready for formal acceptance test to COR.

3. Acceptance Test:

a. Schedule acceptance test date giving COR 30 days' written notice prior to date acceptance test is expected to begin. System must be tested in the presence of a Government representative and OEM-certified representative. System must be tested utilizing approved test equipment to certify proof of performance and emergency compliance. Test must verify that the total system meets specification requirements. Notification of acceptance test must include expected duration of time of the test.

4. Acceptance Test Procedure:

a. Physical and Mechanical Inspection:

1) Government representative may tour areas where system and sub-systems are completely and properly installed to ensure they are operationally ready for proof of performance testing. Prepare system inventory including available spare parts. Each item of installed equipment must be checked to ensure appropriate NRTL labels are affixed.
2) System diagrams, record drawings, equipment manuals, Auto CAD Disks, intermediate, and pretest results must be inventoried and reviewed.
3) Failure of system to meet installation requirements of this specification can be grounds for terminating all testing.

b. Operational Test:
1) Contractor must demonstrate full functionality of system including:
a) Station to master calls.
b) Station to station calls.
c) Broadcast calls.
d) Location identification of stations at intercom master station.

c. Test Conclusion: Government will accept results of the test or require additional testing on deficiencies and shortages. Retesting to comply with these specifications must be done at Government’s convenience and contractor's expense.

3.4 TRAINING

A. Provide training of facility-identified staff assigned to units receiving communications by an IC system. Implement training from master console operator’s perspective, and likewise, for any person whose specific responsibilities include answering IC calls and dispatching an appropriate response, provide operational training from their perspective. A separate training room may be set up that allows this type of individualized training utilizing in-service training unit, prior to cut over of new system.

B. Provide the following minimum training times and durations:
1. 24 hours prior to facility opening,
2. 24 hours during the standard work week, and
3. 24 hours for supervisors and system administrators.

3.5 MAINTENANCE

A. Provide Government personnel with ability to contact contractor and OEM for maintenance and logistic assistance, remote diagnostic testing, and assistance in resolving technical problems at any time, during warranty period.

B. Response Time during Warranty Period:

1. COR is contractor's only official reporting and contact official for IC system trouble calls, during the warranty period.
2. A standard work week is considered 8:00 A.M. to 5:00 P.M. or as designated by COR, Monday through Friday exclusive of Federal holidays.
3. Respond and correct on-site trouble calls, during the standard work week:
   a. A routine trouble call within one working day of its report. A routine trouble is considered a trouble which causes one IC station, or master IC station to be inoperable.
   b. An emergency trouble call within four hours of its report.
      1) An emergency trouble is considered a trouble which causes a IC sub system or equipment cabinet, to be inoperable at any time.
      2) Emergency trouble calls include routine trouble calls in critical emergency health care facilities (i.e., cardiac arrest, intensive care units, etc.). COR must notify contractor of this type of trouble call.
4. If an IC component failure cannot be corrected within four hours (exclusive of the standard work time limits), provide alternate IC equipment.
5. Complete installation of alternate equipment/system within sixteen hours after the four hour trouble shooting time and restore operation of effected location to system performance standards.
6. Replace any sub-system or major system that cannot be corrected within one working day, with compatible temporary equipment returning system or sub-system to full operational capability, until repairs are complete.

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04-2018

SECTION 28 05 00

COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section, Common Work Results for Electronic Safety and Security (ESS), applies to all sections of Division 28.

B. Furnish and install fully functional electronic safety and security cabling system(s), equipment and approved accessories in accordance with the specification section(s), drawing(s), and referenced publications. Capacities and ratings of cable and other items and arrangements for the specified items are shown on each system's required Bill of Materials (BOM) and verified on the approved system drawing(s). If there is a conflict between contract's specification(s) and drawings(s), the contract's specification requirements shall prevail.

C. The Contractor shall provide a fully functional and operating ESS, programmed, configured, documented, and tested as required herein and the respective Safety and Security System Specification(s). The Contractor shall provide calculations and analysis to support design and engineering decisions as specified in submittals. The Contractor shall provide and pay all labor, materials, and equipment, sales and gross receipts and other taxes. The Contractor shall secure and pay for plan check fees, permits, other fees, and licenses necessary for the execution of work as applicable for the project. Give required notices; the Contractor will comply with codes, ordinances, regulations, and other legal requirements of public authorities, which bear on the performance of work.

D. The Contractor shall provide an ESS, installed, programmed, configured, documented, and tested. The security system shall include but not limited to: physical access control, intrusion detection, duress alarms, elevator control interface, video assessment and surveillance, video recording and storage, delayed egress, personal protection system, intercommunication system, fire alarm interface, equipment cabinetry, dedicated photo badging system and associated live camera, report printer, photo badge printer, and uninterruptible power supplies

(UPS) interface. Operator training shall not be required as part of the Security Contractors scope and shall be provided by the Owner. The Security Contractor shall still be required to provide necessary maintenance and troubleshooting manuals as well as submittals as identified herein. The work shall include the procurement and installation of electrical wire and cables, the installation and testing of all system components. Inspection, testing, demonstration, and acceptance of equipment, software, materials, installation, documentation, and workmanship, shall be as specified herein. The Contractor shall provide all associated installation support, including the provision of primary electrical input power circuits.

E. Repair Service Replacement Parts On-site service during the warranty period shall be provided as specified under "Emergency Service". The Contractor shall guarantee all parts and labor for a term of one (1) year, unless dictated otherwise in this specification from the acceptance date of the system as described in Part 5 of this Specification. The Contractor shall be responsible for all equipment, software, shipping, transportation charges, and expenses associated with the service of the system for one (1) year. The Contractor shall provide 24-hour telephone support for the software program at no additional charge to the owner. Software support shall include all software updates that occur during the warranty period.

F. Section Includes:
   1. Description of Work for Electronic Security Systems,
   2. Electronic security equipment coordination with relating Divisions,
   3. Submittal Requirements for Electronic Security,
   4. Miscellaneous Supporting equipment and materials for Electronic Security,
   5. Electronic security installation requirements.

1.2 RELATED WORK

A. Section 01 00 00 - GENERAL REQUIREMENTS. For General Requirements.

B. Section 07 84 00 - FIRESTOPPING. Requirements for firestopping application and use.

C. Section 08 71 00 - DOOR HARDWARE. Requirements for door installation.

D. Section 10 14 00 - SIGNAGE. Requirements for labeling and signs.

E. Section 26 05 11 - REQUIREMENTS FOR ELECTRICAL INSTALLATIONS. Requirements for connection of high voltage.

F. Section 26 05 19 - LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW). Requirements for power cables.

G. Section 26 05 33 – RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS. Requirements for infrastructure.

H. Section 28 05 13 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for conductors and cables.

I. Section 28 05 26 - GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY. Requirements for grounding of equipment.

J. Section 28 05 28.33 - CONDUITS AND BOXES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for infrastructure.

K. Section 28 08 00 - COMMISIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS. Requirements for Commissioning.

L. Section 28 13 00 - PHYSICAL ACCESS CONTROL SYSTEMS (PACS). For physical access control integration.

M. M (IDS). Requirements for alarm systems.

N. Section 28 23 00 - VIDEO SURVEILLANCE. Requirements for security camera systems.

1.2 DEFINITIONS

A. AGC: Automatic Gain Control.

B. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.

C. BICSI: Building Industry Consulting Service International.

D. CCD: Charge-coupled device.

E. Central Station: A PC with software designated as the main controlling PC of the security access system. Where this term is presented with initial capital letters, this definition applies.

F. Channel Cable Tray: A fabricated structure consisting of a one-piece, ventilated-bottom or solid-bottom channel section.

G. Controller: An intelligent peripheral control unit that uses a computer for controlling its operation. Where this term is presented with an initial capital letter, this definition applies.

H. CPU: Central processing unit.

I. Credential: Data assigned to an entity and used to identify that entity.

J. DGP: Data Gathering Panel - component of the Physical Access Control System capable to communicate, store and process information received from readers, reader modules, input modules, output modules, and Security Management System.

K. DTS: Digital Termination Service: A microwave-based, line-of-sight communications provided directly to the end user.

L. EMI: Electromagnetic interference.

M. EMT: Electric Metallic Tubing.

N. ESS: Electronic Security System.

O. File Server: A PC in a network that stores the programs and data files shared by users.

P. GFI: Ground fault interrupter.

Q. IDC: Insulation displacement connector.

R. Identifier: A credential card, keypad personal identification number or code, biometric characteristic, or other unique identification entered as data into the entry-control database for the purpose of identifying an individual. Where this term is presented with an initial capital letter, this definition applies.

S. I/O: Input/Output.

T. Intrusion Zone: A space or area for which an intrusion must be detected and uniquely identified, the sensor or group of sensors assigned to perform the detection, and any interface equipment between sensors and communication link to central-station control unit.

U. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).

V. LAN: Local area network.

W. LCD: Liquid-crystal display.

X. LED: Light-emitting diode.

Y. Location: A Location on the network having a PC-to-Controller communications link, with additional Controllers at the Location connected to the PC-to-Controller link with RS-485 communications loop. Where this term is presented with an initial capital letter, this definition applies.

Z. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.

AA. M-JPEG: Motion – Joint Photographic Experts Group.

BB. MPEG: Moving picture experts group.

CC. NEC: National Electric Code

DD. NEMA: National Electrical Manufacturers Association

EE. NFPA: National Fire Protection Association

FF. NTSC: National Television System Committee.

GG. NRTL: Nationally Recognized Testing Laboratory.

HH. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).

II. II. PACS: Physical Access Control System; A system comprised of cards, readers, door controllers, servers and software to control the physical ingress and egress of people within a given space

JJ. PC: Personal computer. This acronym applies to the Central Station, workstations, and file servers.

KK. PCI Bus: Peripheral component interconnect; a peripheral bus providing a high-speed data path between the CPU and peripheral devices (such as monitor, disk drive, or network).

LL. PDF: (Portable Document Format.) The file format used by the Acrobat document exchange system software from Adobe.

MM. RCDD: Registered Communications Distribution Designer.

NN. RFI: Radio-frequency interference.

OO. RIGID: Rigid conduit is galvanized steel tubing, with a tubing wall that is thick enough to allow it to be threaded.

PP. RS-232: An TIA/EIA standard for asynchronous serial data communications between terminal devices. This standard defines a 25-pin connector and certain signal characteristics for interfacing computer equipment.

QQ. RS-485: An TIA/EIA standard for multipoint communications.

RR. Solid-Bottom or Non-ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal side rails, and a bottom without ventilation openings.

SS. SMS: Security Management System – A SMS is software that incorporates multiple security subsystems (e.g., physical access control, intrusion

detection, closed circuit television, intercom) into a single platform and graphical user interface.

TT. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.

UU. Trough or Ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal rails and a bottom having openings sufficient for the passage of air and using 75 percent or less of the plan area of the surface to support cables.

VV. UPS: Uninterruptible Power Supply

WW. UTP: Unshielded Twisted Pair

XX. Workstation: A PC with software that is configured for specific limited security system functions.

1.4 QUALITY ASSURANCE

A. Manufacturers Qualifications: The manufacturer shall regularly and presently produce, as one of the manufacturer's principal products, the equipment and material specified for this project, and shall have manufactured the item for at least three years.

B. Product Qualification:

1. Manufacturer's product shall have been in satisfactory operation, on three installations of similar size and type as this project, for approximately three years.
2. The Government reserves the right to require the Contractor to submit a list of installations where the products have been in operation before approval.

C. Contractor Qualification:

1. The Contractor or security sub-contractor shall be a licensed security Contractor with a minimum of five (5) years experience installing and servicing systems of similar scope and complexity. The Contractor shall be an authorized regional representative of the Security Management System’s (PACS) manufacturer. The Contractor shall provide four (4) current references from clients with systems of similar scope and complexity which became operational in the past three (3) years. At least three (3) of the references shall be utilizing the same system components, in a similar configuration as the proposed system. The references must include a current point of contact, company or agency name, address, telephone number, complete

system description, date of completion, and approximate cost of the project. The owner reserves the option to visit the reference sites, with the site owner's permission and representative, to verify the quality of installation and the references' level of satisfaction with the system. The Contractor shall provide copies of system manufacturer certification for all technicians. The Contractor shall only utilize factory-trained technicians to install, program, and service the PACS. The Contractor shall only utilize factory-trained technicians to install, terminate and service controller/field panels and reader modules. The technicians shall have a minimum of five (5) continuous years of technical experience in electronic security systems. The Contractor shall have a local service facility. The facility shall be located within 60 miles of the project site. The local facility shall include sufficient spare parts inventory to support the service requirements associated with this contract. The facility shall also include appropriate diagnostic equipment to perform diagnostic procedures. The CORs Representative (COR) reserves the option of surveying the company's facility to verify the service inventory and presence of a local service organization.

2. The Contractor shall provide proof project superintendent with BICSI Certified Commercial Installer Level 1, Level 2, or Technician to provide oversight of the project.
3. Cable installer must have on staff a Registered Communication Distribution Designer (RCDD) certified by Building Industry Consulting Service International. The staff member shall provide consistent oversight of the project cabling throughout design, layout, installation, termination and testing.

D. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within four eight hours of receipt of notification that service is needed. Submit name and address of service organizations.

1.5 GENERAL ARANGEMENT OF CONTRACT DOCUMENTS

A. The Contract Documents supplement to this specification indicates approximate locations of equipment. The installation and/or locations

of the equipment and devices shall be governed by the intent of the design; specification and Contract Documents, with due regard to actual site conditions, recommendations, ambient factors affecting the equipment and operations in the vicinity. The Contract Documents are diagrammatic and do not reveal all offsets, bends, elbows, components, materials, and other specific elements that may be required for proper installation. If any departure from the contract documents is deemed necessary, or in the event of conflicts, the Contractor shall submit details of such departures or conflicts in writing to the owner or owner’s representative for his or her comment and/or approval before initiating work.

B. Anything called for by one of the Contract Documents and not called for by the others shall be of like effect as if required or called by all, except if a provision clearly designed to negate or alter a provision contained in one or more of the other Contract Documents shall have the intended effect. In the event of conflicts among the Contract Documents, the Contract Documents shall take precedence in the following order: the Form of Agreement; the Supplemental General Conditions; the Special Conditions; the Specifications with attachments; and the drawings.

1.6 SUBMITTALS

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

B. The Government's approval shall be obtained for all equipment and material before delivery to the job site. Delivery, storage or installation of equipment or material which has not had prior approval will not be permitted at the job site.

C. 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.

D. The submittals shall include the following:
   1. Information that confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, pictures, nameplate data and test reports as required.
   2. Submittals are required for all equipment anchors and supports. Submittals shall include weights, dimensions, center of gravity, standard connections, manufacturer's recommendations and behavior problems (e.g., vibration, thermal expansion,) associated with equipment or piping so that the proposed installation can be properly reviewed.
   3. Parts list which shall include those replacement parts recommended by the equipment manufacturer, quantity of parts, current price and availability of each part.

E. Submittals shall be in full compliance of the Contract Documents. All submittals shall be provided in accordance with this section. Submittals lacking the breath or depth these requirements will be considered incomplete and rejected. Submissions are considered multidisciplinary and shall require coordination with applicable divisions to provide a complete and comprehensive submission package. All submittals shall include adequate descriptive literature, catalog cuts, shop drawings and other data necessary for the Government to ascertain that the proposed equipment and materials comply with specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify equipment being submitted. Additional general provisions are as follows:
   1. The Contractor shall schedule submittals in order to maintain the project schedule. For coordination drawings refer to Specification Section 01 33 10 - Design Submittal Procedures, which outline basic submittal requirements and coordination. Section 01 33 10 shall be used in conjunction with this section.
   2. The Contractor shall identify variations from requirements of Contract Documents and state product and system limitations, which may be detrimental to successful performance of the completed work or system.

3. Each package shall be submitted at one (1) time for each review and include components from applicable disciplines (e.g., electrical work, architectural finishes, door hardware, etc.) which are required to produce an accurate and detailed depiction of the project.
4. Manufacturer's information used for submittal shall have pages with items for approval tagged, items on pages shall be identified, and capacities and performance parameters for review shall be clearly marked through use of an arrow or highlighting. Provide space for COR and Contractor review stamps.
5. Technical Data Drawings shall be in the latest version of AutoCAD®, drawn accurately, and in accordance with VA CAD Standards CAD Standard Application Guide, and VA BIM Guide. FREEHAND SKETCHES OR COPIED VERSIONS OF THE CONSTRUCTION DOCUMENTS WILL NOT BE ACCEPTED. The Contractor shall not reproduce Contract Documents or copy standard information as the basis of the Technical Data Drawings. If departures from the technical data drawings are subsequently deemed necessary by the Contractor, details of such departures and the reasons thereof shall be submitted in writing to the COR for approval before the initiation of work.
6. Packaging: The Contractor shall organize the submissions according to the following packaging requirements.
   a. Binders: For each manual, provide heavy duty, commercial quality, durable three (3) ring vinyl covered loose leaf binders, sized to receive 8.5 x 11 in paper, and appropriate capacity to accommodate the contents. Provide a clear plastic sleeve on the spine to hold labels describing the contents. Provide pockets in the covers to receive folded sheets.
      1) Where two (2) or more binders are necessary to accommodate data; correlate data in each binder into related groupings according to the Project Manual table of contents. Cross-referencing other binders where necessary to provide essential information for communication of proper operation and/or maintenance of the component or system.

2) Identify each binder on the front and spine with printed binder title, Project title or name, and subject matter covered. Indicate the volume number if applicable.

b. Dividers: Provide heavy paper dividers with celluloid tabs for each Section. Mark each tab to indicate contents.

c. Protective Plastic Jackets: Provide protective transparent plastic jackets designed to enclose diagnostic software for computerized electronic equipment.

d. Text Material: Where written material is required as part of the manual use the manufacturer's standard printed material, or if not available, specially prepared data, neatly typewritten on 8.5 inches by 11 inches 20 pound white bond paper.

e. Drawings: Where drawings and/or diagrams are required as part of the manual, provide reinforced punched binder tabs on the drawings and bind them with the text.

1) Where oversized drawings are necessary, fold the drawings to the same size as the text pages and use as a foldout.

2) If drawings are too large to be used practically as a foldout, place the drawing, neatly folded, in the front or rear pocket of the binder. Insert a type written page indicating the drawing title, description of contents and drawing location at the appropriate location of the manual.

3) Drawings shall be sized to ensure details and text is of legible size. Text shall be no less than 1/16” tall.

f. Manual Content: Submit in accordance with Section 01 00 00, GENERAL REQUIREMENTS.

1) Maintenance and Operation Manuals: Submit as required for systems and equipment specified in the technical sections. Furnish four copies, bound in hardback binders, (manufacturer's standard binders) or an approved equivalent. Furnish one complete manual as specified in the technical section but in no case later than prior to performance of systems or equipment test, and furnish the remaining manuals prior to contract completion.

2) Inscribe the following identification on the cover: the words "MAINTENANCE AND OPERATION MANUAL," the name and location of

the system, equipment, building, name of Contractor, and contract number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the system or equipment.

3) The manuals shall include:
   a) Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.
   b) A control sequence describing start-up, operation, and shutdown.
   c) Description of the function of each principal item of equipment.
   d) Installation and maintenance instructions.
   e) Safety precautions.
   f) Diagrams and illustrations.
   g) Testing methods.
   h) Performance data.
   i) Pictorial "exploded" parts list with part numbers. Emphasis shall be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare parts, and name of servicing organization.
   j) Appendix; list qualified permanent servicing organizations for support of the equipment, including addresses and certified qualifications.

g. Binder Organization: Organize each manual into separate sections for each piece of related equipment. At a minimum, each manual shall contain a title page, table of contents, copies of Product Data supplemented by drawings and written text, and copies of each warranty, bond, certifications, and service Contract issued. Refer to Group I through V Technical Data Package Submittal requirements for required section content.

h. Title Page: Provide a title page as the first sheet of each manual to include the following information; project name and address, subject matter covered by the manual, name and address

of the Project, date of the submittal, name, address, and telephone number of the Contractor, and cross references to related systems in other operating and/or maintenance manuals.

i. Table of Contents: After the title page, include a type written table of contents for each volume, arranged systematically according to the Project Manual format. Provide a list of each product included, identified by product name or other appropriate identifying symbols and indexed to the content of the volume. Where more than one (1) volume is required to hold data for a particular system, provide a comprehensive table of contents for all volumes in each volume of the set.

j. General Information Section: Provide a general information section immediately following the table of contents, listing each product included in the manual, identified by product name. Under each product, list the name, address, and telephone number of the installer and maintenance Contractor. In addition, list a local source for replacement parts and equipment.

k. Drawings: Provide specially prepared drawings where necessary to supplement the manufacturers printed data to illustrate the relationship between components of equipment or systems, or provide control or flow diagrams. Coordinate these drawings with information contained in Project Record Drawings to assure correct illustration of the completed installation.

l. Manufacturer’s Data: Where manufacturer's standard printed data is included in the manuals, include only those sheets that are pertinent to the part or product installed. Mark each sheet to identify each part or product included in the installation. Where more than one (1) item in tabular format is included, identify each item, using appropriate references from the Contract Documents. Identify data that is applicable to the installation and delete references to information which is not applicable.

m. Where manufacturer's standard printed data is not available and the information is necessary for proper operation and maintenance of equipment or systems, or it is necessary to provide additional information to supplement the data included in the manual,

prepare written text to provide the necessary information. Organize the text in a consistent format under a separate heading for different procedures. Where necessary, provide a logical sequence of instruction for each operating or maintenance procedure. Where similar or more than one product is listed on the submittal the Contractor shall differentiate by highlighting the specific product to be utilized.

n. Calculations: Provide a section for circuit and panel calculations.

o. Loading Sheets: Provide a section for DGP Loading Sheets.

p. Certifications: Provide section for Contractor's manufacturer certifications.

7. Contractor Review: Review submittals prior to transmittal. Determine and verify field measurements and field construction criteria. Verify manufacturer's catalog numbers and conformance of submittal with requirements of contract documents. Return non-conforming or incomplete submittals with requirements of the work and contract documents. Apply Contractor's stamp with signature certifying the review and verification of products occurred, and the field dimensions, adjacent construction, and coordination of information is in accordance with the requirements of the contract documents.

8. Resubmission: Revise and resubmit submittals as required within 15 calendar days of return of submittal. Make resubmissions under procedures specified for initial submittals. Identify all changes made since previous submittal.

9. Product Data: Within 15 calendar days after execution of the contract, the Contractor shall submit for approval a complete list of all of major products proposed for use. The data shall include name of manufacturer, trade name, model number, the associated contract document section number, paragraph number, and the referenced standards for each listed product.

F. Group 1 Technical Data Package: Group I Technical Data Package shall be one submittal consisting of the following content and organization. Refer to VA Special Conditions Document for drawing format and content requirements. The data package shall include the following:

1. Section I - Drawings:
   a. General – Drawings shall conform to VA CAD Standards Guide. All text associated with security details shall be 1/8” tall and meet VA text standard for AutoCAD™ drawings.
   b. Cover Sheet – Cover sheet shall consist of Project Title and Address, Project Number, Area and Vicinity Maps.
   c. General Information Sheets – General Information Sheets shall consist of General Notes, Abbreviations, Symbols, Wire and Cable Schedule, Project Phasing, and Sheet Index.
   d. Floor Plans – Floor plans shall be produced from the Architectural backgrounds issued in the Construction Documents. The contractor shall receive floor plans from the prime A/E to develop these drawing sets. Security devices shall be placed on drawings in scale. All text associated with security details shall be 1/8” tall and meet VA text standard for AutoCAD™ drawings. Floor plans shall identify the following:
      1) Security devices by symbol,
      2) The associated device point number (derived from the loading sheets),
      3) Wire & cable types and counts
      4) Conduit sizing and routing
      5) Conduit riser systems
      6) Device and area detail call outs
   e. Architectural details – Architectural details shall be produced for each device mounting type (door details for EECS and IDS, Intrusion Detection system (motion sensor, vibration, microwave Motion Sensor and Camera mounting,
   f. Riser Diagrams – Contractor shall provide a riser diagram indicating riser architecture and distribution of the SMS throughout the facility (or area in scope).
   g. Block Diagrams – Contractor shall provide a block diagram for the entire system architecture and interconnections with SMS subsystems. Block diagram shall identify SMS subsystem (e.g., electronic entry control, intrusion detection, closed circuit television, intercom, and other associated subsystems)

integration; and data transmission and media conversion methodologies.

h. Interconnection Diagrams – Contractor shall provide interconnection diagram for each sensor, and device component. Interconnection diagram shall identify termination locations, standard wire detail to include termination schedule. Diagram shall also identify interfaces to other systems such as elevator control, fire alarm systems, and security management systems.

i. Security Details:

1) Panel Assembly Detail – For each panel assembly, a panel assembly details shall be provided identifying individual panel component size and content.

2) Panel Details – Provide security panel details identify general arrangement of the security system components, backboard size, wire through size and location, and power circuit requirements.

3) Device Mounting Details – Provide mounting detailed drawing for each security device (physical access control system, intrusion detection, video surveillance and assessment, and intercom systems) for each type of wall and ceiling configuration in project. Device details shall include device, mounting detail, wiring and conduit routing.

4) Details of connections to power supplies and grounding

5) Details of surge protection device installation

6) Sensor detection patterns – Each system sensor shall have associated detection patterns.

7) Equipment Rack Detail – For each equipment rack, provide a scaled detail of the equipment rack location and rack space utilization. Use of BISCI wire management standards shall be employed to identify wire management methodology. Transitions between equipment racks shall be shown to include use vertical and horizontal latter rack system.

8) Security Control Room – The contractor shall provide a layout plan for the Security Control Room. The layout plan

shall identify all equipment and details associated with the installation.

9) Operator Console – The contractor shall provide a layout plan for the Operator Console. The layout plan shall identify all equipment and details associated with the installation. Equipment room - the contractor shall provide a layout plan for the equipment room. The layout plan shall identify all equipment and details associated with the installation.

10) Equipment Room – Equipment room details shall provide architectural, electrical, mechanical, plumbing, IT/Data and associated equipment and device placements both vertical and horizontally.

j. Electrical Panel Schedule – Electrical Panel Details shall be provided for all SMS systems electrical power circuits. Panel details shall be provided identifying panel type (Standard, Emergency Power, Emergency/Uninterrupted Power Source, and Uninterrupted Power Source Only), panel location, circuit number, and circuit amperage rating.

k. Door Schedule – A door schedule shall be developed for each door equipped with electronic security components. At a minimum, the door schedule shall be coordinated with Division 08 work and include the following information:

1) Item Number
2) Door Number (Derived from A/E Drawings)
3) Floor Plan Sheet Number
4) Standard Detail Number
5) Door Description (Derived from Loading Sheets)
6) Data Gathering Panel Input Number
7) Door Position or Monitoring Device Type & Model Number
8) Lock Type, Model Number & Power Input/Draw (standby/active)
9) Card Reader Type & Model Number
10) Shunting Device Type & Model Number
11) Sounder Type & Model Number
12) Manufacturer
13) Misc. devices as required

a) Delayed Egress Type & Model Number
b) Intercom
c) Camera
d) Electric Transfer Hinge
e) Electric Pass-through device

14) Remarks column indicating special notes or door configurations

2. Camera Schedule - A camera schedule shall be developed for each camera. Contractors shall coordinate with the COR to determine camera starting numbers and naming conventions. All drawings shall identify wire and cable standardization methodology. Color coding of all wiring conductors and jackets is required and shall be communicated consistently throughout the drawings package submittal. At a minimum, the camera schedule shall include the following information:
   a. Item Number
   b. Camera Number
   c. Naming Conventions
   d. Description of Camera Coverage
   e. Camera Location
   f. Floor Plan Sheet Number
   g. Camera Type
   h. Mounting Type
   i. Standard Detail Reference
   j. Power Input & Draw
   k. Power Panel Location
   l. Remarks Column for Camera
3. Section II – Data Gathering Panel Documentation Package
   a. Contractor shall provide Data Gathering Panel (DGP) input and output documentation packages for review at the Shop Drawing submittal stage and also with the as-built documentation package. The documentation packages shall be provided in both printed and magnetic form at both review stages.
   b. The Contractor shall provide loading sheet documentation package for the associated DGP, including input and output boards for all field panels associated with the project. Documentation shall be

provided in current version Microsoft Excel spreadsheets following the format currently utilized by VA. A separate spreadsheet file shall be generated for each DGP and associated field panels.

c. The spreadsheet names shall follow a sequence that shall display the spreadsheets in numerical order according to the DGP system number. The spreadsheet shall include the prefix in the file name that uniquely identifies the project site. The spreadsheet shall detail all connected items such as card readers, alarm inputs, and relay output connections. The spreadsheet shall include an individual section (row) for each panel input, output and card reader. The spreadsheet shall automatically calculate the system numbers for card readers, inputs, and outputs based upon data entered in initialization fields.

d. All entries must be verified against the field devices. Copies of the floor plans shall be forwarded under separate cover.

e. The DGP spreadsheet shall include an entry section for the following information:

1) DGP number
2) First Reader Number
3) First Monitor Point Number
4) First Relay Number
5) DGP, input or output Location
6) DGP Chain Number
7) DGP Cabinet Tamper Input Number
8) DGP Power Fail Input Number
9) Number of Monitor Points Reserved For Expansion Boards
10) Number of Control Points (Relays) Reserved For Expansion Boards

f. The DGP, input module and output module spreadsheets shall automatically calculate the following information based upon the associated entries in the above fields:

1) System Numbers for Card Readers
2) System Numbers for Monitor Point Inputs
3) System Numbers for Control Points (Relays)
4) Next DGP or input module First Monitor Point Number

5) Next DGP or output module First Control Point Number

g. The DGP spreadsheet shall provide the following information for each card reader:
   1) DGP Reader Number
   2) System Reader Number
   3) Cable ID Number
   4) Description Field (Room Number)
   5) Description Field (Device Type i.e.: In Reader, Out Reader, etc.)
   6) Description Field
   7) DGP Input Location
   8) Date Test
   9) Date Passed
   10) Cable Type
   11) Camera Numbers (of cameras viewing the reader location)

h. The DGP and input module spreadsheet shall provide the following information for each monitor point (alarm input).
   1) DGP Monitor Point Input Number
   2) System Monitor Point Number
   3) Cable ID Number
   4) Description Field (Room Number)
   5) Description Field (Device Type i.e.: Door Contact, Motion Detector, etc.)
   6) DGP or input module Input Location
   7) Date Test
   8) Date Passed
   9) Cable Type
   10) Camera Numbers (of associated alarm event preset call-ups)

i. The DGP and output module spreadsheet shall provide the following information for each control point (output relay).
   1) DGP Control Point (Relay) Number
   2) System (Control Point) Number
   3) Cable ID Number
   4) Description Field (Room Number)
   5) Description Field (Device: Lock Control, Local Sounder, etc.)
   6) Description Field

7) DGP or OUTPUT MODULE Output Location
8) Date Test
9) Date Passed Cable Type
10) Camera Number (of associated alarm event preset call-ups)

j. The DGP, input module and output module spreadsheet shall include the following information or directions in the header and footer:
1) Header
a) DGP Input and Output Worksheet
b) Enter Beginning Reader, Input, and Output Starting Numbers and Sheet Will Automatically Calculate the Remaining System Numbers.
2) Footer
a) File Name
b) Date Printed
c) Page Number

4. Section III - Construction Mock-up: In areas with exposed EMT/Conduit Raceways, contractor shall conceal raceway as much as practical and unobtrusively. In addition, historic significance must be considered to determine installation means and methods for approval by the owner.
5. Section IV - Manufacturers' Data: The data package shall include manufacturers' data for all materials and equipment, including sensors, local processors and console equipment provided under this specification.
6. Section V - System Description and Analysis: The data package shall include system descriptions, analysis, and calculations used in sizing equipment required by these specifications. Descriptions and calculations shall show how the equipment will operate as a system to meet the performance requirements of this specification. The data package shall include the following:
a. Central processor memory size; communication speed and protocol description; rigid disk system size and configuration; flexible disk system size and configuration; back-up media size and configuration; alarm response time calculations; command response time calculations; start-up operations; expansion capability and

method of implementation; sample copy of each report specified; and color photographs representative of typical graphics.

b. Software Data: The data package shall consist of descriptions of the operation and capability of the system, and application software as specified.

c. Overall System Reliability Calculations: The data package shall include all manufacturers' reliability data and calculations required to show compliance with the specified reliability.

7. Section VI – Certifications & References: All specified manufacturer's certifications shall be included with the data package. Contractor shall provide Project references as outlined in Paragraph 1.4 "Quality Assurance".

G. Group II Technical Data Package

1. The Contractor shall prepare a report of "Current Site Conditions" and submit a report to the COR documenting changes to the site, particularly those conditions that affect performance of the system to be installed. The Contractor shall provide specification sheets, or written functional requirements to support the findings, and a cost estimate to correct those site changes or conditions which affect the installation of the system or its performance. The Contractor shall not correct any deficiency without written permission from the COR.

2. System Configuration and Functionality: The contractor shall provide the results of the meeting with VA to develop system requirements and functionality including but not limited to:

a. Baseline configuration

b. Access levels

c. Schedules (intrusion detection, physical access control, holidays, etc.)

d. Badge database

e. System monitoring and reporting (unit level and central control)

f. Naming conventions and descriptors

H. Group III Technical Data Package

1. Development of Test Procedures: The Contractor will prepare performance test procedures for the system testing. The test procedures shall follow the format of the VA Testing procedures and

be customized to the contract requirements. The Contractor will deliver the test procedures to the COR for approval at least 60 calendar days prior to the requested test date.

I. Group IV Technical Data Package

1. Performance Verification Test

a. Based on the successful completion of the pre-delivery test, the Contractor shall finalize the test procedures and report forms for the performance verification test (PVT) and the endurance test. The PVT shall follow the format, layout and content of the pre-delivery test. The Contractor shall deliver the PVT and endurance test procedures to the COR for approval. The Contractor may schedule the PVT after receiving written approval of the test procedures. The Contractor shall deliver the final PVT and endurance test reports within 14 calendar days from completion of the tests. Refer to Part 3 of this section for System Testing and Acceptance requirements.

2. Training Documentation

a. New Facilities and Major Renovations: Familiarization training shall be provided for new equipment or systems. Training can include site familiarization training for VA technicians and administrative personnel. Training shall include general information on new system layout including closet locations, turnover of the completed system including all documentation, including manuals, software, key systems, and full system administration rights. Lesson plans and training manuals training shall be oriented to type of training to be provided.

b. New Unit Control Room:

1) Provide the security personnel with training in the use, operation, and maintenance of the entire control room system (Unit Control and Equipment Rooms). The training documentation must include the operation and maintenance. The first of the training sessions shall take place prior to system turnover and the second immediately after turnover. Coordinate the training sessions with the Owner. Completed classroom sessions will be witnessed and documented by the

Architect/Engineer, and approved by the COR. Instruction is not to begin until the system is operational as designed.

2) The training documents will cover the operation and the maintenance manuals and the control console operators' manuals and service manuals in detail, stressing all important operational and service diagnostic information necessary for the maintenance and operations personnel to efficiently use and maintain all systems.

3) Provide an illustrated control console operator's manual and service manual. The operator's manual shall be written in laymen's language and printed so as to become a permanent reference document for the operators, describing all control panel switch operations, graphic symbol definitions and all indicating functions and a complete explanation of all software.

4) The service manual shall be written in laymen's language and printed so as to become a permanent reference document for maintenance personnel, describing how to run internal self diagnostic software programs, troubleshoot head end hardware and field devices with a complete scenario simulation of all possible system malfunctions and the appropriate corrective measures.

5) Provide a professional color DVD instructional recording of all the operational procedures described in the operator's manual. All charts used in the training session shall be clearly presented on the video. Any DVD found to be inferior in recording or material content shall be reproduced at no cost until an acceptable DVD is submitted. Provide four copies of the training DVD, one to the architect/engineer and three to the owner.

3. System Configuration and Data Entry:

a. The contractor is responsible for providing all system configuration and data entry for the SMS and subsystems (e.g., video matrix switch, intercom, digital video recorders, network video recorders). All data entry shall be performed per VA standards & guidelines. The Contractor is responsible for

participating in all meetings with the client to compile the information needed for data entry. These meetings shall be established at the beginning of the project and incorporated in to the project schedule as a milestone task. The contractor shall be responsible for all data collection, data entry, and system configuration. The contractor shall collect, enter, & program and/or configure the following components:

1) Physical Access control system components,
2) All intrusion detection system components,
3) Video surveillance, control and recording systems,
4) Intercom systems components,
5) All other security subsystems shown in the contract documents.

b. The Contractor is responsible for compiling the card access database for the VA employees, including programming reader configurations, access shifts, schedules, exceptions, card classes and card enrollment databases.

c. Refer to Part 3 for system programming requirements and planning guidelines.

4. Graphics: Based on CAD as-built drawings developed for the construction project, create all map sets showing locations of all alarms and field devices. Graphical maps of all alarm points installed under this contract including perimeter and exterior alarm points shall be delivered with the system. The Contractor shall create and install all graphics needed to make the system operational. The Contractor shall utilize data from the contract documents, Contractor’s field surveys, and all other pertinent information in the Contractor’s possession to complete the graphics. The Contractor shall identify and request from the COR, any additional data needed to provide a complete graphics package. Graphics shall have sufficient level of detail for the system operator to assess the alarm. The Contractor shall supply hard copy, color examples at least 203.2 x 254 mm (8 x 10 in) of each type of graphic to be used for the completed Security system. The graphics examples shall be delivered to the COR for review and approval at least 90 calendar days prior to the scheduled date the Contractor requires them.

J. Group V Technical Data Package: Final copies of the manuals shall be delivered to the COR as part of the acceptance test. The draft copy used during site testing shall be updated with any changes required prior to final delivery of the manuals. Each manual's contents shall be identified on the cover. The manual shall include names, addresses, and telephone numbers of each sub-contractor installing equipment or systems, as well as the nearest service representatives for each item of equipment for each system. The manuals shall include a table of contents and tab sheets. Tab sheets shall be placed at the beginning of each chapter or section and at the beginning of each appendix. The final copies delivered after completion of the endurance test shall include all modifications made during installation, checkout, and acceptance. Six (6) hard-copies and one (1) soft copy on CD of each item listed below shall be delivered as a part of final systems acceptance.

1. Functional Design Manual: The functional design manual shall identify the operational requirements for the entire system and explain the theory of operation, design philosophy, and specific functions. A description of hardware and software functions, interfaces, and requirements shall be included for all system operating modes. Manufacturer developed literature may be used; however, shall be produced to match the project requirements.
2. Equipment Manual: A manual describing all equipment furnished including:
   a. General description and specifications; installation and checkout procedures; equipment electrical schematics and layout drawings; system schematics and layout drawings; alignment and calibration procedures; manufacturer's repair list indicating sources of supply; and interface definition.
3. Software Manual: The software manual shall describe the functions of all software and include all other information necessary to enable proper loading, testing, and operation. The manual shall include:
   a. Definition of terms and functions; use of system and applications software; procedures for system initialization, start-up, and shutdown; alarm reports; reports generation, database format and

data entry requirements; directory of all disk files; and description of all communications protocols including data formats, command characters, and a sample of each type of data transfer.

4. Operator's Manual: The operator's manual shall fully explain all procedures and instructions for the operation of the system, including:
   a. Computers and peripherals; system start-up and shutdown procedures; use of system, command, and applications software; recovery and restart procedures; graphic alarm presentation; use of report generator and generation of reports; data entry; operator commands' alarm messages, and printing formats; and system access requirements.
5. Maintenance Manual: The maintenance manual shall include descriptions of maintenance for all equipment including inspection, recommend schedules, periodic preventive maintenance, fault diagnosis, and repair or replacement of defective components.
6. Spare Parts & Components Data: At the conclusion of the Contractor's work, the Contractor shall submit to the COR a complete list of the manufacturer's recommended spare parts and components required to satisfactorily maintain and service the systems, as well as unit pricing for those parts and components.
7. Operation, Maintenance & Service Manuals: The Contractor shall provide two (2) complete sets of operating and maintenance manuals in the form of an instructional manual for use by the VA Security Guard Force personnel. The manuals shall be organized into suitable sets of manageable size. Where possible, assemble instructions for similar equipment into a single binder. If multiple volumes are required, each volume shall be fully indexed and coordinated.
8. Equipment and Systems Maintenance Manual: The Contractor shall provide the following descriptive information for each piece of equipment, operating system, and electronic system:
   a. Equipment and/or system function.
   b. Operating characteristics.
   c. Limiting conditions.
   d. Performance curves.

e. Engineering data and test.

f. Complete nomenclature and number of replacement parts.

g. Provide operating and maintenance instructions including assembly drawings and diagrams required for maintenance and a list of items recommended to stock as spare parts.

h. Provide information detailing essential maintenance procedures including the following: routine operations, trouble shooting guide, disassembly, repair and re-assembly, alignment, adjusting, and checking.

i. Provide information on equipment and system operating procedures, including the following; start-up procedures, routine and normal operating instructions, regulation and control procedures, instructions on stopping, shut-down and emergency instructions, required sequences for electric and electronic systems, and special operating instructions.

j. Manufacturer equipment and systems maintenance manuals are permissible.

9. Project Redlines: During construction, the Contractor shall maintain an up-to-date set of construction redlines detailing current location and configuration of the project components. The redline documents shall be marked with the words 'Master Redlines' on the cover sheet and be maintained by the Contractor in the project office. The Contractor will provide access to redline documents anytime during the project for review and inspection by the COR or authorized Office of Protection Services representative. Master redlines shall be neatly maintained throughout the project and secured under lock and key in the contractor's onsite project office. Any project component or assembly that is not installed in strict accordance with the drawings shall be so noted on the drawings. Prior to producing Record Construction Documents, the contractor will submit the Master Redline document to the COR for review and approval of all changes or modifications to the documents. Each sheet shall have COR initials indicating authorization to produce "As Built" documents. Field drawings shall be used for data gathering & field changes. These changes shall be

made to the master redline documents daily. Field drawings shall not be considered "master redlines".

10. Record Specifications: The Contractor shall maintain one (1) copy of the Project Specifications, including addenda and modifications issued, for Project Record Documents. The Contractor shall mark the Specifications to indicate the actual installation where the installation varies substantially from that indicated in the Contract Specifications and modifications issued. (Note related Project Record Drawing information where applicable). The Contractor shall pay particular attention to substitutions, selection of product options, and information on concealed installations that would be difficult to identify or measure and record later. Upon completion of the mark ups, the Contractor shall submit record Specifications to the COR. As with master relines, Contractor shall maintain record specifications for COR review and inspection at anytime.
11. Record Product Data: The Contractor shall maintain one (1) copy of each Product Data submittal for Project Record Document purposes. The Data shall be marked to indicate the actual product installed where the installation varies substantially from that indicated in the Product Data submitted. Significant changes in the product delivered to the site and changes in manufacturer's instructions and recommendations for installation shall be included. Particular attention will be given to information on concealed products and installations that cannot be readily identified or recorded later. Note related Change Orders and mark up of Record Construction Documents, where applicable. Upon completion of mark up, submit a complete set of Record Product Data to the COR.
12. Miscellaneous Records: The Contractor shall maintain one (1) copy of miscellaneous records for Project Record Document purposes. Refer to other Specifications for miscellaneous record-keeping requirements and submittals concerning various construction activities. Before substantial completion, complete miscellaneous records and place in good order, properly identified and bound or filed, ready for use and reference. Categories of requirements

resulting in miscellaneous records include a minimum of the following:

a. Certificates received instead of labels on bulk products.
b. Testing and qualification of tradesmen. ("Contractor's Qualifications")
c. Documented qualification of installation firms.
d. Load and performance testing.
e. Inspections and certifications.
f. Final inspection and correction procedures.
g. Project schedule

13. Record Construction Documents (Record As-Built)
    a. Upon project completion, the contractor shall submit the project master redlines to the COR prior to development of Record construction documents. The COR shall be given a minimum of a thirty (30) day review period to determine the adequacy of the master redlines. If the master redlines are found suitable by the COR, the COR will initial and date each sheet and turn redlines over to the contractor for as built development.
    b. The Contractor shall provide the COR a complete set of "as-built" drawings and original master redlined marked "as-built" blue-line in the latest version of AutoCAD drawings unlocked on CD or DVD. The as-built drawing shall include security device number, security closet connection location, data gathering panel number, and input or output number as applicable. All corrective notations made by the Contractor shall be legible when submitted to the COR. If, in the opinion of the COR, any redlined notation is not legible, it shall be returned to the Contractor for re-submission at no extra cost to the Owner. The Contractor shall organize the Record Drawing sheets into manageable sets bound with durable paper cover sheets with suitable titles, dates, and other identifications printed on the cover. The submitted as built shall be in editable formats and the ownership of the drawings shall be fully relinquished to the owner.
    c. Where feasible, the individual or entity that obtained record data, whether the individual or entity is the installer, sub-contractor, or similar entity, is required to prepare the mark up

on Record Drawings. Accurately record the information in a comprehensive drawing technique. Record the data when possible after it has been obtained. For concealed installations, record and check the mark up before concealment. At the time of substantial completion, submit the Record Construction Documents to the COR. The Contractor shall organize into bound and labeled sets for the COR's continued usage. Provide device, conduit, and cable lengths on the conduit drawings. Exact in-field conduit placement/routings shall be shown. All conduits shall be illustrated in their entire length from termination in security closets; no arrowed conduit runs shall be shown. Pull box and junction box sizes are to be shown if larger than 100mm (4 inch).

K. FIPS 201 Compliance Certificates

1. Provide Certificates for all software components and device types utilizing credential verification. Provide certificates for:
   a. Fingerprint Capture Station
   b. Card Readers
   c. Facial Image Capturing Camera
   d. PIV Middelware
   e. Template Matcher
   f. Electromagnetically Opaque Sleeve
   g. Certificate Management
      1) CAK Authentication System
      2) PIV Authentication System
      3) Certificate Validator
      4) Cryptographic Module

K. Approvals will be based on complete submission of manuals together with shop drawings.

L. After approval and prior to installation, furnish the COR with one sample of each of the following:

1. A 300 mm (12 inch) length of each type and size of wire and cable along with the tag from the coils of reels from which the samples were taken.
2. Each type of conduit and pathway coupling, bushing and termination fitting.
3. Conduit hangers, clamps and supports.

4. Duct sealing compound.

M. Completed System Readiness Checklists provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 28 08 00 COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS.

N. In addition to the requirement of SUBMITTALS, the VA reserves the right to request the manufacturer to arrange for a VA representative to see typical active systems in operation, when there has been no prior experience with the manufacturer or the type of equipment being submitted.

1.7 APPLICABLE PUBLICATIONS

A. The publications listed below (including amendments, addenda, revisions, supplement, and errata) form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American National Standards Institute (ANSI)/ International Code Council (ICC):

A117.1.....Standard on Accessible and Usable Buildings and Facilities

C. American National Standards Institute (ANSI)/ Security Industry Association (SIA):

AC-03.....Access Control: Access Control Guideline Dye Sublimation Printing Practices for PVC Access Control Cards

CP-01-00.....Control Panel Standard-Features for False Alarm Reduction

PIR-01-00.....Passive Infrared Motion Detector Standard - Features for Enhancing False Alarm Immunity

TVAC-01.....CCTV to Access Control Standard - Message Set for System Integration

D. American National Standards Institute (ANSI)/Electronic Industries Alliance (EIA):

330-09.....Electrical Performance Standards for CCTV Cameras

375A-76.....Electrical Performance Standards for CCTV Monitors

E. American National Standards Institute (ANSI):

ANSI S3.2-99.....Method for measuring the Intelligibility of Speech over Communications Systems

F. American Society for Testing and Materials (ASTM)

B1-13.....Standard Specification for Hard-Drawn Copper Wire

B3-13.....Standard Specification for Soft or Annealed Copper Wire

B8-11 (2017).....Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

C1238-97 (2012).....Standard Guide for Installation of Walk-Through Metal Detectors

D2301-10 (2017).....Standard Specification for Vinyl Chloride Plastic Pressure Sensitive Electrical Insulating Tape

G. Architectural Barriers Act (ABA), 1968

H. Department of Justice: American Disability Act (ADA)

28 CFR Part 36-2010 ADA Standards for Accessible Design

I. Department of Veterans Affairs:

VHA National CAD Standard Application Guide, 2006

VA BIM Guide, V1.0 10

J. Federal Communications Commission (FCC):

(47 CFR 15) Part 15 Limitations on the Use of Wireless Equipment/Systems

K. Federal Information Processing Standards (FIPS):

FIPS-201-1.....Personal Identity Verification (PIV) of Federal Employees and Contractors

L. Federal Specifications (Fed. Spec.):

A-A-59544-08.....Cable and Wire, Electrical (Power, Fixed Installation)

M. Government Accountability Office (GAO):

GAO-03-8-02.....Security Responsibilities for Federally Owned and Leased Facilities

N. Homeland Security Presidential Directive (HSPD):

HSPD-12.....Policy for a Common Identification Standard for Federal Employees and Contractors

O. Institute of Electrical and Electronics Engineers (IEEE):

81-2012.....IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

802.3af-08.....Power over Ethernet Standard

802.3at-09 .....Power over Ethernet (PoE) Plus Standard

C2-07.....National Electrical Safety Code

C62.41-02.....IEEE Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits

C95.1-05.....Standards for Safety Levels with Respect to Human Exposure in Radio Frequency Electromagnetic Fields

P. International Organization for Standardization (ISO):

7810.....Identification cards – Physical characteristics

7811.....Physical Characteristics for Magnetic Stripe Cards

7816-1.....Identification cards - Integrated circuit(s) cards with contacts - Part 1: Physical characteristics

7816-2.....Identification cards - Integrated circuit cards - Part 2: Cards with contacts -Dimensions and location of the contacts

7816-3.....Identification cards - Integrated circuit cards - Part 3: Cards with contacts - Electrical interface and transmission protocols

7816-4.....Identification cards - Integrated circuit cards - Part 11: Personal verification through biometric methods

7816-10.....Identification cards - Integrated circuit cards - Part 4: Organization, security and commands for interchange

14443.....Identification cards - Contactless integrated circuit cards; Contactless Proximity Cards

Operating at 13.56 MHz in up to 5 inches distance

15693.....Identification cards -- Contactless integrated circuit cards - Vicinity cards; Contactless Vicinity Cards Operating at 13.56 MHz in up to 50 inches distance

19794.....Information technology - Biometric data interchange formats

Q. National Electrical Contractors Association

303-2005.....Installing Closed Circuit Television (CCTV) Systems

R. National Electrical Manufactures Association (NEMA):

250-14.....Enclosures for Electrical Equipment (1000 Volts Maximum)

TC-3-16.....PVC Fittings for Use with Rigid PVC Conduit and Tubing

FB1-14.....Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable

S. National Fire Protection Association (NFPA):

70-20..... National Electrical Code (NEC)

731-20.....Standards for the Installation of Electric Premises Security Systems

99-21.....Health Care Facilities

T. National Institute of Justice (NIJ)

0601.02-03.....Standards for Walk-Through Metal Detectors for use in Weapons Detection

0602.02-03.....Hand-Held Metal Detectors for Use in Concealed Weapon and Contraband Detection

U. National Institute of Standards and Technology (NIST):

IR 6887 V2.1.....Government Smart Card Interoperability Specification (GSC-IS)

Special Pub 800-37.....Guide for Applying the Risk Management Framework to Federal Information Systems

Special Pub 800-63.....Electronic Authentication Guideline

Special Pub 800-73-3....Interfaces for Personal Identity Verification (4 Parts)
.....Pt. 1- End Point PIV Card Application Namespace, Data Model & Representation
.....Pt. 2- PIV Card Application Card Command Interface
.....Pt. 3- PIV Client Application Programming Interface
.....Pt. 4- The PIV Transitional Interfaces & Data Model Specification
Special Pub 800-76-1....Biometric Data Specification for Personal Identity Verification
Special Pub 800-78-2....Cryptographic Algorithms and Key Sizes for Personal Identity Verification
Special Pub 800-79-1....Guidelines for the Accreditation of Personal Identity Verification Card Issuers
Special Pub 800-85B-1...DRAFTPIV Data Model Test Guidelines
Special Pub 800-85A-2...PIV Card Application and Middleware Interface Test Guidelines (SP 800-73-3 compliance)
Special Pub 800-96.....PIV Card Reader Interoperability Guidelines
Special Pub 800-104A....Scheme for PIV Visual Card Topography

V. Occupational and Safety Health Administration (OSHA):
29 CFR 1910.97.....Nonionizing radiation

W. Section 508 of the Rehabilitation Act of 1973

X. Security Industry Association (SIA):
AG-01 .....Security CAD Symbols Standards

Y. Underwriters Laboratories, Inc. (UL):
1-05.....Flexible Metal Conduit
5-16.....Surface Metal Raceway and Fittings
6-07.....Rigid Metal Conduit
44-14.....Thermoset-Insulated Wires and Cables
50-15.....Enclosures for Electrical Equipment
83-14.....Thermoplastic-Insulated Wires and Cables
294-13.....The Standard of Safety for Access Control System Units
305-12.....Standard for Panic Hardware

360-13.....Liquid-Tight Flexible Steel Conduit
444-17.....Safety Communications Cables
464-16.....Audible Signal Appliances
467-13.....Electrical Grounding and Bonding Equipment
486A-13.....Wire Connectors and Soldering Lugs for Use with Copper Conductors
486C-13.....Splicing Wire Connectors
486D-15.....Insulated Wire Connector Systems for Underground Use or in Damp or Wet Locations
486E-15.....Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors
493-07.....Thermoplastic-Insulated Underground Feeder and Branch Circuit Cable
514A-13.....Metallic Outlet Boxes
514B-12.....Fittings for Cable and Conduit
51-12.....Schedule 40 and 80 Rigid PVC Conduit
609-96.....Local Burglar Alarm Units and Systems
634-16.....Standards for Connectors with Burglar-Alarm Systems
636-01.....Standard for Holdup Alarm Units and Systems
639-07.....Standard for Intrusion-Detection Units
651-11.....Schedule 40 and 80 Rigid PVC Conduit
651A-11.....Type EB and A Rigid PVC Conduit and HDPE Conduit
752-05.....Standard for Bullet-Resisting Equipment
797-07.....Electrical Metallic Tubing
827-14.....Central Station Alarm Services
1037-16.....Standard for Anti-theft Alarms and Devices
1635-10.....Digital Alarm Communicator System Units
1076-95.....Standards for Proprietary Burglar Alarm Units and Systems
1242-06.....Intermediate Metal Conduit
1479-15.....Fire Tests of Through-Penetration Fire Stops
1981-14.....Central Station Automation System
2058-05.....High Security Electronic Locks
60950.....Safety of Information Technology Equipment

60950-1.....Information Technology Equipment - Safety - Part 1: General Requirements

Z. Uniform Federal Accessibility Standards (UFAS) 1984

AA. United States Department of Commerce:

Special Pub 500-101 ....Care and Handling of Computer Magnetic Storage Media

1.8 COORDINATION

A. Coordinate arrangement, mounting, and support of electronic safety and security equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for electronic safety and security items that are behind finished surfaces or otherwise concealed.

1.9 MAINTENANCE & SERVICE

A. General Requirements

1. The Contractor shall provide all services required and equipment necessary to maintain the entire integrated electronic security system in an operational state as specified for a period of one (1) year after formal written acceptance of the system. The Contractor shall provide all necessary material required for performing scheduled adjustments or other non-scheduled work. Impacts on facility operations shall be minimized when performing scheduled adjustments or other non-scheduled work. See also General Project Requirements.

B. Description of Work

1. The adjustment and repair of the security system includes all software updates, panel firmware, and the following new items computers equipment, communications transmission equipment and data transmission media (DTM), local processors, security system sensors, physical access control equipment, facility interface, signal transmission equipment, and video equipment.

C. Personnel

1. Service personnel shall be certified in the maintenance and repair of the selected type of equipment and qualified to accomplish all work promptly and satisfactorily. The COR shall be advised in writing of the name of the designated service representative, and of any change in personnel. The COR shall be provided copies of system manufacturer certification for the designated service representative.

D. Schedule of Work

1. The work shall be performed during regular working hours, Monday through Friday, excluding federal holidays.

E. System Inspections

1. These inspections shall include:
   a. The Contractor shall perform two (2) minor inspections at six (6) month intervals or more if required by the manufacturer, and two (2) major inspections offset equally between the minor inspections to effect quarterly inspection of alternating magnitude.
      1) Minor Inspections shall include visual checks and operational tests of all console equipment, peripheral equipment, local processors, sensors, electrical and mechanical controls, and adjustments on printers.
      2) Major Inspections shall include all work described for Minor Inspections and the following: clean all system equipment and local processors including interior and exterior surfaces; perform diagnostics on all equipment; operational tests of the CPU, switcher, peripheral equipment, recording devices, monitors, picture quality from each camera; check, walk test, and calibrate each sensor; run all system software diagnostics

and correct all problems; and resolve any previous outstanding problems.

F. Emergency Service

1. The owner shall initiate service calls whenever the system is not functioning properly. The Contractor shall provide the Owner with an emergency service center telephone number. The emergency service center shall be staffed 24 hours a day 365 days a year. The Owner shall have sole authority for determining catastrophic and non-catastrophic system failures within parameters stated in General Project Requirements.
   a. For catastrophic system failures, the Contractor shall provide same day four (4) hour service response with a defect correction time not to exceed eight (8) hours from notification. Catastrophic system failures are defined as any system failure that the Owner determines will place the facility(s) at increased risk.
   b. For non-catastrophic failures, the Contractor within eight (8) hours with a defect correction time not to exceed 24 hours from notification.

G. Operation

1. Performance of scheduled adjustments and repair shall verify operation of the system as demonstrated by the applicable portions of the performance verification test.

H. Records & Logs

1. The Contractor shall maintain records and logs of each task and organize cumulative records for each component and for the complete system chronologically. A continuous log shall be submitted for all devices. The log shall contain all initial settings, calibration, repair, and programming data. Complete logs shall be maintained and available for inspection on site, demonstrating planned and systematic adjustments and repairs have been accomplished for the system.

I. Work Request

1. The Contractor shall separately record each service call request, as received. The record shall include the serial number identifying the component involved, its location, date and time the call was

received, specific nature of trouble, names of service personnel assigned to the task, instructions describing the action taken, the amount and nature of the materials used, and the date and time of commencement and completion. The Contractor shall deliver a record of the work performed within five (5) working days after the work was completed.

J. System Modifications

1. The Contractor shall make any recommendations for system modification in writing to the COR. No system modifications, including operating parameters and control settings, shall be made without prior written approval from the COR. Any modifications made to the system shall be incorporated into the operation and maintenance manuals and other documentation affected.

K. Software

1. The Contractor shall provide all software updates when approved by the Owner from the manufacturer during the installation and 12-month warranty period and verify operation of the system. These updates shall be accomplished in a timely manner, fully coordinated with the system operators, and incorporated into the operations and maintenance manuals and software documentation. There shall be at least one (1) scheduled update near the end of the first year's warranty period, at which time the Contractor shall install and validate the latest released version of the Manufacturer's software. All software changes shall be recorded in a log maintained in the unit control room. An electronic copy of the software update shall be maintained within the log. At a minimum, the contractor shall provide a description of the modification, when the modification occurred, and name and contact information of the individual performing the modification. The log shall be maintained in a white 3 ring binder and the cover marked "SOFTWARE CHANGE LOG".

1.10 MINIMUM REQUIREMENTS

A. References to industry and trade association standards and codes are minimum installation requirement standards.

B. Drawings and other specification sections shall govern in those instances where requirements are greater than those specified in the above standards.

1.11 DELIVERY, STORAGE, & HANDLING

A. Equipment and materials shall be protected during shipment and storage against physical damage, dirt, moisture, cold and rain:

1. During installation, enclosures, equipment, controls, controllers, circuit protective devices, and other like items, shall be protected against entry of foreign matter; and be vacuum cleaned both inside and outside before testing and operating and repainting if required.
2. Damaged equipment shall be, as determined by the COR, placed in first class operating condition or be returned to the source of supply for repair or replacement.
3. Painted surfaces shall be protected with factory installed removable heavy craft paper, sheet vinyl or equal.
4. Damaged paint on equipment and materials shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious.

B. Central Station, Workstations, and Controllers:

1. Store in temperature and humidity controlled environment in original manufacturer's sealed containers. Maintain ambient temperature between 10 to 30 deg C (50 to 85 deg F), and not more than 80 percent relative humidity, non-condensing.
2. Open each container; verify contents against packing list, and file copy of packing list, complete with container identification for inclusion in operation and maintenance data.
3. Mark packing list with designations which have been assigned to materials and equipment for recording in the system labeling schedules generated by cable and asset management system.
4. Save original manufacturer's containers and packing materials and deliver as directed under provisions covering extra materials.

1.12 PROJECT CONDITIONS

A. Environmental Conditions: System shall be capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:

1. Interior, Controlled Environment: System components, except central-station control unit, installed in temperature-controlled interior environments shall be rated for continuous operation in ambient conditions of 2 to 50 deg C (36 to 122 deg F) dry bulb and

20 to 90 percent relative humidity, non-condensing. NEMA 250, Type 1 enclosure.

2. Interior, Uncontrolled Environment: System components installed in non-temperature-controlled interior environments shall be rated for continuous operation in ambient conditions of -18 to 50 deg C (0 to 122 deg F) dry bulb and 20 to 90 percent relative humidity, non-condensing. NEMA 250, Type 4X enclosures.
3. Exterior Environment: System components installed in locations exposed to weather shall be rated for continuous operation in ambient conditions of -34 to 50 deg C (-30 to 122 deg F) dry bulb and 20 to 90 percent relative humidity, condensing. Rate for continuous operation where exposed to rain as specified in NEMA 250, winds up to 137 km/h (85 mph) and snow cover up to 610 mm (24 in) thick. NEMA 250, Type 4X enclosures.
4. Hazardous Environment: System components located in areas where fire or explosion hazards may exist because of flammable gases or vapors, flammable liquids, combustible dust, or ignitable fibers shall be rated, listed, and installed according to NFPA 70.
5. Corrosive Environment: For system components subjected to corrosive fumes, vapors, and wind-driven salt spray in coastal zones, provide NEMA 250, Type 4X enclosures.

B. Security Environment: Use vandal resistant enclosures in high-risk areas where equipment may be subject to damage.

C. Console: All console equipment shall, unless noted otherwise, be rated for continuous operation under ambient environmental conditions of 15.6 to 29.4 deg C (60 to 85 deg F) and a relative humidity of 20 to 80 percent.

1.13 EQUIPMENT AND MATERIALS

A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, for which replacement parts shall be available.

B. When more than one unit of the same class of equipment is required, such units shall be the product of a single manufacturer.

C. Equipment Assemblies and Components:

1. Components of an assembled unit need not be products of the same manufacturer.

2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
3. Components shall be compatible with each other and with the total assembly for the intended service.
4. Constituent parts which are similar shall be the product of a single manufacturer.

D. Factory wiring shall be identified on the equipment being furnished and on all wiring diagrams.

E. When Factory Testing Is Specified:
1. The Government shall have the option of witnessing factory tests. The contractor shall notify the VA through the COR a minimum of 15 working days prior to the manufacturers making the factory tests.
2. Four copies of certified test reports containing all test data shall be furnished to the COR prior to final inspection and not more than 90 days after completion of the tests.
3. When equipment fails to meet factory test and re-inspection is required, the contractor shall be liable for all additional expenses, including expenses of the Government.

1.14 ELECTRICAL POWER

A. Electrical power of 120 Volts Alternating Current (VAC) shall be indicated on the Division 26 drawings. Additional locations requiring primary power required by the security system shall be shown as part of these contract documents. Primary power for the security system shall be configured to switch to emergency backup sources automatically if interrupted without degradation of any critical system function. Alarms shall not be generated as a result of power switching, however, an indication of power switching on (on-line source) shall be provided to the alarm monitor. The Security Contractor shall provide an interface (dry contact closure) between the PACS and the Uninterruptible Power Supply (UPS) system so the UPS trouble signals and main power fail appear on the PACS operator terminal as alarms.

B. Failure of any on-line battery shall be detected and reported as a fault condition. Battery backed-up power supplies shall be provided sized for 8 hours of operation at actual connected load. Requirements for additional power or locations shall be included with the contract

to support equipment and systems offered. The following minimum requirements shall be provided for power sources and equipment.

1. Emergency Generator
   a. Report Printers: Unit Control Room
   b. Video Monitors: Unit Control Room
   c. Intercom Stations
   d. Radio System
   e. Lights: Unit Control Room, Equipment Rooms, & Security Offices
   f. Outlets: Security Outlets dedicated to security equipment racks or security enclosure assemblies.
   g. Security Device Power Supplies (DGP, VASS, Card Access, Lock Power, etc.) powered from the security closets or remotely: various locations
   h. Telephone/Radio Recording Equipment: Unit Control Room.
   i. VASS Camera Power Supplies: Security Closets
   j. VASS Pan/Tilt Units: Various Locations
   k. VASS Outdoor Housing Heaters and Blowers: Various Sites
   l. Intercom Master Control System
   m. Fiber Optic Receivers/Transmitters
   n. Security office Weapons Storage
   o. Outlets that charge handheld radios
2. Uninterruptible Power Supply (UPS) on Emergency Power
   a. The following 120VAC circuits shall be provided by others. The Security Contractor shall coordinate exact locations with the Electrical Contractor:
      1) Security System Monitors and Keyboards: Control Room
      2) CPU: Control Equipment Room
      3) Communications equipment: Control Equipment Room and various sites.
      4) VASS Matrix Switcher: Control Equipment Room
      5) VASS: Control Equipment Room
      6) Digital Video Recorders, encoders & decoders: Control Room
      7) All equipment Room racked equipment.
      8) Network switches

1.15 TRANSIENT VOLTAGE SUPPRESSION, POWER SURGE SUPPLESION, & GROUNDING

A. Transient Voltage Surge Suppression: All cables and conductors extending beyond building façade, except fiber optic cables, which serve as communication, control, or signal lines shall be protected against Transient Voltage surges and have Transient Voltage Surge Suppression (TVSS) protection. The TVSS device shall be UL listed in accordance with Standard TIA 497B installed at each end. Lighting and surge suppression shall be a multi-strike variety and include a fault indicator. Protection shall be furnished at the equipment and additional triple solid state surge protectors rated for the application on each wire line circuit shall be installed within 914.4 mm (3 ft) of the building cable entrance. Fuses shall not be used for surge protection. The inputs and outputs shall be tested in both normal mode and common mode to verify there is no interference.

1. A 10-microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.
2. An 8-microsecond rise time by 20-microsecond pulse width waveform with a peak voltage of 1000 volts and a peak current of 500 amperes.
3. Maximum series current: 2 AMPS. Provide units manufactured by Advanced Protection Technologies, model # TE/FA 10B or TE/FA 20B.
4. Operating Temperature and Humidity: -40 to 85 deg C (-40 to 185 deg F), 0 to 95 percent relative humidity.

B. Grounding and Surge Suppression

1. The Security Contractor shall provide grounding and surge suppression to stabilize the voltage under normal operating conditions. To ensure the operation of over current devices, such as fuses, circuit breakers, and relays, under ground-fault conditions.
2. Security Contractor shall engineer and provide proper grounding and surge suppression as required by local jurisdiction and prevailing codes and standards referenced in this document.
3. Principal grounding components and features. Include main grounding buses and grounding and bonding connections to service equipment.
4. Details of interconnection with other grounding systems. The lightning protection system shall be provided by the Security Contractor.

5. Locations and sizes of grounding conductors and grounding buses in electrical, data, and communication equipment rooms and closets.
6. AC power receptacles are not to be used as a ground reference point.
7. Any cable that is shielded shall require a ground in accordance with the best practices of the trade and manufactures installation instructions.
8. Protection should be provided at both ends of cabling.

1.16 COMPONENT ENCLOSURES

A. Construction of Enclosures

1. Consoles, power supply enclosures, detector control and terminal cabinets, control units, wiring gutters, and other component housings, collectively referred to as enclosures, shall be so formed and assembled as to be sturdy and rigid.
2. Thickness of metal in-cast and sheet metal enclosures of all types shall not be less than those in Tables I and II, UL 611. Sheet steel used in fabrication of enclosures shall be not less than 14 gauge. Consoles shall be 16-gauge.
3. Doors and covers shall be flanged. Enclosures shall not have pre-punched knockouts. Where doors are mounted on hinges with exposed pins, the hinges shall be of the tight pin type or the ends of hinge pins shall be tack welded to prevent removal. Doors having a latch edge length of less than 609.6 mm (24 in) shall be provided with a single construction core. Where the latch edge of a hinged door is more than 609.6 mm (24 in) or more in length, the door shall be provided with a three-point latching device with construction core; or alternatively with two, one located near each end.
4. Any ventilator openings in enclosures and cabinets shall conform to the requirements of UL 611. Unless otherwise indicated, sheet metal enclosures shall be designed for wall mounting with tip holes slotted. Mounting holes shall be in positions that remain accessible when all major operating components are in place and the door is open, but shall be in accessible when the door is closed.
5. Covers of pull and junction boxes provided to facilitate initial installation of the system shall be held in place by tamper proof Torx Center post security screws. Stenciled or painted labels shall be affixed to such boxes indicating they contain no connections.

These labels shall not indicate the box is part of the Electronic Security System (ESS).

B. Consoles & Equipment Racks: All consoles and vertical equipment racks shall include a forced air-cooling system to be provided by others.

1. Vertical Equipment Racks:

a. The forced air blowers shall be installed in the vented top of each cabinet and shall not reduce usable rack space.

b. The forced air fan shall consist of one fan rated at 105 CFM per rack bay and noise level shall not exceed 55 decibels.

c. Vertical equipment racks are to be provided with full sized clear plastic locking doors and vented top panels as shown on contract drawings.

2. Console racks:

a. Forced air fans shall be installed in the top rear of each console bay. The forced air fan shall consist of one fan rated at 105 CFM mounted to a 133mm vented blank panel the noise level of each fan shall not exceed 55 decibels. The fans shall be installed so air is pulled from the bottom of the rack or cabinet and exhausted out the top.

b. Console racks are to be provided with flush mounted hinged rear doors with recessed locking latch on the bottom and middle sections of the consoles. Provide code access to support wiring for devices located on the work surfaces.

C. Tamper Provisions and Tamper Switches:

1. Enclosures, cabinets, housings, boxes and fittings or every product description having hinged doors or removable covers and which contain circuits, or the integrated security system and its power supplies shall be provided with cover operated, corrosion-resistant tamper switches.

2. Tamper switches shall be arranged to initiate an alarm signal that will report to the monitoring station when the door or cover is moved. Tamper switches shall be mechanically mounted to maximize the defeat time when enclosure covers are opened or removed. It shall take longer than 1 second to depress or defeat the tamper switch after opening or removing the cover. The enclosure and tamper switch shall function together in such a manner as to

prohibit direct line of sign to any internal component before the switch activates.

3. Tamper switches shall be inaccessible until the switch is activated. Have mounting hardware concealed so the location of the switch cannot be observed from the exterior of the enclosure. Be connected to circuits which are under electrical supervision at all times, irrespective of the protection mode in which the circuit is operating. Be spring-loaded and held in the closed position by the door or cover and be wired so they break the circuit when the door cover is disturbed. Tamper circuits shall be adjustable type screw sets and shall be adjusted by the contractor to eliminate nuisance alarms associated with incorrectly mounted tamper device shall annunciate prior to the enclosure door opening (within 1/4 " tolerance. The tamper device or its components shall not be visible or accessing with common tools to bypass when the enclosure is in the secured mode.
4. The single gang junction boxes for the portrait alarming and pull boxes with less than 102 square mm will not require tamper switches.
5. All enclosures over 305 square mm shall be hinged with an enclosure lock.
6. Control Enclosures: Maintenance/Safety switches on control enclosures, which must be opened to make routing maintenance adjustments to the system and to service the power supplies, shall be push/pull-set automatic reset type.
7. Provide one (1) enclosure tamper switch for each 609 linear mm of enclosure lock side opening evenly spaced.
8. All security screws shall be Torx-Post Security Screws.
9. The contractor shall provide the owner with two (2) torx-post screwdrivers.

1.17 ELECTRONIC COMPONENTS

A. All electronic components of the system shall be of the solid-state type, mounted on printed circuit boards conforming to UL 796. Boards shall be plug-in, quick-disconnect type. Circuitry shall not be so densely placed as to impede maintenance. All power-dissipating components shall incorporate safety margins of not less than 25 percent

with respect to dissipation ratings, maximum voltages, and current-carrying capacity.

1.18 SUBSTITUTE MATERIALS & EQUIPMENT

A. Where variations from the contract requirements are requested in accordance with the GENERAL CONDITIONS and Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, the connecting work and related components shall include, but not be limited to additions or changes to branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels and installation methods.

B. In addition to this Section the Security Contractor shall also reference Section II, Products and associated divisions. The COR shall have final authority on the authorization or refusal of substitutions. If there are no proposed substitutions, a statement in writing from the Contractor shall be submitted to the COR stating same. In the preparation of a list of substitutions, the following information shall be included, as a minimum:

1. Identity of the material or devices specified for which there is a proposed substitution.
2. Description of the segment of the specification where the material or devices are referenced.
3. Identity of the proposed substitute by manufacturer, brand name, catalog or model number and the manufacturer’s product name.
4. A technical statement of all operational characteristic expressing equivalence to items to be substituted and comparison, feature-by-feature, between specification requirements and the material or devices called for in the specification; and Price differential.

C. Materials Not Listed: Furnish all necessary hardware, software, programming materials, and supporting equipment required to place the specified major subsystems in full operation. Note that some supporting equipment, materials, and hardware may not be described herein. Depending on the manufacturers selected by the COR, some equipment, materials and hardware may not be contained in either the Contract Documents or these written specifications, but are required by the manufacturer for complete operation according to the intent of the design and these specifications. In such cases, the COR shall be given the opportunity to approve the additional equipment, hardware and

materials that shall be fully identified in the bid and in the equipment list submittal. The COR shall be consulted in the event there is any question about which supporting equipment, materials, or hardware is intended to be included.

D. Response to Specification: The Contractor shall submit a point-by-point statement of compliance with each paragraph of the security specification. The statement of compliance shall list each paragraph by number and indicate "COMPLY" opposite the number for each paragraph where the Contractor fully complies with the specification. Where the proposed system cannot meet the requirements of the paragraph, and does not offer an equivalent solution, the offers shall indicate "DOES NOT COMPLY" opposite the paragraph number. Where the proposed system does not comply with the paragraph as written, but the bidder feels it will accomplish the intent of the paragraph in a manner different from that described, the offers shall indicate "COMPARABLE". The offers shall include a statement fully describing the "comparable" method of satisfying the requirement. Where a full and concise description is not provided, the offered system shall be considered as not complying with the specification. Any submission that does not include a point-by-point statement of compliance, as described above, shall be disqualified. Submittals for products shall be in precise order with the product section of the specification. Submittals not in proper sequence will be rejected.

1.19 LIKE ITEMS

A. Where two or more items of equipment performing the same function are required, they shall be exact duplicates produced by one manufacturer. All equipment provided shall be complete, new, and free of any defects.

1.20 WARRANTY

A. The Contractor shall, as a condition precedent to the final payment, execute a written guarantee (warranty) to the COR certifying all contract requirements have been completed according to the final specifications. Contract drawings and the warranty of all materials and equipment furnished under this contract are to remain in satisfactory operating condition (ordinary wear and tear, abuse and causes beyond his control for this work accepted) for one (1) year from the date the Contactor received written notification of final

acceptance from the COR. Demonstration and training shall be performed prior to system acceptance. All defects or damages due to faulty materials or workmanship shall be repaired or replaced without delay, to the COR's satisfaction, and at the Contractor's expense. The Contractor shall provide quarterly inspections during the warranty period. The contractor shall provide written documentation to the COR on conditions and findings of the system and device(s). In addition, the contractor shall provide written documentation of test results and stating what was done to correct any deficiencies. The first inspection shall occur 90 calendar days after the acceptance date. The last inspection shall occur 30 calendar days prior to the end of the warranty. The warranty period shall be extended until the last inspection and associated corrective actions are complete. When equipment and labor covered by the Contractor's warranty, or by a manufacturer's warranty, have been replaced or restored because of it’s failure during the warranty period, the warranty period for the replaced or repaired equipment or restored work shall be reinstated for a period equal to the original warranty period, and commencing with the date of completion of the replacement or restoration work. In the event any manufacturer customarily provides a warranty period greater than one (1) year, the Contractor's warranty shall be for the same duration for that component.

1.21 SINGULAR NUMBER

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

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS

A. All equipment associated within the Security Control Room, Security Console and Security Equipment Room shall be UL 827, UL 1981, and UL 60950 compliant and rated for continuous operation. Environmental conditions (i.e. temperature, humidity, wind, and seismic activity) shall be taken under consideration at each facility and site location prior to installation of the equipment.

B. All equipment shall operate on a 120 or 240 volts alternating current (VAC); 50 Hz or 60 Hz AC power system unless documented otherwise in subsequent sections listed within this specification. All equipment shall have a back-up source of power that will provide a minimum of 8 hours of run time in the event of a loss of primary power to the facility.

C. The system shall be designed, installed, and programmed in a manner that will allow for ease of operation, programming, servicing, maintenance, testing, and upgrading of the system.

D. All equipment and materials for the system will be compatible to ensure correct operation.

2.2 EQUIPMENT ITEMS

A. The Security Management System shall provide full interface with all components of the security subsystem as follows:

1. Shall allow for communication between the Physical Access Control System and Database Management and all subordinate work and monitoring stations, enrollment centers for badging and biometric devices as part of the PACS, local annunciation centers, the electronic Security Management System (SMS), and all other VA redundant or backup command center or other workstations locations.
2. Shall provide automatic continuous communication with all systems that are monitored by the SMS, and shall automatically annunciate any communication failures or system alarms to the SMS operator providing identification of the system, nature of the alarm, and location of the alarm.
3. Controlling devices shall be utilized to interface the SMS with all field devices.
4. The Security control room and security console will be supported by an uninterrupted power supply (UPS) or dedicated backup generator power circuit.
5. The Security Equipment room, Security Control Room, and Security Operator Console shall house the following equipment i.e. refer to individual master specifications for each security subsystem’s specific requirements:
   a. Security Console Bays and Equipment Racks
   b. Security Network Server and Workstation

c. CCTV Monitoring, Controlling, and Recording Equipment
d. PACS Monitoring and Controlling Equipment
e. IDS Monitoring and Controlling Equipment
f. Security Access Detection Monitoring Equipment
g. EPPS Monitoring and Controlling Equipment
h. Main Panels for all Security Systems
i. Power Supply Units (PSU) for all field devices
j. Life safety and power monitoring equipment
k. All other building systems deemed necessary by the VA to include, but not limited to, heating, ventilation and air conditioning (HVAC), elevator control, portable radio, fire alarm monitoring, and other potential systems.
l. Police two-way radio control consoles/units.

B. Security Console Bays - shall be EIA 310D compliant and:
1. Utilize stand-up, sit-down, and vertical equipment racks in any combination to monitor and control the security subsystems.
2. Shall be wide enough for equipment that requires a minimum 19 inch (47.5 cm) mounting area.
3. Shall be made of metal, furnished with wire ways, a power strip, a thermostatic controlled bottom or top mounted fan units, a hinge mounted rear door, a hinge mounted front door made of Plexiglas, and a louvered top. When possible, pre-fabricated (standard off-the-shelf) security console equipment shall be used in place of customized designed consoles.
4. A wire management system shall be designed and installed so that all cables are mounted in a manner that they do not interfere with day-to-day operations, are labeled for quick identification, and so that high voltage power cables do not cause signal interference with low voltage and data carrying cables.
5. Shall be mounted on lockable casters.
6. Shall be ergonomically designed so that all devices requiring repetitive interaction with by the operator can be easily accessed, observed, and accomplished.
7. Controls and displays shall be located so that they are not obscured during normal operation. Control and display units installed with a

work bench shall be a minimum of 3 in. (7.5 cm) from all edges of the work bench area.

8. All security subsystem controls shall be installed within the same operating console bay of their associated equipment.
9. Video monitors shall be mounted above all controls within a console bay and positioned in a manner that minimum strain is placed on the operator viewing them at the console.
10. At least one workbench for every three (3) console bays shall be provided free of control equipment to allow for appropriate operator workspace.
11. All console devices shall be labeled and marked with a minimum of quarter inch bold print.
12. All non-security related equipment that is required to be monitored shall be installed in a console bay separate from the security subsystem equipment and clearing be identified as such.
13. Console bays and related equipment shall be arranged in priority order and sequenced based upon their pre-defined security subsystem operations criticality established by the COR.
14. The following minimum console technical characteristics shall be taken into consideration when designing for and installing the security console and equipment racks:

	Stand-Up	Sit-Down	Vertical Equipment Rack
Workstation Height	No Greater than 84 in. (210 cm)	No greater than 72 in. (150 cm)	No greater than 96 in. (240 cm)
Bench board Slope	21 in. (52.5 cm)	25 in. (62.5 cm)	N/A
Bench board Angle	15 degrees	15 degrees	N/A
Depth of Console	24 in. (60 cm)	24 in. (60 cm)	N/A
Leg and Feet Clearance	6 sq. ft. from center of Console Slope front	6 sq. ft. from center of Console Slope front	6 sq. ft. from center of Console Slope front

Distance Between Console Rows	96 in. (240 cm)	96 in. (240 cm)	96 in. (240 cm)
Distance Between Console and Wall	36 in. (90 cm) from the rear and/or side of console or rack	36 in. (90 cm) from the rear and/or side of console or rack	36 in. (90 cm) from the rear and/or side of console or rack

C. Security Console Configuration:

1. The size shall be defined by the number of console bays required to house and operate the security subsystems, as well as any other factors that may influence the overall design of the space. A small Access Control System and Database Management shall contain no more than four (4) security console bays. A large Access Control System and Database Management shall contain no less than five (5) and no more than eight (8) security console bays.
2. Shall meet the following minimum spacing requirements to ensure that a Access Control System and Database Management is provided to house existing and future security subsystems and other equipment listed in paragraph 2.3.C:
   a. 500 square feet for a large Access Control System and Database Management.
   b. 300 square feet for a small Access Control System and Database Management.
   c. If office, training room and conference space, is a processing area as well as holding cell space is to be located adjacent to the Access Control System and Database Management, these space requirements also need to be considered.
3. Shall be located in an area within, at a minimum, the first level/line of security defense defined by the VA. If the Access Control System and Database Management is to be located outside the first level of security, then the area shall be constructed or retrofit to meet or exceed those requirements outlined in associated VA Master Specifications.
4. Shall not be located within or near an area with little to no blast mitigation standoff space protection, adjacent to an outside wall

exposed to vehicle parking and traffic, within a basement or potential flood zone area, in close approximately to major utility areas, or near an exposed air intake(s).

5. Access shall meet UFAS and ADA accessibility requirements.
6. Construction shall be slab to slab and free of windows, with the exception of a service window. All penetrations into the room shall be sealed with fire stopping materials. This material shall apply in accordance with Section 07 84 00, FIRESTOPPING.
7. A service window shall be installed in the wall next to the main entrance of the Access Control System and Database Management or where it best can be monitored and accessed by the security console operator. The window shall meet all requirements set forth in UL 752, to include at a minimum, Class III ballistic level protection. The windows shall be set in a minimum or four (4) inches (100 mm) solid concrete units to ceiling height with either masonry or gypsum wall board to the underside of the slab above. It shall also contain a service tray constructed in a manner that only objects no larger than 3 inches (7.5 cm) in width may pass through it.
8. The walls making up or surrounding the Access Control System and Database Management shall be made of materials that at a minimum offer Class III ballistic level protection for the security console operator(s).
9. There will be a main power cut-off button/switch located inside the Access Control System and Database Management in the event of an electrical fire or related event occurs.
10. Shall have a fire alarm detection unit that is tied into the main building fire alarm system and have at least two fire extinguishers located within it.
11. Shall utilize a fire suppression system similar to that used by the VA’s computer and telecommunications room operating areas.
12. The floor shall be raised a minimum of 4 inches (10 cm) from the concrete floor base. Wire ways shall be utilized under the raised floor for separation of signal and power wires and cables.
13. Access shall be monitored and controlled by the PACS via card reader and fixed camera that utilizes a wide angle lens. A 1 in. (2.5 cm) deadbolt shall be utilized as a mechanical override for the door in

the event of electrical failure of the PACS, card reader, or locking mechanism.

14. There shall only be one point of ingress and egress to and from the Security Control Room. The door shall be made of solid core wood or better. If a window is required for the door, then the window shall be ballistic resistant with a Millar covering.
15. A two-way intercom shall be placed at the point of entry into the Security Control Room for access-communication control purposes.
16. A remote push-button door unlocking device shall not be installed for the electronic PACS locking mechanism providing access control into the Security Control Room.
17. All controlling equipment and power supplies that must be wall mounted shall be mounted in a manner that maximizes usability of the Security Control Room wall space. All equipment shall be mounted to three quarter inch fire retardant plywood. The plywood shall be fastened to the wall from slab to slab and fixed to the existing walls supports.

D. Security Control Room Ventilation

1. Shall meet or exceed all requirements laid out in VA Master Specification listed in Division 23, HEATING, VENTILATION, AND AIR CONDITIONING.
2. Controls shall be via a separate air handling system that provides an isolated supply and return system. The Security Control Room shall have a dedicated thermostat control unit and cut-off switch to be able to shut off ventilation to the control room in the event of a chemical, biological, or radiological (CBR) event or other related emergency.
3. There shall be a louver installed in the control room door to assist with ventilation of the room. The louver shall be exactly 12 x 12 inches (30 x 30 cm) and closeable.

E. Security Control Room and Security Console Lighting:

1. The following factors shall be taken into consideration for lighting of the Security Control Room and console area:
   a. Shadows: To reduce eye strain and fatigue, shadows shall be avoided.

b. Glare: The readability of all display panels, labels, and equipment shall not be interfered with or create visibility problems.

2. The following table shall provide guidance on the amount of footcandles required per work area and type of task performed:

Work Area/Type of Task		Footcandles
Main Operating Panels		50
Secondary Display Panels		50
Seated Workstations		100
Reading	Handwriting	100
	Typed Documents	50
	Visual Display Units	10
Logbook Recording		100
Maintenance Area		50
Emergency/Back-up Lighting		10

F. Remote security console access: For facilities that have a remote, secondary back-up control console or workstation shall apply the following requirements:

1. The secondary stations shall the requirements outlined in Sections 2.2.A-G.
2. Installation of an intercom station or telephone line shall be installed and provide direct one touch call-up for communications between the primary Security Control Console and secondary Security Control Console.
3. Secondary stations shall not have priority over a primary Security Control Console.
4. The primary Access Control System and Database Management shall have the ability to shut off power and a signal to a secondary control station in the event the area has been compromised.

G. Wires and Cables:

1. Shall meet or exceed the manufactures recommendation for power and signals.
2. Shall be carried in an enclosed conduit system, utilizing electromagnetic tubing (EMT) to include the equivalent in flexible

metal, rigid galvanized steel (RGS) to include the equivalent of liquid tight, polyvinylchloride (PVC) schedule 40 or 80.

3. All conduits will be sized and installed per the NEC. All security system signal and power cables that traverse or originate in a high security office space will contained in either EMT or RGS conduit.
4. All conduit, pull boxes, and junction boxes shall be marked with colored permanent tape or paint that will allow it to be distinguished from all other infrastructure conduit.
5. Conduit fills shall not exceed 50 percent unless otherwise documented.
6. A pull string shall be pulled along and provided with signal and power cables to assist in future installations.
7. At all locations where there is a wall penetration or core drilling is conducted to allow for conduit to be installed, fire stopping materials shall be applied to that area.
8. High voltage and signal cables shall not share the same conduit and shall be kept separate up to the point of connection. High voltage for the security subsystems shall be any cable or sets of cables carrying 30 VDC/VAC or higher.
9. For all equipment that is carrying digital data between the Security Control Room, Security Equipment Room, Security Console, or at a remote monitoring station, it shall not be less that 20 AWG and stranded copper wire for each conductor. The cable or each individual conductor within the cable shall have a shield that provides 100% coverage. Cables with a single overall shield shall have a tinned copper shield drain wire.

2.3 FIBER OPTIC EQUIPMENT

A. 8 Channel Fiber Optic Transcievers (Video&PTZ Control)

1. The field-located and central-located fiber optic transceivers shall utilize wave division multiplexing to transmit and receive video and data pan-tilt-zoom control signals over two standard 62.5/125 multimode fibers.
2. The units shall be capable of operating over a range of 2 km.
3. The units shall be NTSC color compatible.
4. The units shall support data rates up to 64 Kbps.
5. The units shall be surface or rack mountable.

6. The units shall be UL listed.
7. The units shall meet or exceed the following specifications:
   a. Video
      1) Input/Output: 1 volt pk-pk (75 ohms)
      2) Input/Output Channels: 8
      3) Bandwidth: 10 Hz - 6.5 MHZ per channel
      4) Differential Gain:<2%
      5) Differential Phase: <0.7°
      6) Tilt: <1%
      7) Signal to Noise Ratio: 60 dB
   b. Data (Control)
      1) Data Channels: 2
      2) Data Format: RS-232, RS-422, 2 wire or 4 wire RS-485 with Tri-State Manchester Bi-Phase and Sensornet
      3) Data Rate: DC - 100 kbps (NRZ)
      4) Bit Error Rate: < 1 in 10-9 @ Maximum Optical Loss Budget
      5) Operating Mode: Simplex or Full-Duplex
      6) Wavelength: 1310/1550 nm, Multimode or Singlemode
      7) Optical Emitter: Laser Diode
      8) Number of Fibers: 1
   c. Connectors
      1) Optical: ST
      2) Power and Data: Terminal Block with Screw Clamps
      3) Video: BNC (Gold Plated Center-Pin)
   d. Electrical and Mechanical
      1) Power: 12 VDC @ 500 mA (stand-alone)
      2) Current Protection: Automatic Resettable Solid-State Current Limiters
   e. Environmental
      1) MTBF: > 100,000 hours
      2) Operating Temp: -40 to 74 deg C (-40 to 165 deg F)
      3) Storage Temp: -40 to 85 deg C (-40 to 185 deg F)
      4) Relative Humidity: 0% to 95% (non-condensing)

B. Fiber Optic Transmitters: The central-located fiber optic transmitters shall utilize wave division multiplexing to transmit video and signals over standard 62.5/125 multimode fibers.

1. The units shall be capable of operating over a range of 4.8 km.
2. The units shall be NTSC color compatible.
3. The units shall support data rates up to 64 Kbps.
4. The units shall be surface or rack mountable.
5. The units shall be UL listed.
6. The units shall meet or exceed the following specifications:
   a. Video
      1) Input:1 volt pk-pk (75 ohms)
      2) Bandwidth: 5H2 - 10 MHZ
      3) Differential Gain:<5%
      4) Tilt: <1%
      5) Signal-Noise: 60db
      6) Wavelength: 850nm
      7) Number of Fibers: 1
      8) Operating Temp: -20 to 70 deg C (-4 to 158 deg F)
      9) Connectors:
         a) Power: Female plug with screw clamps
         b) Video: BNC
         c) Optical: ST
      10) Power: 12 VDC

C. Fiber Optic Receivers: The field-located fiber optic receivers shall utilize wave division multiplexing to receive video signals over standard 62.5/125 multimode fiber.
1. The units shall be capable of operating over a range of 4.8 km.
2. The units shall be NTSC color compatible.
3. The units shall support data rates up to 64 Kbps.
4. The units shall be surface or rack mountable.
5. The units shall be UL listed.
6. The units shall meet or exceed the following specifications:
   a. Video
      1) Output: 1 volt pk-pk (75 ohms)
      2) Bandwidth: 5H2 - 10 MHZ
      3) Differential Gain: <5%
      4) Tilt: <1%
      5) Signal-Noise: 60dB
      6) Wavelength: 850nm

7) Number of Fibers: 1
8) Surface Mount: 106.7 x 88.9 x 25.4 mm (4.2 x 3.5 x 1 in)
9) Operating Temp: -20 to 70 deg C (-4 to 158 deg F)
10) Connectors:
11) Power: Female plug block with screw clamps
12) Video: BNC
13) Optical: ST
14) Power: 12 VAC8 Channel Fiber Optic Transcievers (Video&PTZ Control)

D. Fiber Optic Sub Rack with Power Supply

1. The Card Cage Rack shall provide high-density racking for fiber-optic modules. The unit shall be designed to mount in standard 483 mm (19 in) instrument racks and to accommodate the equivalent of 15 1-inch modules.

a. Specifications

1) Card Orientation: Vertical
2) Construction: Aluminum
3) Current Consumption: 0.99 A
4) Humidity: 95.0 % RH
5) Input Power: 100-240 VAC, 60/50 Hz
6) Mounting: Mounts in standard 483 mm (19 in) rack using four (4) screws (optional wall brackets purchased separately)
7) Number of Outputs: 1.0
8) Number of Slots 15.0
9) Operating Temperature: -40 to +75 deg C (-40.0 to 167.0 deg F)
10) Output Voltage: 13.5 V
11) Output Current 6.0 A
12) Power Dissipation: 28.0 W
13) Power Factor: 48.0
14) Power Supply: (built-in)
15) Rack Units: 3RU
16) Redundant Capability: Yes
17) Weight: 2.43 kg (5.35 lb)
18) Width: 483 mm (19.0 in)

2.4 TRANSIENT VOLTAGE SURGE SUPPRESSION DEVICES (TVSS) AND SURGE SUPPRESION

A. Transient Voltage Surge Suppression

1. All cables and conductors extending beyond building perimeter, except fiber optic cables, which serve as communication, control, or signal lines shall be protected against Transient Voltage surges and have Transient Voltage surge suppression protection (TVSS) UL listed in accordance with Standard 497B installed at each end. Lighting and surge suppression shall be a multi-strike variety and include a fault indicator. Protection shall be furnished at the equipment and additional triple solid state surge protectors rated for the application on each wire line circuit shall be installed within 915 mm (36 in) of the building cable entrance. Fuses shall not be used for surge protection. The inputs and outputs shall be tested in both normal mode and common mode using the following waveforms:
   a. A 10-microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.
   b. An 8-microsecond rise time by 20-microsecond pulse width waveform with a peak voltage of 1000 volts and a peak current of 500 amperes.
   c. Maximum series current: 2 AMPS. Provide units manufactured by Advanced Protection Technologies, model # TE/FA 10B or TE/FA 20B or approved equivalent.
   d. Operating Temperature and Humidity: -40 to + 85 deg C (-40 to 185 deg F), and 0 to 95 percent relative humidity, non-condensing.

B. Physical Access Control Systems

1. Suppressors shall be installed on AC power at the point of service and shall meet the following criteria:
   a. UL1449 2nd Edition, 2007, listed
   b. UL1449 S.V.R. of 400 Volts or lower
   c. Status Indicator Light(s)
   d. Minimum Surge Current Capacity: 40,000 Amps (8 x 20 µsec)
   e. Maximum Continuous Current: 15 Amps
   f. MCOV: 125 VAC
   g. Service Voltage: 110-120 VAC

2. Suppressors shall be installed on the Low Voltage circuit at both the point of entrance and exit of the building. Suppressors shall meet the following criteria:
   a. UL 497B
   b. Minimum Surge Current Capacity: 2,000 Amps per pair
   c. Maximum Continuous Current: 5 Amps
   d. MCOV: 33 Volts
   e. Service Voltage: 24Volts
3. Suppressors shall be installed on the communication circuit between the access controller and card reader at both the entrance and exit of the building. Suppressors shall meet the following criteria:
   a. Conforms with UL497B standards (where applicable)
   b. Clamp level for 12 and 24V power: 18VDC / 38VDC
   c. Clamp level for Data/LED: 6.8VDC
   d. Service Voltage for Power: 12VDC/24VDC
   e. Service Voltage for Data/LED: <5VDC
   f. Clamp level – PoE Access Power: 72V
   g. Clamp level – PoE Access Data: 7.9V
   h. Service Voltage – PoE Access: 48VAC – 54VAC
   i. Service Voltage – PoE Data: <5VDC

C. Intercom Systems
1. Suppressors shall be installed on the AC power at the point of service and shall meet the following criteria:
   a. UL 1449 Listed
   b. UL 1449 S.V.R. of 400 Volts or lower
   c. Diagnostic Indicator Light(s)
   d. Integrated ground terminating post (where case/chassis ground exists)
   e. Minimum Surge Current Capacity of 13,000 Amps (8 x 20 µSec)
2. Suppressors shall be installed on incoming central office lines and shall meet the following criteria:
   a. UL 497A Listed
   b. Multi Stage protection design
   c. Auto-reset current protection not to exceed 2 Amps per pair
   d. Minimum Surge Current of 500 Amps per pair (8 x 20 µSec)

3. Suppressors shall be installed on all telephone/intercom circuits that enter or leave separate buildings and shall meet the following criteria:
   a. UL 497A Listed (where applicable)
   b. UL 497B Listed (horns, strobes, speakers or communication circuits over 300 feet)
   c. Multi Stage protection design
   d. Auto-reset over-current protection not to exceed 5 Amps per pair
   e. Minimum Surge Current of 1000 Amps per pair (8 x 20 µSec)

D. Intrusion Detection Systems
1. Suppressors shall be installed on AC at the point of service and shall meet the following criteria:
   a. UL 1449, 2nd Edition 2007, listed
   b. UL 1449 S.V.R. of 400 Volts or lower
   c. Status Indicator Lights
   d. Center screw for terminating Class II transformers
   e. Minimum Surge Current Capacity of 32,000 Amps (8 x 20 µSec)
2. Suppressors shall be installed on all Telephone Communication Interface circuits and shall meet the following criteria:
   a. UL 497A Listed
   b. Multi Stage protection design
   c. Surge Current Capacity: 9,000 Amps (8x20 µSec)
   d. Clamp Voltage: 130Vrms
   e. Auto reset current protection not to exceed 150 milliAmps
3. Suppressors shall be installed on all burglar alarm initiating and signaling loops and addressable circuits which enter or leave separate buildings. The following criteria shall be met:
   a. UL 497B for data communications or annunciation (powered loops)
   b. Fail-short/fail-safe mode.
   c. Surge Current Capacity: 9,000 Amps (8x20 µSec)
   d. Clamp Voltage: 15 Vrms
   e. Joule Rating: 76 Joules per pair (10x1000 µSec)
   f. Auto-reset current protection not to exceed 150 milliAmps for UL 497A devices.

E. Video Surveillance System

1. Protectors shall be installed on coaxial cable systems on points of entry and exit from separate buildings. Suppressors shall be installed at each exterior camera location and include protection for 12 and/or 24 volt power, data signal and motor controls (for Pan, Tilt and Zoom systems). SPDs shall protect all modes herein mentioned and contain all modes in a single unit system. Protection for all systems mentioned above shall be incorporated at the head end equipment. Additionally a minimum 450VA battery back up shall be used to protect the DVR or VCR and monitor. Protectors shall meet the following criteria:
   a. Head-End Power
      1) UL 1778, cUL (Battery Back Up)
      2) Minimum Surge Current Capacity: 65,000 Amps (8x20µsec)
      3) Minimum of two (2) NEMA 5-15R Receptacles (one (1) AC power only, one (1) with UPS)
      4) All modes protected (L-N, L-G, N-G)
      5) EMI/RFI Filtering
      6) Maximum Continuous Current: 12 Amps
   b. Camera Power
      1) Minimum Surge Current Capacity: 1,000 Amps (8X20µsec); 240 Amps for IP Video/PoE cameras
      2) Screw Terminal Connection
      3) All protection modes L-G (all Lines)
      4) MCOV <40VAC
   c. Video And Data
      1) Surge Current Capacity 1,000 Amps per conductor
      2) “BNC” Connection (Coax)
      3) Protection modes: L-G (Data), Center Pin-G, Shield-G (Coax)
      4) Band Pass 0-2GHz
      5) Insertion Loss <0.3dB

F. Grounding and Surge Suppression
   1. The Security Contractor shall provide grounding and surge suppression to stabilize the voltage under normal operating conditions. This is to ensure the operation of over current devices, such as fuses, circuit breakers, and relays, underground-fault conditions.

2. The Contractor shall engineer, provide, ad install proper grounding and surge suppression as required by local jurisdiction and prevailing codes and standards, referenced in this document.
3. Principal grounding components and features shall include: main grounding buses, grounding, and bonding connections to service equipment.
4. The Contractor shall provide detail drawings of interconnection with other grounding systems including lightning protection systems.
5. The Contractor shall provide details of locations and sizes of grounding conductors and grounding buses in electrical, data, and communication equipment rooms and closets.
6. AC power receptacles are not to be used as a ground reference point.
7. Any cable that is shielded shall require a ground in accordance with applicable codes, the best practices of the trade, and all manufactures' installation instructions.

G. 120 VAC Surge Suppression
1. Continuous Current: Unlimited (parallel connection)
2. Max Surge Current: 13,500 Amps
3. Protection Modes: L - N, L - G, N - G
4. Warranty: Ten Year Limited Warranty
5. Dimension: 73.7 x 41.1 x 52.1 mm (2.90 x 1.62 x 2.05 in)
6. Weight: 2.88 g (0.18 lbs)
7. Housing: ABS

2.5 INSTALLATION KIT

A. General:
1. The kit shall be provided that, at a minimum, includes all connectors and terminals, labeling systems, audio spade lugs, barrier strips, punch blocks or wire wrap terminals, heat shrink tubing, cable ties, solder, hangers, clamps, bolts, conduit, cable duct, and/or cable tray, etc., required to accomplish a neat and secure installation. All wires shall terminate in a spade lug and barrier strip, wire wrap terminal or punch block. Unfinished or unlabeled wire connections shall not be allowed. All unused and partially opened installation kit boxes, coaxial, fiber-optic, and twisted pair cable reels, conduit, cable tray, and/or cable duct bundles, wire rolls, physical installation hardware shall be turned

over to the COR. The following sections outline the minimum required installation sub-kits to be used:

2. System Grounding:
   a. The grounding kit shall include all cable and installation hardware required. All head end equipment and power supplies shall be connected to earth ground via internal building wiring, according to the NEC.
   b. This includes, but is not limited to:
      1) Coaxial Cable Shields
      2) Control Cable Shields
      3) Data Cable Shields
      4) Equipment Racks
      5) Equipment Cabinets
      6) Conduits
      7) Cable Duct blocks
      8) Cable Trays
      9) Power Panels
      10) Grounding
      11) Connector Panels
3. Coaxial Cable: The coaxial cable kit shall include all coaxial connectors, cable tying straps, heat shrink tabbing, hangers, clamps, etc., required to accomplish a neat and secure installation.
4. Wire and Cable: The wire and cable kit shall include all connectors and terminals, audio spade lugs, barrier straps, punch blocks, wire wrap strips, heat shrink tubing, tie wraps, solder, hangers, clamps, labels etc., required to accomplish a neat and orderly installation.
5. Conduit, Cable Duct, and Cable Tray: The kit shall include all conduit, duct, trays, junction boxes, back boxes, cover plates, feed through nipples, hangers, clamps, other hardware required to accomplish a neat and secure conduit, cable duct, and/or cable tray installation in accordance with the NEC and this document.
6. Equipment Interface: The equipment kit shall include any item or quantity of equipment, cable, mounting hardware and materials needed to interface the systems with the identified sub-system(s) according to the OEM requirements and this document.

7. Labels: The labeling kit shall include any item or quantity of labels, tools, stencils, and materials needed to label each subsystem according to the OEM requirements, as-installed drawings, and this document.
8. Documentation: The documentation kit shall include any item or quantity of items, computer discs, as installed drawings, equipment, maintenance, and operation manuals, and OEM materials needed to provide the system documentation as required by this document and explained herein.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electronic safety and security equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to piping systems installed at a required slope.

F. Equipment location shall be as close as practical to locations shown on the drawings.

G. Inaccessible Equipment:

1. Where the Government determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to the Government.
2. "Conveniently accessible" is defined as being capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.

3.2 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electronic safety and security installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section 07 84 00 "Firestopping."

3.3 COMMISIONING

A. Provide commissioning documentation in accordance with the requirements of Section 28 08 00 – COMMISIONIN OF ELECTRONIC SAFETY AND SECURITY SYSTEMS for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.

B. Components provided under this section of the specification will be tested as part of a larger system. Refer to section 28 08 00 – COMMISIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS and related sections for contractor responsibilities for system commissioning.

3.4 DEMONSTRATION AND TRAINING

A. Training shall be provided in accordance with Article, INSTRUCTIONS, of Section 01 00 00, GENERAL REQUIREMENTS.

B. Training shall be provided for the particular equipment or system as required in each associated specification.

C. A training schedule shall be developed and submitted by the contractor and approved by the COR at least 30 days prior to the planned training.

D. Provide services of manufacturer’s technical representative for 8 hours to instruct VA personnel in operation and maintenance of units.

E. Submit training plans and instructor qualifications in accordance with the requirements of Section 28 08 00 – COMMISIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS.

3.5 WORK PERFORMANCE

A. Job site safety and worker safety is the responsibility of the contractor.

B. For work on existing stations, arrange, phase and perform work to assure electronic safety and security service for other buildings at all times. Refer to Article OPERATIONS AND STORAGE AREAS under Section 01 00 00, GENERAL REQUIREMENTS.

C. New work shall be installed and connected to existing work neatly and carefully. Disturbed or damaged work shall be replaced or repaired to its prior conditions, as required by Section 01 00 00, GENERAL REQUIREMENTS.

D. Coordinate location of equipment and conduit with other trades to minimize interferences. See the GENERAL CONDITIONS.

3.6 SYSTEM PROGRAMMING

A. General Programming Requirements

1. This following section shall be used by the contractor to identify the anticipated level of effort (LOE) required setup, program, and configure the Electronic Security System (ESS). The contractor shall be responsible for providing all setup, configuration, and programming to include data entry for the Security Management System (SMS) and subsystems (e.g., video matrix switch, intercoms, digital video recorders, intrusion devices, including integration of subsystems to the SMS (e.g., camera call up, time synchronization, intercoms). System programming for existing or new SMS servers shall not be conducted at the project site.

B. Level of Effort for Programming

1. The Contractor shall perform and complete system programming (including all data entry) at an offsite location using the Contractor’s own copy of the SMS software. The Contractor’s copy of the SMS software shall be of the Owners current version. Once system programming has been completed, the Contractor shall deliver the data to the COR on data entry forms and an approved electronic medium, utilizing data from the contract documents. The completed forms shall be delivered to the COR for review and approval at least 90 calendar days prior to the scheduled date the Contractor requires it. The Contractor shall not upload system programming until the COR has provided written approval. The Contractor is responsible for backing up the system prior to uploading new programming data. Additional programming requirements are provided as follows:

a. Programming for New SMS Server: The contractor shall provide all other system related programming. The contractor will be responsible for uploading personnel information (e.g., ID Cards backgrounds, names, access privileges, personnel photos, access

schedules, personnel groupings) along with coordinating with COR for device configurations, standards, and groupings. VA shall provide database to support Contractor's data entry tasks. The contractor shall anticipate a weekly coordination meeting and working with COR to ensure data uploading is performed without incident of loss of function or data loss.

b. Programming for Existing SMS Servers: The contractor shall perform all related system programming except for personnel data as noted. The contractor will not be responsible for uploading personnel information (e.g., ID Cards backgrounds, names, access privileges, access schedules, personnel groupings). The contractor shall anticipate a weekly coordination meeting and working alongside of COR to ensure data uploading is performed without incident of loss of function or data loss. System programming for SMS servers shall be performed by using the Contractor's own server and software. These servers shall not be connected to existing devices or systems at any time.

2. The Contractor shall identify and request from the COR, any additional data needed to provide a complete and operational system as described in the contract documents.
3. Contractor and COR coordination on programming requires a high level of coordination to ensure programming is performed in accordance with VA requirements and programming uploads do not disrupt existing systems functionality. The contractor shall anticipate a minimum a weekly coordination meeting. Contractor shall ensure data uploading is performed without incident of loss of function or data loss. The following Level of Effort Chart is provided to communicate the expected level of effort required by contractors on VA ESS projects. Calculations to determine actual levels of effort shall be confirmed by the contractor before project award.

Description of Tasks

Description of Systems	Develop System Loading Sheets	Coordination	Initial Set-up Configuration	Graphic Maps	System Programming	Final Checks	Level of Effort (Typical Tasks)

SMS Setup & Configuration	e.g., program monitoring stations, programming networks, interconnections between CCTV, intercoms, time synchronization	e.g., retrieve IP addresses, naming conventions, standard event descriptions, programming templates, coordinate special system needs	e.g., Load system Operating System and Application software, general system configurations	e.g., develop naming conventions, develop file folders, confirming accuracy of AutoCAD Floor Plans, convert file into jpeg file	e.g., program monitoring stations, programming networks, interconnections between CCTV, intercoms, time synchronization	e.g., check all system diagnostics (e.g., clients, panels)	Load and set-up 4-6 CDs and configure servers (to configure Loading and Configuring software Administrative account, audit log, Keystrokes, mouse clicks, multi-screen configuration

Electronic Entry Control Systems	PART 1 - e.g., setup of device, door groups & schedules, REX, Locks, link graphics	PART 2 - e.g., confirming device configurations, naming conventions, event description and narratives	PART 3 - e.g., enter data from loading sheets; configure components, link events, cameras, and graphics		PART .g., setup of device, door groups & schedules, REX, Locks, link graphics	PART 5 - .g., performing entry testing to confirm correct set-up and configuration	PART 6 - e.g., creating a door, door configuration, adding request to exit, door monitors and relays, door timers, door related events (e.g., access, access denied, forced open, held open), linkages, controlled areas, advanced door monitoring, time zones, sequence of operations

Intrusion Detection Systems	PART 7 - e.g., enter door groups & schedules, link devices - REX, lock, & graphics	PART 8 - e.g., confirming device configurations, naming conventions, event description and narratives	PART 9 - e.g., enter data from loading sheets; configure components, link events, cameras, and graphics		PART .g., enter door groups & schedules, link devices - REX, lock, & graphics	PART 11 .g., walk test, device position, and masking	PART 12 - e.g., setting up monitoring and control points (e.g., motion sensors, glassbreaks, vibration sensor, strobes, sounders) creating intrusion zones, creating arm/disarm panel, timed sequences, time zones, icon placements on graphic maps, clearance levels, events (e.g., armed, disarmed, zone violation, device alarm activations), LCD reader messages,

CCTV Systems	PART 13 - .g., programming call-ups recording	PART 14 - .g., confirming device configurations, naming conventions	PART 15 - .g., enter data from loading sheets; camera naming convention, sequences, configure components)		PART .g., programming call-ups recording	PART 17 .g., confirm area of coverage, call-up per event generated and recording rates	PART 18 - e.g., setting up cameras points, recording ratios (e.g., normal, alarm event) timed recording, linkages, maps placements, call-ups
Intercoms Systems	PART 19 - .g., programming events & call-ups	PART 20 - .g., confirming device configurations, naming conventions, event description and narratives	PART 21 - .g., enter data from loading sheets; configure components, link events, cameras, and graphics		PART .g., programming events & call-ups	PART 23 .g., confirm operation, SMS event generation and camera call-up	PART 24 - e.g., setup linkages, events for activations, device troubles, land devices on graphic maps

Conso le Monit oring Compo nents	PART 25 - /A	PART 26 - er monitor	PART 27 - er monitor	PART 28 - er graphic map	PART /A	PART 30 er monito r	PART 31 - N/A
Note: Programming tasks are supported through the contractor's development of the Technical Data Package Submittals.							

Table 1 Contractor Level of Effort

3.7 TESTING AND ACCEPTANCE

A. Performance Requirements

1. General:

   a. The Contractor shall perform contract field, performance verification, and endurance testing and make adjustments of the completed security system when permitted. The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform all testing. Written notification of planned testing shall be given to the COR at least 60 calendar days prior to the test and after the Contractor has received written approval of the specific test procedures.

   b. The COR shall witness all testing and system adjustments during testing. Written permission shall be obtained from the COR before proceeding with the next phase of testing. Original copies of all data produced during performance verification and endurance testing shall be turned over to the COR at the conclusion of each phase of testing and prior to COR approval of the test.

2. Test Procedures and Reports: The test procedures, compliant w/ VA standard test procedures, shall explain in detail, step-by-step actions and expected results demonstrating compliance with the requirements of the specification. The test reports shall be used to document results of the tests. The reports shall be delivered to the COR within seven (7) calendar days after completion of each test.

B. Pre-Delivery Testing

1. The purpose of the pre-delivery test is to establish that a system is suitable for installation. As such, pre-delivery test shall be a mock-up of the system as planned in the contract documents. The Contractor shall assemble the Security Test System at the Contractors local project within 50-miles of the project site, and perform tests to demonstrate the performance of the system complies with the contract requirements in accordance with the approved pre-delivery test procedures. The tests shall take place during regular daytime working hours on weekdays. Model numbers of equipment tested shall be identical to those to be delivered to the site. Original copies of all data produced during pre-delivery testing, including results of each test procedure, shall be documented and delivered to the COR at the conclusion of pre-delivery testing and prior to COR's approval of the test. The test report shall be arranged so all commands, stimuli, and responses are correlated to allow logical interpretation. For Existing System modifications, the contractor shall provide their own server with loaded applicable software to support PDT.
2. Test Setup: The pre-delivery test setup shall include the following:
   a. All console equipment.
      1) At least one of each type of data transmission media (DTM) and associated equipment to provide a fully integrated PACS.
      2) The number of local processors shall equal the amount required by the site design.
      3) Enough sensor simulators to provide alarm signal inputs to the system equal to the number of sensors required by the design. The alarm signals shall be manually or software generated.
      4) Contractor to prove to owner all systems are appropriately sized and configured as sized.
      5) Integration of VASS, intercom systems, other subsystems.
3. During the bidding process the contractor shall submit a request for information to the Owner to determine if a pre-delivery test will be required. If a pre-delivery test is not required, the contractor

shall provide a written notification that the Pre-delivery Test is not required in their shop drawings submission.

C. Intermediate Testing

1. After completion of 30-50 percent of the installation of ESS cabinet(s) and equipment, one local and remote control stations and prior to any further work, this portion of the system must be pretested, inspected, and certified. Each item of installed equipment shall be checked to ensure appropriate FCC listing & UL certification labels are affixed, NFPA, Emergency, Safety, and JCAHCO guidelines are followed, and proper installation practices are followed. The intermediate test shall include a full operational test.

D. The inspection and test will be conducted by a factory-certified contractor representative and witnessed by a Government Representative. The results of the inspection will be officially recorded by a designated Government Representative and maintained on file by the COR (RE), until completion of the entire project. The results will be compared to the Acceptance Test results.

E. Contractor’s Field Testing (CFT)

1. The Contractor shall calibrate and test all equipment, verify DTM operation, place the integrated system in service, and test the integrated system. Ground rods installed by this Contractor within the base of camera poles shall be tested as specified in IEEE STD 142. The Contractor shall test all security systems and equipment, and provide written proof of a 100% operational system before a date is established for the system acceptance test. Documentation package for CFT shall include completed (fully annotated details of test details) for each device and system tested, and annotated loading sheets documenting complete testing to COR approval. CFT test documentation package shall conform to submittal requirements outlined in this Section. The Contractor’s field testing procedures shall be identical to the COR’s acceptance testing procedures. The Contractor shall provide the COR with a written listing of all equipment and software indicating all equipment and components have been tested and passed. The Contractor shall deliver a written report to theCOR stating the installed complete system has been

calibrated, tested, and is ready to begin performance verification testing; describing the results of the functional tests, diagnostics, and calibrations; and the report shall also include a copy of the approved acceptance test procedure. Performance verification testing shall not take place until written notice by contractor is received certifying that a contractors field test was successful.

F. Performance Verification Test (PVT)

1. Test team:

a. After the system has been pretested and the Contractor has submitted the pretest results and certification to the COR, then the Contractor shall schedule an acceptance test to date and give the COR written, notice as described herein, prior to the date the acceptance test is expected to begin. The system shall be tested in the presence of a Government Representative, an OEM certified representative, representative of the Contractor and other approved by the COR. The system shall be tested utilizing the approved test equipment to certify proof of performance, FCC, UL and Emergency Service compliance. The test shall verify that the total system meets all the requirements of this specification. The notification of the acceptance test shall include the expected length (in time) of the test.

2. The Contractor shall demonstrate the completed Physical Access Control System PACS complies with the contract requirements. In addition, the Contractor shall provide written certification that the system is 100% operational prior to establishing a date for starting PVT. Using approved test procedures, all physical and functional requirements of the project shall be demonstrated and shown. The PVT will be stopped and aborted as soon as 10 technical deficiencies are found requiring correction. The Contractor shall be responsible for all travel and lodging expenses incurred for out-of-town personnel required to be present for resumption of the PVT. If the acceptance test is aborted, the re-test will commence from the beginning with a retest of components previously tested and accepted.

3. The PVT, as specified, shall not begin until receipt of written certification that the Contractors Field Testing was successful. This shall include certification of successful completion of testing as specified in paragraph "Contractor's Field Testing", and upon successful completion of testing at any time when the system fails to perform as specified. Upon termination of testing by the COR or Contractor, the Contractor shall commence an assessment period as described for Endurance Testing Phase II.
4. Upon successful completion of the acceptance test, the Contractor shall deliver test reports and other documentation, as specified, to the COR prior to commencing the endurance test.
5. Additional Components of the PVT shall include:
   a. System Inventory
      1) All Device equipment
      2) All Software
      3) All Logon and Passwords
      4) All Cabling System Matrices
      5) All Cable Testing Documents
      6) All System and Cabinet Keys
   b. Inspection
      1) Contractor shall record an inspection punch list noting all system deficiencies. The contractor shall prepare an inspection punch list format for CORs approval.
      2) As a minimum the punch list shall include a listing of punch list items, punch list item location, description of item problem, date noted, date corrected, and details of how item was corrected.
6. Partial PVT - At the discretion of COR, the Performance Verification Test may be performed in part should a 100% compliant CFT be performed. In the event that a partial PVT will be performed instead of a complete PVT; the partial PVT shall be performed by testing 10% of the system. The contractor shall perform a test of each procedure on select devices or equipment.

G. Endurance Test
1. The Contractor shall demonstrate the specified probability of detection and false alarm rate requirements of the completed system.

The endurance test shall be conducted in phases as specified below. The endurance test shall not be started until the COR notifies the Contractor, in writing, that the performance verification test is satisfactorily completed, training as specified has been completed, and correction of all outstanding deficiencies has been satisfactorily completed. VA shall operate the system 24 hours per day, including weekends and holidays, during Phase I and Phase III endurance testing. VA will maintain a log of all system deficiencies. The COR may terminate testing at any time the system fails to perform as specified. Upon termination of testing, the Contractor shall commence an assessment period as described for Phase II. During the last day of the test, the Contractor shall verify the appropriate operation of the system. Upon successful completion of the endurance test, the Contractor shall deliver test reports and other documentation as specified to the COR prior to acceptance of the system.

2. Phase I (Testing): The test shall be conducted 24 hours per day for 15 consecutive calendar days, including holidays, and the system shall operate as specified. The Contractor shall make no repairs during this phase of testing unless authorized in writing by the COR. If the system experiences no failures, the Contractor may proceed directly to Phase III testing after receiving written permission from the COR.
3. Phase II (Assessment):
   a. After the conclusion of Phase I, the Contractor shall identify all failures, determine causes of all failures, repair all failures, and deliver a written report to the COR. The report shall explain in detail the nature of each failure, corrective action taken, results of tests performed, and recommend the point at which testing should be resumed.
   b. After delivering the written report, the Contractor shall convene a test review meeting at the job site to present the results and recommendations to the COR. The meeting shall not be scheduled earlier than five (5) business days after the COR receives the report. As part of this test review meeting, the Contractor shall demonstrate all failures have been corrected by performing

appropriate portions of the performance verification test. Based on the Contractor's report and the test review meeting, the COR will provide a written determine of either the restart date or require Phase I be repeated.

4. Phase III (Testing): The test shall be conducted 24 hours per day for 15 consecutive calendar days, including holidays, and the system shall operate as specified. The Contractor shall make no repairs during this phase of testing unless authorized in writing by the COR.
5. Phase IV (Assessment):
   a. After the conclusion of Phase III, the Contractor shall identify all failures, determine causes of all failures, repair all failures, and deliver a written report to the COR. The report shall explain in detail the nature of each failure, corrective action taken, results of tests performed, and recommend the point at which testing should be resumed.
   b. After delivering the written report, the Contractor shall convene a test review meeting at the job site to present the results and recommendations to the COR. The meeting shall not be scheduled earlier than five (5) business days after receipt of the report by the COR. As a part of this test review meeting, the Contractor shall demonstrate that all failures have been corrected by repeating appropriate portions for the performance verification test. Based on the review meeting the test should not be scheduled earlier than five (5) business days after the COR receives the report. As a part of this test review meeting, the Contractor shall demonstrate all failures have been corrected by repeating appropriate portions of the performance verification test. Based on the Contractor's report and the test review meeting, the COR will provide a written determine of either the restart date or require Phase III be repeated. After the conclusion of any re-testing which the COR may require, the Phase IV assessment shall be repeated as if Phase III had just been completed.

H. Exclusions

1. The Contractor will not be held responsible for failures in system performance resulting from the following:
   a. An outage of the main power in excess of the capability of any backup power source provided the automatic initiation of all backup sources was accomplished and that automatic shutdown and restart of the PACS performed as specified.
   b. Failure of an Owner furnished equipment or communications link, provided the failure was not due to Contractor furnished equipment, installation, or software.
   c. Failure of existing Owner owned equipment, provided the failure was not due to Contractor furnished equipment, installation, or software.

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10-01-18

SECTION 28 05 13

CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the finishing, installation, connection, testing and certification the conductors and cables required for a fully functional for electronic safety and security (ESS) system.

1.2 RELATED WORK

A. Section 01 00 00 - GENERAL REQUIREMENTS. For General Requirements.

B. Section 07 84 00 - FIRESTOPPING. Requirements for firestopping application and use.

C. Section 28 05 00 – COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY. Requirements for general requirements that are common to more than one section in Division 28.

D. Section 28 05 26 - GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.

E. Section 28 05 28.33 - CONDUITS AND BOXES FOR ELECTRONIC SECURITY AND SAFETY. Requirements for infrastructure.

F. Section 28 08 00 - COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS. Requirements for commissioning.

1.3 DEFINITIONS

A. BICSI: Building Industry Consulting Service International.

B. EMI: Electromagnetic interference.

C. IDC: Insulation displacement connector.

D. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).

E. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.

F. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).

G. RCDD: Registered Communications Distribution Designer.

H. Solid-Bottom or Nonventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal side rails, and a bottom without ventilation openings.

I. Trough or Ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal rails and a bottom having openings sufficient for the passage of air and using 75 percent or less of the plan area of the surface to support cables.

J. UTP: Unshielded twisted pair.

1.4 QUALITY ASSURANCE

A. See section 28 05 00, Paragraph 1.4.

1.5 SUBMITTALS

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

1. Manufacturer's Literature and Data: Showing each cable type and rating.
2. Certificates: Two weeks prior to final inspection, deliver to the COR four copies of the certification that the material is in accordance with the drawings and specifications and diagrams for cable management system.
3. Shop Drawings: Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
   a. Vertical and horizontal offsets and transitions.
   b. Clearances for access above and to side of cable trays.
   c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
   d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.
   e. System labeling schedules, including electronic copy of labeling schedules that are part of the cable and asset identification system of the software specified in Parts 2 and 3.
4. Wiring Diagrams. Show typical wiring schematics including the following:
   a. Workstation outlets, jacks, and jack assemblies.
   b. Patch cords.

c. Patch panels.

5. Cable Administration Drawings: As specified in Part 3 "Identification" Article.
6. Project planning documents as specified in Part 3.
7. Maintenance Data: For wire and cable to include in maintenance manuals.

1.6 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are reference in the text by the basic designation only.

B. American Society of Testing Material (ASTM):

D2301-04.....Standard Specification for Vinyl Chloride Plastic Pressure Sensitive Electrical Insulating Tape

C. Federal Specifications (Fed. Spec.):

A-A-59544-08.....Cable and Wire, Electrical (Power, Fixed Installation)

D. National Fire Protection Association (NFPA):

70-20.....National Electrical Code (NEC)

E. Underwriters Laboratories, Inc. (UL):

44-05.....Thermoset-Insulated Wires and Cables
83-08.....Thermoplastic-Insulated Wires and Cables
467-07.....Electrical Grounding and Bonding Equipment
486A-03.....Wire Connectors and Soldering Lugs for Use with Copper Conductors
486C-04.....Splicing Wire Connectors
486D-05.....Insulated Wire Connector Systems for Underground Use or in Damp or Wet Locations
486E-00.....Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors
493-07.....Thermoplastic-Insulated Underground Feeder and Branch Circuit Cable
514B-04.....Fittings for Cable and Conduit
1479-03.....Fire Tests of Through-Penetration Fire Stops

1.7 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test optical fiber cable to determine the continuity of the strand end to end. Use optical loss test set.
2. Test optical fiber cable on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector; include the loss value of each. Retain test data and include the record in maintenance data.
3. Test each pair of UTP cable for open and short circuits.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install UTP, optical fiber, and coaxial cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 GENERAL

A. General: All cabling locations shall be in conduit systems as outlined in Division 28 unless a waiver is granted in writing or an exception is noted on the construction drawings.

B. Support of Open Cabling: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.

1. Support brackets with cable tie slots for fastening cable ties to brackets.
2. Lacing bars and spools.
3. Straps and other devices.

C. Cable Trays:

1. Cable Tray Materials: Metal, suitable for indoors, and protected against corrosion by electroplated zinc galvanizing, complying with ASTM B 633, Type 1, not less than 0.000472 inch (0.012 mm) thick.
2. Basket Cable Trays: 6 inches (150 mm) wide and 2 inches (50 mm) deep. Wire mesh spacing shall not exceed 2 by 4 inches (50 by 100 mm).
3. Trough Cable Trays: Nominally 6 inches (150 mm) wide.

4. Ladder Cable Trays: Nominally 18 inches (455 mm) wide, and a rung spacing of 12 inches (305 mm).
5. Channel Cable Trays: One-piece construction, nominally 4 inches (100 mm) wide. Slot spacing shall not exceed 4-1/2 inches (115 mm) o.c.
6. Solid-Bottom Cable Trays: One-piece construction, nominally 12 inches (305 mm) wide. Provide with solid covers.

D. Conduit and Boxes: Comply with requirements in Division 28 Section "Conduits and Backboxes for Electrical Systems." Flexible metal conduit shall not be used.
1. Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.

2.2 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements for plywood backing panels in Division 06 Section "Rough Carpentry".

2.3 UTP CABLE

A. Description: 100-ohm, 4-pair UTP, formed into 25-pair binder groups covered with a blue thermoplastic jacket.
1. Comply with ICEA S-90-661 for mechanical properties.
2. Comply with TIA/EIA-568-B.1 for performance specifications.
3. Comply with TIA/EIA-568-B.2, Category 6.
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
a. Communications, General Purpose: Type CM or CMG.
b. Communications, Plenum Rated: Type CMP, complying with NFPA 262.
c. Communications, Riser Rated: Type CMR, complying with UL 1666.
d. Communications, Limited Purpose: Type CMX.
e. Multipurpose: Type MP or MPG.
f. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.
g. Multipurpose, Riser Rated: Type MPR or MPP, complying with UL 1666.

2.4 UTP CABLE HARDWARE

A. UTP Cable Connecting Hardware: IDC type, using modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of the same category or higher.

B. Connecting Blocks: 110-style for Category 6. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.

2.5 OPTICAL FIBER CABLE

A. Description: Multimode, 50/125-micrometer, 24-fiber, nonconductive, tight buffer, optical fiber cable.

1. Comply with ICEA S-83-596 for mechanical properties.
2. Comply with TIA/EIA-568-B.3 for performance specifications.
3. Comply with TIA/EIA-492AAAA-B for detailed specifications.
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
   a. General Purpose, Nonconductive: Type OFN or OFNG.
   b. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
   c. Riser Rated, Nonconductive: Type OFNR, complying with UL 1666.
   d. General Purpose, Conductive: Type OFC or OFCG.
   e. Plenum Rated, Conductive: Type OFCP, complying with NFPA 262.
   f. Riser Rated, Conductive: Type OFCR, complying with UL 1666.
5. Conductive cable shall be steel armored type.
6. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.
7. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.

B. Jacket:

1. Jacket Color: Aqua for 50/125-micrometer cable.
2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA-598-B.
3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

2.6 OPTICAL FIBER CABLE HARDWARE

A. Cable Connecting Hardware: Meet the Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.

1. Quick-connect, simplex and duplex, Type LC connectors. Insertion loss shall be not more than 0.75 dB.
2. Type SFF connectors may be used in termination racks, panels, and equipment packages.

2.7 COAXIAL CABLE

A. General Coaxial Cable Requirements: Broadband type, recommended by cable manufacturer specifically for broadband data transmission applications. Coaxial cable and accessories shall have 75-ohm nominal impedance with a return loss of 20 dB maximum from 7 to 806 MHz.

B. RG-11/U: NFPA 70, Type CATV.

1. No. 14 AWG, solid, copper-covered steel conductor.
2. Gas-injected, foam-PE insulation.
3. Double shielded with 100 percent aluminum polyester tape and 60 percent aluminum braid.
4. Jacketed with sunlight-resistant, black PVC or PE.
5. Suitable for outdoor installations in ambient temperatures ranging from minus 40 to plus 85 deg C.

C. RG59/U: NFPA 70, Type CATVR.

1. No. 20 AWG, solid, silver-plated, copper-covered steel conductor.
2. Gas-injected, foam-PE insulation.
3. Triple shielded with 100 percent aluminum polyester tape and 95 percent aluminum braid; covered by aluminum foil with grounding strip.
4. Color-coded PVC jacket.

D. RG-6/U: NFPA 70, Type CATV or CM.

1. No. 16 AWG, solid, copper-covered steel conductor; gas-injected, foam-PE insulation.
2. Double shielded with 100 percent aluminum-foil shield and 60 percent aluminum braid.
3. Jacketed with black PVC or PE.
4. Suitable for indoor installations.

E. RG59/U: NFPA 70, Type CATV.
   1. No. 20 AWG, solid, copper-covered steel conductor; gas-injected, foam-PE insulation.
   2. Double shielded with 100 percent aluminum polyester tape and 40 percent aluminum braid.
   3. PVC jacket.
F. RG59/U (Plenum Rated): NFPA 70, Type CMP.
   1. No. 20 AWG, solid, copper-covered steel conductor; foam fluorinated ethylene propylene insulation.
   2. Double shielded with 100 percent aluminum-foil shield and 65 percent aluminum braid.
   3. Copolymer jacket.
G. NFPA and UL compliance, listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1655, and with NFPA 70 "Radio and Television Equipment" and "Community Antenna Television and Radio Distribution" Articles. Types are as follows:
   1. CATV Cable: Type CATV.
   2. CATV Plenum Rated: Type CATVP, complying with NFPA 262.
   3. CATV Riser Rated: Type CATVR, complying with UL 1666.
   4. CATV Limited Rating: Type CATVX.

2.8 COAXIAL CABLE HARDWARE

A. Coaxial-Cable Connectors: Type BNC, 75 ohms.

2.9 RS-232 CABLE

A. Standard Cable: NFPA 70, Type CM.
   1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
   2. Polypropylene insulation.
   3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
   4. PVC jacket.
   5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
   6. Flame Resistance: Comply with UL 1581.
B. Plenum-Rated Cable: NFPA 70, Type CMP.

1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
2. Plastic insulation.
3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
4. Plastic jacket.
5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
6. Flame Resistance: Comply with NFPA 262.

2.10 RS-485 CABLE

A. Standard Cable: NFPA 70, Type CM.
1. Paired, 2 pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1581.

B. Plenum-Rated Cable: NFPA 70, Type CMP.
1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
2. Fluorinated ethylene propylene insulation.
3. Unshielded.
4. Fluorinated ethylene propylene jacket.
5. Flame Resistance: NFPA 262, Flame Test.

2.11 LOW-VOLTAGE CONTROL CABLE

A. Paired Lock Cable: NFPA 70, Type CMG.
1. 1 pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1581.

B. Plenum-Rated, Paired Lock Cable: NFPA 70, Type CMP.
1. 1 pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors.

2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with NFPA 262.

C. Paired Lock Cable: NFPA 70, Type CMG.
1. 1 pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1581.

D. Plenum-Rated, Paired Lock Cable: NFPA 70, Type CMP.
1. 1 pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors.
2. Fluorinated ethylene propylene insulation.
3. Unshielded.
4. Plastic jacket.
5. Flame Resistance: NFPA 262, Flame Test.

2.12 CONTROL-CIRCUIT CONDUCTORS

A. Class 1 Control Circuits: Stranded copper, Type THHN-THWN, in raceway complying with UL 83.

B. Class 2 Control Circuits: Stranded copper, Type THHN-THWN, in raceway complying with UL 83.

C. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type TW or TF, complying with UL 83.

2.13 FIRE ALARM WIRE AND CABLE

A. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.

B. Signaling Line Circuits: Twisted, shielded pair, not less than size as recommended by system manufacturer.
1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a 2-hour rating.

C. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.

1. Low-Voltage Circuits: No. 16 AWG, minimum.
2. Line-Voltage Circuits: No. 12 AWG, minimum.
3. Multiconductor Armored Cable: NFPA 70, Type MC, copper conductors, Type TFN/THHN conductor insulation, copper drain wire, copper armor with outer jacket with red identifier stripe, NTRL listed for fire alarm and cable tray installation, plenum rated, and complying with requirements in UL 2196 for a 2-hour rating.

2.14 IDENTIFICATION PRODUCTS

A. Comply with UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.15 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test UTP and optical fiber cables on reels according to TIA/EIA-568-B.1.

C. Factory test UTP cables according to TIA/EIA-568-B.2.

D. Factory test multimode optical fiber cables according to TIA/EIA-526-14-A and TIA/EIA-568-B.3.

E. Factory sweep test coaxial cables at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response, or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results.

F. Cable will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

2.16 WIRE LUBRICATING COMPOUND

A. Suitable for the wire insulation and conduit it is used with, and shall not harden or become adhesive.

B. Shall not be used on wire for isolated type electrical power systems.

2.17 FIREPROOFING TAPE

A. The tape shall consist of a flexible, conformable fabric of organic composition coated one side with flame-retardant elastomer.

B. The tape shall be self-extinguishing and shall not support combustion. It shall be arc-proof and fireproof.

C. The tape shall not deteriorate when subjected to water, gases, salt water, sewage, or fungus and be resistant to sunlight and ultraviolet light.

D. The finished application shall withstand a 200-ampere arc for not less than 30 seconds.

E. Securing tape: Glass cloth electrical tape not less than 0.18 mm (7 mils) thick, and 19 mm (3/4 inch) wide.

PART 3 - EXECUTION

3.1 INSTALLATION OF CONDUCTORS AND CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA/EIA-568-B.1.
2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
3. Install 110-style IDC termination hardware unless otherwise indicated.
4. Terminate all conductors; no cable shall contain un-terminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
6. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
8. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
9. Pulling Cable:
   a. Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

b. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling of cables.
c. Use ropes made of nonmetallic material for pulling feeders.
d. Attach pulling lines for feeders by means of either woven basket grips or pulling eyes attached directly to the conductors, as approved by the COR.
e. Pull in multiple cables together in a single conduit.

C. Splice cables and wires where necessary only in outlet boxes, junction boxes, or pull boxes.
1. Splices and terminations shall be mechanically and electrically secure.
2. Where the Government determines that unsatisfactory splices or terminations have been installed, remove the devices and install approved devices at no additional cost to the Government.

D. Seal cable and wire entering a building from underground, between the wire and conduit where the cable exits the conduit, with a non-hardening approved compound.

E. Unless otherwise specified in other sections install wiring and connect to equipment/devices to perform the required functions as shown and specified.

F. Except where otherwise required, install a separate power supply circuit for each system so that malfunctions in any system will not affect other systems.

G. Where separate power supply circuits are not shown, connect the systems to the nearest panel boards of suitable voltages, which are intended to supply such systems and have suitable spare circuit breakers or space for installation.

H. Install a red warning indicator on the handle of the branch circuit breaker for the power supply circuit for each system to prevent accidental de-energizing of the systems.

I. System voltages shall be 120 volts or lower where shown on the drawings or as required by the NEC.

J. UTP Cable Installation:
1. Comply with TIA/EIA-568-B.2.

2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

K. Optical Fiber Cable Installation:

1. Comply with TIA/EIA-568-B.3.
2. Cable shall be terminated on connecting hardware that is rack or cabinet mounted.

L. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend copper cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 60 inches (1525 mm) apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

M. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.
2. Install cabling after the flooring system has been installed in raised floor areas.
3. Coil cable 72 inches (1830 mm) long shall be neatly coiled not less than 12 inches (300 mm) in diameter below each feed point.

N. Outdoor Coaxial Cable Installation:

1. Install outdoor connections in enclosures complying with NEMA 250, Type 4X. Install corrosion-resistant connectors to keep out moisture.
2. Attach antenna lead-in cable to support structure at intervals not exceeding 36 inches (915 mm).

O. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (600 mm).

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
   a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (75 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
5. Separation between Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
6. Separation between Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.2 FIRE ALARM WIRING INSTALLATION

A. Comply with NECA 1 and NFPA 72.
B. Wiring Method: Install wiring in metal raceway according to Division 28 Section CONDUITS AND BACKBOXES FOR ELECTRICAL SYSTEMS."
   1. Install plenum cable in environmental air spaces, including plenum ceilings.

2. Fire alarm circuits and equipment control wiring associated with the fire alarm system shall be installed in a dedicated raceway system. This system shall not be used for any other wire or cable.

C. Wiring Method:

1. Cables and raceways used for fire alarm circuits, and equipment control wiring associated with the fire alarm system, may not contain any other wire or cable.
2. Fire-Rated Cables: Use of 2-hour, fire-rated fire alarm cables, NFPA 70, Types MI and CI, is permitted.
3. Signaling Line Circuits: Power-limited fire alarm cables may be installed in the same cable or raceway as signaling line circuits.

D. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

E. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.

F. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.

G. Risers: Install at least two vertical cable risers to serve the fire alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent the receipt or transmission of signals from other floors or zones.

H. Wiring to Remote Alarm Transmitting Device: 1-inch (25-mm) conduit between the fire alarm control panel and the transmitter. Install

number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.3 CONTROL CIRCUIT CONDUCTORS

A. Minimum Conductor Sizes:
   1. Class 1 remote-control and signal circuits, No. 14 AWG.
   2. Class 2 low-energy, remote-control and signal circuits, No. 16 AWG.
   3. Class 3 low-energy, remote-control, alarm and signal circuits, No. 12 AWG.

3.4 CONNECTIONS

A. Comply with requirements in Division 28 Section, PHYSICAL ACCESS CONTROL for connecting, terminating, and identifying wires and cables.
B. Comply with requirements in Division 28 Section "INTRUSION DETECTION" for connecting, terminating, and identifying wires and cables.
C. Comply with requirements in Division 28 Section "VIDEO SURVEILLANCE" for connecting, terminating, and identifying wires and cables.
D. Comply with requirements in Division 28 Section "ELECTRONIC PERSONAL PROTECTION SYSTEMS" for connecting, terminating, and identifying wires and cables.
E. Comply with requirements in Division 28 Section "FIRE DETECTION AND ALARM" for connecting, terminating, and identifying wires and cables.

3.5 FIRESTOPPING

A. Comply with requirements in Division 07 Section "PENETRATION FIRESTOPPING."
B. Comply with TIA/EIA-569-A, "Firestopping" Annex A.
C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.6 GROUNDING

A. For communications wiring, comply with ANSI-J-STD-607-A and with BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
B. For low-voltage wiring and cabling, comply with requirements in Division 28 Section "GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY."

3.7 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A.
B. Install a permanent wire marker on each wire at each termination.

C. Identifying numbers and letters on the wire markers shall correspond to those on the wiring diagrams used for installing the systems.

D. Wire markers shall retain their markings after cleaning.

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

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Visually inspect UTP and optical fiber cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA/EIA-568-B.1.

2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.

3. Test UTP cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross connection.

   a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

4. Optical Fiber Cable Tests:

   a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

   b. Link End-to-End Attenuation Tests:

1) Multimode Link Measurements: Test at 850 or 1300 nm in 1 direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.
2) Attenuation test results for links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.

5. Coaxial Cable Tests: Comply with requirements in Division 27 Section "Master Antenna Television System."

D. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.

E. End-to-end cabling will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

3.9 EXISTING WIRING

A. Unless specifically indicated on the plans, existing wiring shall not be reused for the new installation. Only wiring that conforms to the specifications and applicable codes may be reused. If existing wiring does not meet these requirements, existing wiring may not be reused and new wires shall be installed.

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SECTION 28 05 26

GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the finishing, installation, connection, testing and certification of the grounding and bonding required for a fully functional Electronic Safety and Security (ESS) system.

B. "Grounding electrode system" refers to all electrodes required by NEC, as well as including made, supplementary, grounding electrodes.

C. The terms "connect" and "bond" are used interchangeably in this specification and have the same meaning.

1.2 RELATED WORK

A. Section 01 00 00 - GENERAL REQUIREMENTS. For General Requirements.

B. Section 28 05 00 - REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATIONS. For general electrical requirements, quality assurance, coordination, and project conditions that are common to more than one section in Division 28.

C. Section 28 05 13 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for low voltage power and lighting wiring.

D. Section 28 08 00 - COMMISIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS. Requirements for commissioning.

1.3 SUBMITTALS

A. Submit in accordance with Section 28 05 00, COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY.

B. Shop Drawings:

1. Clearly present enough information to determine compliance with drawings and specifications.
2. Include the location of system grounding electrode connections and the routing of aboveground and underground grounding electrode conductors.

C. Test Reports: Provide certified test reports of ground resistance.

D. Certifications: Two weeks prior to final inspection, submit four copies of the following to the Contracting Officers Representative (COR):

1. Certification that the materials and installation are in accordance with the drawings and specifications.

2. Certification by the contractor that the complete installation has been properly installed and tested.

1.4 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

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

B1-07.....Standard Specification for Hard-Drawn Copper Wire

B3-07.....Standard Specification for Soft or Annealed Copper Wire

B8-04.....Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

C. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

81-1983.....IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

C2-07.....National Electrical Safety Code

D. National Fire Protection Association (NFPA):

70-20.....National Electrical Code (NEC)

99-21.....Health Care Facilities

E. Underwriters Laboratories, Inc. (UL):

44-05 .....Thermoset-Insulated Wires and Cables

83-08 .....Thermoplastic-Insulated Wires and Cables

467-07 .....Grounding and Bonding Equipment

486A-486B-03 .....Wire Connectors

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING CONDUCTORS

A. Equipment grounding conductors shall be UL 83 insulated stranded copper, except that sizes 6 mm² (10 AWG) and smaller shall be solid copper. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes 25 mm² (4 AWG) and larger shall be permitted to be identified per NEC.

B. Bonding conductors shall be ASTM B8 bare stranded copper, except that sizes 6 mm² (10 AWG) and smaller shall be ASTM B1 solid bare copper wire.

2.2 GROUND RODS

A. Copper clad steel, 19 mm (3/4-inch) diameter by 3000 mm (10 feet) long, conforming to UL 467.

B. Quantity of rods shall be as required to obtain the specified ground resistance.

2.3 SPLICES AND TERMINATION COMPONENTS

A. Components shall meet or exceed UL 467 and be clearly marked with the manufacturer, catalog number, and permitted conductor size(s).2.4 ground connections

B. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

C. Below Grade: Exothermic-welded type connectors.

D. Above Grade:

1. Bonding Jumpers: Compression-type connectors, using zinc-plated fasteners and external tooth lockwashers.
2. Connection to Building Steel: Exothermic-welded type connectors.
3. Ground Busbars: Two-hole compression type lugs, using tin-plated copper or copper alloy bolts and nuts.
4. Rack and Cabinet Ground Bars: One-hole compression-type lugs, using zinc-plated or copper alloy fasteners.
5. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts.
   a. Pipe Connectors: Clamp type, sized for pipe.
6. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.4 EQUIPMENT RACK AND CABINET GROUND BARS

A. Provide solid copper ground bars designed for mounting on the framework of open or cabinet-enclosed equipment racks with minimum dimensions of 4 mm thick by 19 mm wide (3/8 inch x ¾ inch).

2.5 GROUND TERMINAL BLOCKS

A. At any equipment mounting location (e.g., backboards and hinged cover enclosures) where rack-type ground bars cannot be mounted, provide screw lug-type terminal blocks.

2.6 SPLICE CASE GROUND ACCESSORIES

A. Splice case grounding and bonding accessories shall be supplied by the splice case manufacturer when available. Otherwise, use 16 mm² (6 AWG) insulated ground wire with shield bonding connectors.

2.7 COMPUTER ROOM GROUND

A. Provide 50mm2 (1/0 AWG) bare copper grounding conductors bolted at mesh intersections to form an equipotential grounding grid. The equipotential grounding grid shall form a 600mm (24 inch) mesh pattern. The grid shall be bonded to each of the access floor pedestals.

2.8 SECURITY CONTROL ROOM GROUND

A. Provide 50mm2 (1/0 AWG) stranded copper grounding conductor(s) color coded with a green jacket, bolted at the Room's Communications System Grounding Electrode Cooper Plate and circulate to each equipment rack ground buss bar through the wire management system. Connect each equipment rack, wire management system's cable tray, ladder, etc. to the circulating ground wire with a minimum 25mm2 (4AWG) stranded Cooper Wire, color coded with a green jacket.

1. Connect each equipment rack ground buss bar to the circulating ground wire a indicated in 2.9.A, and
2. Connect each additional room item to the circulating ground wire as indicated in 2.9.A.

PART 3 - EXECUTION

3.1 GENERAL

A. Ground in accordance with the NEC, as shown on drawings, and as specified herein.

B. System Grounding:

1. Secondary service neutrals: Ground at the supply side of the secondary disconnecting means and at the related transformers.
2. Separately derived systems (transformers downstream from the service entrance): Ground the secondary neutral.

C. Equipment Grounding: Metallic structures, including ductwork and building steel, enclosures, raceways, junction boxes, outlet boxes,

cabinets, machine frames, and other conductive items in close proximity with electrical circuits, shall be bonded and grounded.

3.2 INACCESSIBLE GROUNDING CONNECTIONS

A. Make grounding connections, which are buried or otherwise normally inaccessible (except connections for which periodic testing access is required) by exothermic weld.

3.3 CORROSION INHIBITORS

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

3.4 CONDUCTIVE PIPING

A. Bond all conductive piping systems, interior and exterior, to the building to the grounding electrode system. Bonding connections shall be made as close as practical to the equipment ground bus.

3.5 COMPUTER ROOM/SECURITY EQUIPMENT ROOM GROUNDING

A. Conduit: Ground and bond metallic conduit systems as follows:
   1. Ground metallic service conduit and any pipes entering or being routed within the computer room at each end using 16 mm² (6AWG) bonding jumpers.
   2. Bond at all intermediate metallic enclosures and across all joints using 16 mm² (6 AWG) bonding jumpers.

3.6 WIREWAY GROUNDING

A. Ground and Bond Metallic Wireway Systems as follows:
   1. Bond the metallic structures of wireway to provide 100 percent electrical continuity throughout the wireway system by connecting a 16 mm² (6 AWG) bonding jumper at all intermediate metallic enclosures and across all section junctions.
   2. Install insulated 16 mm² (6 AWG) bonding jumpers between the wireway system bonded as required in paragraph 1 above, and the closest building ground at each end and approximately every 16 meters (50 feet).
   3. Use insulated 16 mm² (6 AWG) bonding jumpers to ground or bond metallic wireway at each end at all intermediate metallic enclosures and cross all section junctions.
   4. Use insulated 16 mm² (6 AWG) bonding jumpers to ground cable tray to column-mounted building ground plates (pads) at each end and approximately every 15 meters.

3.7 LIGHTNING PROTECTION SYSTEM

A. Bond the lightning protection system to earth ground externally to the building. Under no condition shall the electrical system's third of fourth ground electrode system, or the telecommunications system circulating ground system be connected to the lightning protection system. The Facility's structural steel may be used to connected the lightning protection system at the direction of the COR certified by an independent certified grounding contractor.

3.8 EXTERIOR LIGHT/CAMERA POLES

A. Provide 20 ft of No. 4 bare copper coiled at bottom of pole base excavation prior to pour, plus additional unspliced length in and above foundation as required to reach pole ground stud.

3.9 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. Resistance of the grounding electrode system shall be measured using a four-terminal fall-of-potential method as defined in IEEE 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not fewer than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

C. Services at power company interface points shall comply with the power company ground resistance requirements.

D. Below-grade connections shall be visually inspected by the COR prior to backfilling. The contractor shall notify the COR 24 hours before the connections are ready for inspection.

3.10 GROUND ROD INSTALLATION

A. Drive each rod vertically in the earth, not less than 3000 mm (10 feet) in depth.

B. Where permanently concealed ground connections are required, make the connections by the exothermic process to form solid metal joints. Make

accessible ground connections with mechanical pressure type ground connectors.

C. Where rock prevents the driving of vertical ground rods, install angled ground rods or grounding electrodes in horizontal trenches to achieve the specified resistance.

3.11 GROUNDING FOR RF/EMI CONTROL

A. Install bonding jumpers to bond all conduit, cable trays, sleeves and equipment for low voltage signaling and data communications circuits. Bonding jumpers shall consist of 100 mm (4 inches) wide copper strip or two 6 mm² (10 AWG) copper conductors spaced minimum 100 mm (4 inches) apart. Use 16 mm² (6 AWG) copper where exposed and subject to damage.

B. Comply with the following when shielded cable is used for data circuits.

1. Shields shall be continuous throughout each circuit.
2. Connect shield drain wires together at each circuit connection point and insulate from ground. Do not ground the shield.
3. Do not connect shields from different circuits together.
4. Shield shall be connected at one end only. Connect shield to signal reference at the origin of the circuit. Consult with equipment manufacturer to determine signal reference.

3.12 LABELING

A. Comply with requirements in Division 26 Section "ELECTRICAL IDENTIFICATION" Article for instruction signs. The label or its text shall be green.

B. Install labels at the telecommunications bonding conductor and grounding equalizer and at the grounding electrode conductor where exposed.

1. Label Text: "If this connector or cable is loose or if it must be removed for any reason, notify the facility manager."

3.13 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.

3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal at individual ground rods. Make tests at ground rods before any conductors are connected.
   a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
   b. Perform tests by fall-of-potential method according to IEEE 81.

C. Grounding system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. Report measured ground resistances that exceed the following values:
   1. Power Distribution Units or Panel boards Serving Electronic Equipment: 3 ohm(s).
   2. Manhole Grounds: 10 ohms.

F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

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SECTION 28 05 28.33

CONDUITS AND BACKBOXES FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the finishing, installation, connection, testing certification of the conduit, fittings, and boxes to form a complete, coordinated, raceway system(s). Conduits and when approved separate UL Certified and Listed partitioned telecommunications raceways are required for a fully functional Electronic Safety and Security (ESS) system. Raceways are required for all electronic safety and security cabling 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 01 00 00 - GENERAL REQUIREMENTS. For General Requirements.

B. Section 06 10 00 - ROUGH CARPENTRY. Requirements for mounting board for communication closets.

C. Section 07 84 00 - FIRESTOPPING. Requirements for sealing around penetrations to maintain the integrity of fire rated construction.

D. Section 07 60 00 - FLASHING AND SHEET METAL. Requirements for fabrications for the deflection of water away from the building envelope at penetrations.

E. Section 07 92 00 - JOINT SEALANTS. Requirements for sealing around conduit penetrations through the building envelope to prevent moisture migration into the building.

F. Section 09 91 00 - PAINTING. Requirements for identification and painting of conduit and other devices.

G. Section 28 05 00 - COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY. For general electrical requirements, general arrangement of the contract documents, coordination, quality assurance, project conditions, equipment and materials, and items that is common to more than one section of Division 28.

H. Section 28 05 26 - GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.

I. Section 28 08 00 - COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS. Requirements for commissioning - systems readiness checklists, and training.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. ENT: Electrical nonmetallic tubing.

C. EPDM: Ethylene-propylene-diene terpolymer rubber.

D. FMC: Flexible metal conduit.

E. IMC: Intermediate metal conduit.

F. LFMC: Liquidtight flexible metal conduit.

G. LFNC: Liquidtight flexible nonmetallic conduit.

H. NBR: Acrylonitrile-butadiene rubber.

I. RNC: Rigid nonmetallic conduit.

1.4 QUALITY ASSURANCE

A. Refer to Paragraph 1.4 Quality Assurance, in Section 28 05 00, COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY.

1.5 SUBMITTALS

A. Submit in accordance with Section 28 05 00, COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY and Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. Furnish the following:

B. Shop Drawings:

1. Size and location of main feeders;
2. Size and location of panels and pull boxes
3. Layout of required conduit penetrations through structural elements.
4. The specific item proposed and its area of application shall be identified on the catalog cuts.

C. Certification: Prior to final inspection, deliver to the Contracting Officers Representative (COR) four copies of the certification that the material is in accordance with the drawings and specifications and has been properly installed.

D. Completed System Readiness Checklists provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 28 08 00 COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS.

E. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

F. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.
   1. Custom enclosures and cabinets.
   2. Handholes and boxes for underground wiring, including the following:
      a. Duct entry provisions, including locations and duct sizes.
      b. Frame and cover design.
      c. Grounding details.
      d. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.
      e. Joint details.

G. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
   1. Structural members in the paths of conduit groups with common supports.
   2. HVAC and plumbing items and architectural features in the paths of conduit groups with common supports.

H. Manufacturer Seismic Qualification Certification: Submit certification that enclosures and cabinets and their mounting provisions, including those for internal components, will withstand seismic forces defined in Division 16 Section "Electrical Supports and Seismic Restraints." Include the following:
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
      a. The term "withstand" means "the cabinet or enclosure will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will retain its enclosure characteristics, including its interior accessibility, after the seismic event."
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

I. Source quality-control test reports.

1.6 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent

referenced. Publications are referenced in the text by the basic designation only.

B. National Electrical Manufacturers Association (NEMA):

TC-3-04.....PVC Fittings for Use with Rigid PVC Conduit and Tubing

FB1-07.....Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable

C. National Fire Protection Association (NFPA):

70-20.....National Electrical Code (NEC)

D. Underwriters Laboratories, Inc. (UL):

1-05.....Flexible Metal Conduit

5-04.....Surface Metal Raceway and Fittings

6-07.....Rigid Metal Conduit

50-07.....Enclosures for Electrical Equipment

360-09.....Liquid-Tight Flexible Steel Conduit

467-07.....Grounding and Bonding Equipment

514A-04.....Metallic Outlet Boxes

514B-04.....Fittings for Cable and Conduit

514C-02.....Nonmetallic Outlet Boxes, Flush-Device Boxes and Covers

651-05.....Schedule 40 and 80 Rigid PVC Conduit

651A-07.....Type EB and A Rigid PVC Conduit and HDPE Conduit

797-07.....Electrical Metallic Tubing

1242-06.....Intermediate Metal Conduit

PART 2 - PRODUCTS

2.1 GENERAL

A. Conduit Size: In accordance with the NEC, but not less than 20 mm (3/4 inch) unless otherwise shown.

2.2 CONDUIT

A. Rigid galvanized steel: Shall Conform to UL 6, ANSI C80.1.

B. Rigid aluminum: Shall Conform to UL 6A, ANSI C80.5.

C. Rigid intermediate steel conduit (IMC): Shall Conform to UL 1242, ANSI C80.6.

D. Electrical metallic tubing (EMT): Shall Conform to UL 797, ANSI C80.3. Maximum size not to exceed 105 mm (4 inches) and shall be permitted only with cable rated 600 volts or less.

E. Flexible galvanized steel conduit: Shall Conform to UL 1.

F. Liquid-tight flexible metal conduit: Shall Conform to UL 360.

G. Direct burial plastic conduit: Shall conform to UL 651 and UL 651A, heavy wall PVC or high density polyethylene (PE).

2.3 WIREWAYS AND RACEWAYS

A. Surface metal raceway: Shall Conform to UL 5.

2.4 CONDUIT FITTINGS

A. Rigid steel and IMC conduit fittings:

1. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
2. Standard threaded couplings, locknuts, bushings, and elbows: Only steel or malleable iron materials are acceptable. Integral retractable type IMC couplings are also acceptable.
3. Locknuts: Bonding type with sharp edges for digging into the metal wall of an enclosure.
4. 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.
5. 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.
6. 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.

B. Rigid aluminum conduit fittings:

1. Standard threaded couplings, locknuts, bushings, and elbows: Malleable iron, steel or aluminum alloy materials; Zinc or cadmium plate iron or steel fittings. Aluminum fittings containing more than 0.4 percent copper are prohibited.
2. Locknuts and bushings: As specified for rigid steel and IMC conduit.

3. Set screw fittings: Not permitted for use with aluminum conduit.

C. Electrical metallic tubing fittings:
1. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
2. Only steel or malleable iron materials are acceptable.
3. Couplings and connectors: Concrete tight and rain tight, with connectors having insulated throats. Use gland and ring compression type couplings and connectors for conduit sizes 50 mm (2 inches) and smaller. Use set screw type couplings with four set screws each for conduit sizes over 50 mm (2 inches). Use set screws of case-hardened steel with hex head and cup point to firmly seat in wall of conduit for positive grounding.
4. Indent type connectors or couplings are prohibited.
5. Die-cast or pressure-cast zinc-alloy fittings or fittings made of "pot metal" are prohibited.

D. Flexible steel conduit fittings:
1. Conform to UL 514B. Only steel or malleable iron materials are acceptable.
2. Clamp type, with insulated throat.

E. Liquid-tight flexible metal conduit fittings:
1. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
2. Only steel or malleable iron materials are acceptable.
3. Fittings must incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening. Connectors shall have insulated throats.

F. Direct burial plastic conduit fittings:
1. Fittings shall meet the requirements of UL 514C and NEMA TC3.
2. As recommended by the conduit manufacturer.

G. Surface metal raceway fittings: As recommended by the raceway manufacturer.

H. Expansion and deflection couplings:
1. Conform to UL 467 and UL 514B.
2. Accommodate, 19 mm (0.75 inch) deflection, expansion, or contraction in any direction, and allow 30 degree angular deflections.
3. Include internal flexible metal braid sized to guarantee conduit ground continuity and fault currents in accordance with UL 467, and the NEC code tables for ground conductors.

4. Jacket: Flexible, corrosion-resistant, watertight, moisture and heat resistant molded rubber material with stainless steel jacket clamps.

2.5 CONDUIT SUPPORTS

A. Parts and hardware: Zinc-coat or provide equivalent corrosion protection.

B. Individual Conduit Hangers: Designed for the purpose, having a pre-assembled closure bolt and nut, and provisions for receiving a hanger rod.

C. Multiple conduit (trapeze) hangers: Not less than 38 mm by 38 mm (1-1/2 by 1-1/2 inch), 12 gage steel, cold formed, lipped channels; with not less than 9 mm (3/8 inch) diameter steel hanger rods.

D. Solid Masonry and Concrete Anchors: Self-drilling expansion shields, or machine bolt expansion.

2.6 OUTLET, JUNCTION, AND PULL BOXES

A. UL-50 and UL-514A.

B. Cast metal where required by the NEC or shown, and equipped with rustproof boxes.

C. Nonmetallic Outlet and Device Boxes: NEMA OS 2.

D. Metal Floor Boxes: Cast or sheet metal, semi-adjustable, rectangular.

E. Sheet metal boxes: Galvanized steel, except where otherwise shown.

F. Flush mounted wall or ceiling boxes shall be installed with raised covers so that front face of raised cover is flush with the wall. Surface mounted wall or ceiling boxes shall be installed with surface style flat or raised covers.

2.7 CABINETS

A. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.

B. Hinged door in front cover with flush latch and concealed hinge.

C. Key latch to match panelboards.

D. Metal barriers to separate wiring of different systems and voltage.

E. Accessory feet where required for freestanding equipment.

2.8 WIREWAYS

A. Equip with hinged covers, except where removable covers are shown.

2.9 WARNING TAPE

A. Standard, 4-Mil polyethylene 76 mm (3 inches) wide tape non-detectable type, red with black letters, and imprinted with "CAUTION BURIED ELECTRONIC SAFETY AND SECURITY CABLE BELOW".

2.10 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. Description: Comply with SCTE 77.
   1. Color of Frame and Cover: Gray.
   2. Configuration: Units shall be designed for flush burial and have closed bottom, unless otherwise indicated.
   3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
   4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
   5. Cover Legend: Molded lettering, as indicated for each service.
   6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
   7. Handholes 300 mm wide by 600 mm long (2 inches wide by 24 inches long) and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or a combination of the two.

C. Fiberglass Handholes and Boxes with Polymer-Concrete Frame and Cover: Sheet-molded, fiberglass-reinforced, polyester-resin enclosure joined to polymer-concrete top ring or frame.

D. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with covers of polymer concrete.

2.11 SLEEVES FOR RACEWAYS

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch (1.3- or 3.5-mm) thickness as indicated and of length to suit application.

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 84 00 "FIRESTOPPING."

2.12 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.

1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
2. Pressure Plates: Plastic. Include two for each sealing element.
3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.13 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time. WIRELINE DATA TRANSMISSION MEDIA FOR SECURITY SYSTEMS

PART 3 - EXECUTION

3.1 PENETRATIONS

A. Cutting or Holes:

1. Locate holes in advance where they are proposed in the structural sections such as ribs or beams. Obtain the approval of the COR prior to drilling through structural sections.
2. Cut holes through concrete and masonry in new and existing structures with a diamond core drill or concrete saw. Pneumatic hammer, impact electric, hand or manual hammer type drills are not allowed, except where permitted by the COR as required by limited working space.

B. Fire Stop: Where conduits, wireways, and other electronic safety and security raceways pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING, with rock wool fiber or silicone foam sealant only. Completely fill and seal clearances between raceways and openings with the fire stop material.

C. Waterproofing: At floor, exterior wall, and roof conduit penetrations, completely seal clearances around the conduit and make watertight as specified in Section 07 92 00, "JOINT SEALANTS".

3.2 INSTALLATION, GENERAL

A. Install conduit as follows:

1. In complete runs before pulling in cables or wires.
2. Flattened, dented, or deformed conduit is not permitted. Remove and replace the damaged conduits with new undamaged material.
3. Assure conduit installation does not encroach into the ceiling height head room, walkways, or doorways.
4. Cut square with a hacksaw, ream, remove burrs, and draw up tight.
5. Mechanically continuous.
6. Independently support conduit at 2.4 m (8 foot) on center. Do not use other supports i.e., (suspended ceilings, suspended ceiling supporting members, lighting fixtures, conduits, mechanical piping, or mechanical ducts).
7. Support within 300 mm (12 inches) of changes of direction, and within 300 mm (12 inches) of each enclosure to which connected.
8. Close ends of empty conduit with plugs or caps at the rough-in stage to prevent entry of debris, until wires are pulled in.
9. Conduit installations under fume and vent hoods are prohibited.
10. Secure conduits to cabinets, junction boxes, pull boxes and outlet boxes with bonding type locknuts. For rigid and IMC conduit installations, provide a locknut on the inside of the enclosure, made up wrench tight. Do not make conduit connections to junction box covers.
11. Flashing of penetrations of the roof membrane is specified in Section 07 60 00, "FLASHING AND SHEET METAL".
12. Do not use aluminum conduits in wet locations.
13. Unless otherwise indicated on the drawings or specified herein, all conduits shall be installed concealed within finished walls, floors and ceilings.

B. 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.

C. Layout and Homeruns:
1. Install conduit with wiring, including homeruns, as shown.
2. Deviations: Make only where necessary to avoid interferences and only after drawings showing the proposed deviations have been submitted approved by the COR.

D. Fire Alarm:
1. Fire alarm conduit shall be painted red (a red "top-coated" conduit from the conduit manufacturer may be used in lieu of painted conduit) in accordance with the requirements of Section 28 31 00, "FIRE DETECTION AND ALARM".

3.3 CONCEALED WORK INSTALLATION

A. In Concrete:
1. Conduit: Rigid steel, IMC or EMT. Do not install EMT in concrete slabs that are in contact with soil, gravel or vapor barriers.
2. Align and run conduit in direct lines.
3. Install conduit through concrete beams only when the following occurs:
   a. Where shown on the structural drawings.
   b. As approved by the 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 inch) thick is prohibited.
   a. Conduit outside diameter larger than 1/3 of the slab thickness is prohibited.
   b. Space between conduits in slabs: Approximately six conduit diameters apart, except one conduit diameter at conduit crossings.
   c. Install conduits approximately in the center of the slab so that there will be a minimum of 19 mm (3/4 inch) of concrete around the conduits.
5. Make couplings and connections watertight. Use thread compounds that are UL approved conductive type to insure low resistance ground continuity through the conduits. Tightening set screws with pliers is prohibited.

B. Furred or Suspended Ceilings and in Walls:
1. Conduit for conductors above 600 volts:

a. Rigid steel or rigid aluminum.
b. Aluminum conduit mixed indiscriminately with other types in the same system is prohibited.

2. Conduit for conductors 600 volts and below:
   a. Rigid steel, IMC, rigid aluminum, or EMT. Different type conduits mixed indiscriminately in the same system is prohibited.
3. Align and run conduit parallel or perpendicular to the building lines.
4. Connect recessed lighting fixtures to conduit runs with maximum 1800 mm (6 feet) of flexible metal conduit extending from a junction box to the fixture.
5. Tightening set screws with pliers is prohibited.

3.4 EXPOSED WORK INSTALLATION

A. Unless otherwise indicated on the drawings, exposed conduit is only permitted in mechanical and electrical rooms.
B. Conduit for Conductors 600 volts and below:
   1. Rigid steel, IMC, rigid aluminum, or EMT. Different type of conduits mixed indiscriminately in the system is prohibited.
C. Align and run conduit parallel or perpendicular to the building lines.
D. Install horizontal runs close to the ceiling or beams and secure with conduit straps.
E. Support horizontal or vertical runs at not over 2400 mm (eight foot) intervals.
F. Surface metal raceways: Use only where shown.
G. Painting:
   1. Paint exposed conduit as specified in Section09 91 00, “PAINTING”.
   2. Paint all conduits containing cables rated over 600 volts safety orange. Refer to Section 09 91 00, “PAINTING” for preparation, paint type, and exact color. In addition, paint legends, using 50 mm (two inch) high black numerals and letters, showing the cable voltage rating. Provide legends where conduits pass through walls and floors and at maximum 6000 mm (20 foot) intervals in between.

3.5 EXPANSION JOINTS

A. Conduits 75 mm (3 inches) and larger, that are secured to the building structure on opposite sides of a building expansion joint, require expansion and deflection couplings. Install the couplings in accordance with the manufacturer's recommendations.

B. Provide conduits smaller than 75 mm (3 inches) with junction boxes on both sides of the expansion joint. Connect conduits to junction boxes with sufficient slack of flexible conduit to produce 125 mm (5 inch) vertical drop midway between the ends. Flexible conduit shall have a copper green ground bonding jumper installed. In lieu of this flexible conduit, expansion and deflection couplings as specified above for 375 mm (15 inches) and larger conduits are acceptable.

C. Install expansion and deflection couplings where shown.

D. Seismic Areas: In seismic areas, provide conduits rigidly secured to the building structure on opposite sides of a building expansion joint with junction boxes on both sides of the joint. Connect conduits to junction boxes with 375 mm (15 inches) of slack flexible conduit. Flexible conduit shall have a copper green ground bonding jumper installed.

3.6 CONDUIT SUPPORTS, INSTALLATION

A. Safe working load shall not exceed 1/4 of proof test load of fastening devices.

B. Use pipe straps or individual conduit hangers for supporting individual conduits. Maximum distance between supports is 2.5 m (8 foot) on center.

C. Support multiple conduit runs with trapeze hangers. Use trapeze hangers that are designed to support a load equal to or greater than the sum of the weights of the conduits, wires, hanger itself, and 90 kg (200 pounds). Attach each conduit with U-bolts or other approved fasteners.

D. Support conduit independently of junction boxes, pull boxes, fixtures, suspended ceiling T-bars, angle supports, and similar items.

E. Fasteners and Supports in Solid Masonry and Concrete:

1. New Construction: Use steel or malleable iron concrete inserts set in place prior to placing the concrete.
2. Existing Construction:
   a. Steel expansion anchors not less than 6 mm (1/4 inch) bolt size and not less than 28 mm (1-1/8 inch) embedment.
   b. Power set fasteners not less than 6 mm (1/4 inch) diameter with depth of penetration not less than 75 mm (3 inches).
   c. Use vibration and shock resistant anchors and fasteners for attaching to concrete ceilings.

F. Hollow Masonry: Toggle bolts are permitted.

G. Bolts supported only by plaster or gypsum wallboard are not acceptable.

H. Metal Structures: Use machine screw fasteners or other devices specifically designed and approved for the application.

I. Attachment by wood plugs, rawl plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.

J. Chain, wire, or perforated strap shall not be used to support or fasten conduit.

K. Spring steel type supports or fasteners are prohibited for all uses except: Horizontal and vertical supports/fasteners within walls.

L. Vertical Supports: Vertical conduit runs shall have riser clamps and supports in accordance with the NEC and as shown. Provide supports for cable and wire with fittings that include internal wedges and retaining collars.

3.7 BOX INSTALLATION

A. Boxes for Concealed Conduits:

1. Flush mounted.
2. Provide raised covers for boxes to suit the wall or ceiling, construction and finish.

B. In addition to boxes shown, install additional boxes where needed to prevent damage to cables and wires during pulling in operations.

C. Remove only knockouts as required and plug unused openings. Use threaded plugs for cast metal boxes and snap-in metal covers for sheet metal boxes.

D. Outlet boxes in the same wall mounted back-to-back are prohibited. A minimum 600 mm (24 inch), center-to-center lateral spacing shall be maintained between boxes).

E. Minimum size of outlet boxes for ground fault interrupter (GFI) receptacles is 100 mm (4 inches) square by 55 mm (2-1/8 inches) deep, with device covers for the wall material and thickness involved.

F. Stencil or install phenolic nameplates on covers of the boxes identified on riser diagrams; for example "SIG-FA JB No. 1".

G. On all Branch Circuit junction box covers, identify the circuits with black marker.

3.8 ELECTRONIC SAFETY AND SECURITY CONDUIT

A. Install the electronic safety and security raceway system as shown on drawings.

B. Minimum conduit size of 19 mm (3/4 inch), but not less than the size shown on the drawings.

C. All conduit ends shall be equipped with insulated bushings.

D. All 100 mm (four inch) conduits within buildings shall include pull boxes after every two 90 degree bends. Size boxes per the NEC.

E. Vertical conduits/sleeves through closets floors shall terminate not less than 75 mm (3 inches) below the floor and not less than 75 mm (3 inches) below the ceiling of the floor below.

F. Terminate conduit runs to/from a backboard in a closet or interstitial space at the top or bottom of the backboard. Conduits shall enter communication closets next to the wall and be flush with the backboard.

G. Where drilling is necessary for vertical conduits, locate holes so as not to affect structural sections such as ribs or beams.

H. All empty conduits located in communications closets or on backboards shall be sealed with a standard non-hardening duct seal compound to prevent the entrance of moisture and gases and to meet fire resistance requirements.

I. Conduit runs shall contain no more than four quarter turns (90 degree bends) between pull boxes/backboards. Minimum radius of communication conduit bends shall be as follows (special long radius):

Sizes of Conduit Trade Size	Radius of Conduit Bends mm, Inches
¾	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)

A. Furnish and install 19 mm (3/4 inch) thick fire retardant plywood specified in on the wall of communication closets where shown on drawings . Mount the plywood with the bottom edge 300 mm (one foot) above the finished floor.

B. Furnish and pull wire in all empty conduits. (Sleeves through floor are exceptions).

3.9 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 28 08 00 – "COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS" for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.

B. Components provided under this section of the specification will be tested as part of a larger system. Refer to Section 28 08 00, "COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS" and related sections for contractor responsibilities for system commissioning.

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SECTION 28 08 00

COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. The requirements of this Section apply to all sections of Division 28.

B. This project will have selected building systems commissioned. The complete list of equipment and systems to be commissioned is specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. The commissioning process, which the Contractor is responsible to execute, is defined in Section 01 91 00 GENERAL COMMISSIONING REQUIRMENTS. A Commissioning Agent (CxA) appointed by the VA will manage the commissioning process.

1.2 RELATED WORK

A. Section 01 00 00 GENERAL REQUIREMENTS.

B. Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

C. Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

1.3 SUMMARY

A. This Section includes requirements for commissioning the Facility electronic safety and security systems, related subsystems and related equipment. This Section supplements the general requirements specified in Section 01 91 00 General Commissioning Requirements.

B. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for more details regarding processes and procedures as well as roles and responsibilities for all Commissioning Team members.

1.4 DEFINITIONS

A. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for definitions.

1.5 COMMISSIONED SYSTEMS

A. Commissioning of a system or systems specified in Division 28 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 28, is required in cooperation with the VA and the Commissioning Agent.

B. The Facility exterior closure systems commissioning will include the systems listed in Section 01 91 00 General Commissioning Requirements:

1.6 SUBMITTALS

A. The commissioning process requires review of selected Submittals that pertain to the systems to be commissioned. The Commissioning Agent will provide a list of submittals that will be reviewed by the Commissioning Agent. This list will be reviewed and approved by the VA prior to forwarding to the Contractor. Refer to Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, and SAMPLES for further details.

B. The commissioning process requires Submittal review simultaneously with engineering review. Specific submittal requirements related to the commissioning process are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 CONSTRUCTION INSPECTIONS

A. Commissioning of Electronic Safety and Security systems will require inspection of individual elements of the electronic safety and security systems 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 electronic safety and security systems inspections as required to support the Commissioning Process.

3.2 PRE-FUNCTIONAL CHECKLISTS

A. The Contractor shall complete Pre-Functional Checklists to verify systems, subsystems, and equipment installation is complete and systems are ready for Systems Functional Performance Testing. The Commissioning Agent will prepare Pre-Functional Checklists to be used to document equipment installation. The Contractor shall complete the checklists. Completed checklists shall be submitted to the VA and to the Commissioning Agent for review. The Commissioning Agent may spot check a sample of completed checklists. If the Commissioning Agent determines that the information provided on the checklist is not accurate, the Commissioning Agent will return the marked-up checklist to the Contractor for correction and resubmission. If the Commissioning Agent determines that a significant number of completed

checklists for similar equipment are not accurate, the Commissioning Agent will select a broader sample of checklists for review. If the Commissioning Agent determines that a significant number of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and resubmission. Refer to SECTION 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for Pre-Functional Checklists, Equipment Startup Reports, and other commissioning documents.

3.3 CONTRACTORS TESTS

A. Contractor tests as required by other sections of Division 28 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 . 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 and Commissioning Agent. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and

troubleshooting of the installed systems. Contractor shall submit training agendas and trainer resumes in accordance with the requirements of Section 01 91 00. The instruction shall be scheduled in coordination with the VA after submission and approval of formal training plans. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS and Division 28 Sections for additional Contractor training requirements.

----- END -----

SECTION 28 13 00

PHYSICAL ACCESS CONTROL SYSTEM

PART 1 – GENERAL

1.1 DESCRIPTION

A. This section specifies the finishing, installation, connection, testing and certification of a complete and fully operating Physical Access Control System, hereinafter referred to as the PACS.

B. This Section includes a Physical Access Control System consisting of a system server, operating system and application software, and field-installed Controllers connected by a high-speed electronic data transmission network. The PACS shall have the following:

1. Physical Access Control:
   a. Regulating access through doors
   b. Anti-passback
   c. Visitor assignment
   d. Surge and tamper protection
   e. Secondary alarm annunciator
   f. Credential cards and readers
   g. Biometric identity verification equipment
   h. Push-button switches
   i. RS-232 ASCII interface
   j. Credential creation and credential holder database and management
   k. Monitoring of field-installed devices
   l. Reporting
2. Security:
   a. Real-time guard tour.
   b. Time and attendance.
   c. Key tracking.
   d. Video and camera control.
   e. Time and attendance

C. System Architecture:

1. Criticality, operational requirements, and/or limiting points of failure may dictate the development of an enterprise and regional server architecture as opposed to system capacity. Provide server and workstation configurations with all necessary connectors, interfaces and accessories as shown.

D. PACS shall provide secure and reliable identification of Federal employees and contractors by utilizing credential authentication per FIPS-201.

E. Physical Access Control System (PACS) shall consist of:

1. Head-End equipment server,
2. One or more networked PC-based workstations,
3. Physical Access Control System and Database Management Software,
4. Credential validation software/hardware,
5. Field installed controllers,
6. PIV Middelware,
7. Card readers,
8. Biometric identification devices,
9. PIV cards,
10. Supportive information system,
11. Door locks and sensors,
12. Power supplies,
13. Interfaces with:
    a. Video Surveillance and Assessment System,
    b. Gate, turnstile, and traffic arm controls,
    c. Automatic door operators,
    d. Intrusion Detection System,
    e. Intercommunication System
    f. Fire Protection System,
    g. HVAC,
    h. Building Management System,
    i. Elevator Controls,

F. Head-End equipment server, workstations and controllers shall be connected by a high-speed electronic data transmission network.

G. Information system supporting PACS , Head-End equipment server, workstations, network switches, routers and controllers shall comply with FIPS 200 requirements (Minimum Security Requirements for Federal Information and Information Systems)and NIST Special Publication 800-53 (Recommended Security Controls for Federal Information Systems).

H. PACS system shall support:

1. Multiple credential authentication modes,
2. Bidirectional communication with the reader,

3. Incident response policy implementation capability; system shall have capability to automatically change access privileges for certain user groups to high security areas in case of incident/emergency.
4. Visitor management,

I. All security relevant decisions shall be made on "secure side of the door". Secure side processing shall include;
1. Challenge/response management,
2. PKI path discovery and validation,
3. Credential identifier processing,
4. Authorization decisions.

J. For locations where secure side processing is not applicable the tamper switches and certified cryptographic processing shall be provided per FIPS-140-2.

K. System Software: Based on CCure 9000, version 3.00.3 central-station, workstation operating system, server operating system, and application software.

L. Software and controllers shall be capable of matching full 56 bit FASC-N plus minimum of 32 bits of public key certificate data.

M. Software shall have the following capabilities:
1. Multiuser multitasking to allow for independent activities and monitoring to occur simultaneously at different workstations.
2. Support authentication and enrolment;
   a. PIV verification,
   b. Expiration date check,
   c. Biometric check,
   d. Digital photo display/check,
   e. Validate digital signatures of data objects (Objects are signed by the Trusted Authority
   f. Private key challenge (CAK & PAK to verify private key public key pairs exist and card is not a clone)
3. Support CRL validation via OCSP or SCVP on a scheduled basis and automatically deny access to any revoked credential in the system.
4. Graphical user interface to show pull-down menus and a menu tree format that complies with interface guidelines of Microsoft Windows operating system.

5. System license shall be for the entire system and shall include capability for future additions that are within the indicated system size limits specified in this Section.
6. System shall have open architecture that allows importing and exporting of data and interfacing with other systems that are compatible with CCure 9000, version 3.00.3 operating system.
7. Operator login and access shall be utilized via integrated smart card reader and password protection.

N. Systems Networks:
1. A standalone system network shall interconnect all components of the system. This network shall include communications between a central station and any peer or subordinate workstations, enrollment stations, local annunciation stations, portal control stations or redundant central stations.

O. Security Management System Server Redundancy:
1. The SMS shall support multiple levels of fault tolerance and SMS redundancy listed and described below:
   a. Hot Standby Servers
   b. Clustering
   c. Disk Mirroring
   d. RAID Level 10
   e. Distributed Intelligence

P. Number of points:
1. PACS shall support multiple autonomous regional servers that can connect to a master command and controller server.
2. Unlimited number of access control readers, unlimited number of inputs or outputs, unlimited number of client workstations, unlimited number of cardholders.
3. Total system solution to enable enterprise-wide, networked, multi-user access to all system resources via a wide range of options for connectivity with the customer’s existing LAN and WAN.

Q. Console Network:
1. Console network, if required, shall provide communication between a central station and any subordinate or separate stations of the system. Where redundant central or parallel stations are required, the console network shall allow the configuration of stations as master and slave. The console network may be a part of the field

device network or may be separate depending upon the manufacturer's system configuration.

R. Network(s) connecting PCs and Controllers shall comply with NIST Special Publication 800-53 (Recommended Security Controls for Federal Information Systems) and consist of one or more of the following:
   1. Local area, IEEE 802.3 Fast Ethernet 100 BASE-TX, star topology network based on TCP/IP.
   2. Direct-connected, RS-232 cable from the COM port of the Central Station to the first Controller, then RS-485 to interconnect the remainder of the Controllers at that Location.

1.2 RELATED WORK

A. Section 01 00 00 - GENERAL REQUIREMENTS. For General Requirements.
B. Section 07 84 00 - FIRESTOPPING. Requirements for firestopping application and use.
C. Section 08 71 00 - DOOR HARDWARE. Requirements for door installation.
D. Section 10 14 00 - SIGNAGE. Requirements for labeling and signs.
E. Section 26 05 11 - REQUIREMENTS FOR ELECTRICAL INSTALLATIONS. Requirements for connection of high voltage.
F. Section 26 05 19 - LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES. Requirements for power cables.
G. Section 26 05 33 – RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS. Requirements for infrastructure.
H. Section 26 05 41 - UNDERGROUND ELECTRICAL CONSTRUCTION. Requirements for underground installation of wiring.
I. Section 26 56 00 - EXTERIOR LIGHTING. Requirements for perimeter lighting.
J. Section 28 05 00 - COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY. For general requirements that are common to more than one section in Division 28.
K. Section 28 05 13 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for conductors and cables.
L. Section 28 05 26 - GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY. Requirements for grounding of equipment.
M. Section 28 05 28.33 - CONDUITS AND BOXES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for infrastructure.

N. Section 28 08 00 - COMMISIONING OF ELECTRONIC SAFETY AND SECURITY. For requirements for commissioning, systems readiness checklists, and training.

O. Section 28 13 16 - ACCESS CONTROL SYSTEM AND DATABASE MANAGEMENT. Requirements for control and operation of all security systems.

P. Section 28 23 00 - VIDEO SURVEILLANCE. Requirements for security camera systems.

Q. Section 28 26 00 - ELECTRONIC PERSONAL PROTECTION SYSTEM (EPPS). Requirements for emergency and interior communications.

R. Section 28 31 00 - FIRE DETECTION AND ALARM. Requirements for integration with fire detection and alarm system.

1.3 QUALITY ASSURANCE

A. The Contractor shall be responsible for providing, installing, and the operation of the PACS as shown. The Contractor shall also provide certification as required.

B. The security system will be installed and tested to ensure all components are fully compatible as a system and can be integrated with all associated security subsystems, whether the security system is stand-alone or a part of a complete Information Technology (IT) computer network.

C. Manufacturers Qualifications: The manufacturer shall regularly and presently produce, as one of the manufacturer's principal products, the equipment and material specified for this project, and shall have manufactured the item for at least three years.

D. Product Qualifications:

1. Manufacturer's product shall have been in satisfactory operation, on three installations of similar size and type as this project, for approximately three years.
2. The Government reserves the right to require the Contractor to submit a list of installations where the products have been in operation before approval.

E. Contractor Qualifications:

1. The Contractor or security sub-contractor shall be a licensed security Contractor with a minimum of five (5) years experience installing and servicing systems of similar scope and complexity. The Contractor shall be an authorized regional representative of the Security Management System’s (PACS) manufacturer. The Contractor

shall provide four (4) current references from clients with systems of similar scope and complexity which became operational in the past three (3) years. At least three (3) of the references shall be utilizing the same system components, in a similar configuration as the proposed system. The references must include a current point of contact, company or agency name, address, telephone number, complete system description, date of completion, and approximate cost of the project. The owner reserves the option to visit the reference sites, with the site owner's permission and representative, to verify the quality of installation and the references' level of satisfaction with the system. The Contractor shall provide copies of system manufacturer certification for all technicians. The Contractor shall only utilize factory-trained technicians to install, program, and service the PACS. The Contractor shall only utilize factory-trained technicians to install, terminate and service controller/field panels and reader modules. The technicians shall have a minimum of five (5) continuous years of technical experience in electronic security systems. The Contractor shall have a local service facility. The facility shall be located within 60 miles of the project site. The local facility shall include sufficient spare parts inventory to support the service requirements associated with this contract. The facility shall also include appropriate diagnostic equipment to perform diagnostic procedures. The COR reserves the option of surveying the company's facility to verify the service inventory and presence of a local service organization.

a. The Contractor shall provide proof project superintendent with BICSI Certified Commercial Installer Level 1, Level 2, or Technician to provide oversight of the project.
b. Cable installer must have on staff a Registered Communication Distribution Designer (RCDD) certified by Building Industry Consulting Service International. The staff member shall provide consistent oversight of the project cabling throughout design, layout, installation, termination and testing.

F. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within four eight hours of

receipt of notification that service is needed. Submit name and address of service organizations.

1.4 SUBMITTALS

A. Submit below items in conjunction with Master Specification Sections 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, and Section 28 05 00 COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY.

B. Provide certificates of compliance with Section 1.3, Quality Assurance.

C. Provide a complete and thorough pre-installation and as-built design package in both electronic format and on paper, minimum size 48 x 48 inches (1220 x 1220 millimeters); drawing submittals shall be per the established project schedule.

D. Shop drawing and as-built packages shall include, but not be limited to:

1. Index Sheet that shall:
   a. Define each page of the design package to include facility name, building name, floor, and sheet number.
   b. Provide a complete list of all security abbreviations and symbols.
   c. Reference all general notes that are utilized within the design package.
   d. Specification and scope of work pages for all individual security systems that are applicable to the design package that will:
      1) Outline all general and job specific work required within the design package.
      2) Provide a detailed device identification table outlining device Identification (ID) and use for all security systems equipment utilized in the design package.
2. Drawing sheets that will be plotted on the individual floor plans or site plans shall:
   a. Include a title block as defined above.
   b. Clearly define the drawings scale in both standard and metric measurements.
   c. Provide device identification and location.
   d. Address all signal and power conduit runs and sizes that are associated with the design of the electronic security system and other security elements (e.g., barriers, etc.).

e. Identify all pull box and conduit locations, sizes, and fill capacities.

f. Address all general and drawing specific notes for a particular drawing sheet.

3. A detailed riser drawing for each applicable security subsystem shall:

a. Indicate the sequence of operation.

b. Relationship of integrated components on one diagram.

c. Include the number, size, identification, and maximum lengths of interconnecting wires.

d. Wire/cable types shall be defined by a wire and cable schedule. The schedule shall utilize a lettering system that will correspond to the wire/cable it represents (example: A = 18 AWG/1 Pair Twisted, Unshielded). This schedule shall also provide the manufacturer’s name and part number for the wire/cable being installed.

4. A detailed system drawing for each applicable security system shall:

a. Clearly identify how all equipment within the system, from main panel to device, shall be laid out and connected.

b. Provide full detail of all system components wiring from point-to-point.

c. Identify wire types utilized for connection, interconnection with associate security subsystems.

d. Show device locations that correspond to the floor plans.

e. All general and drawing specific notes shall be included with the system drawings.

5. A detailed schedule for all of the applicable security subsystems shall be included. All schedules shall provide the following information:

a. Device ID.

b. Device Location (e.g. site, building, floor, room number, location, and description).

c. Mounting type (e.g. flush, wall, surface, etc.).

d. Power supply or circuit breaker and power panel number.

e. In addition, for the PACS, provide the door ID, door type (e.g. wood or metal), locking mechanism (e.g. strike or electromagnetic lock) and control device (e.g. card reader or biometrics).

6. Detail and elevation drawings for all devices that define how they were installed and mounted.

E. Pre-installation design packages shall go through a full review process conducted by the Contractor along with a VA representative to ensure all work has been clearly defined and completed. All reviews shall be conducted in accordance with the project schedule. There shall be four (4) stages to the review process:

1. 35 percent
2. 65 percent
3. 90 percent
4. 100 percent

F. Provide manufacturer security system product cut-sheets. Submit for approval at least 30 days prior to commencement of formal testing, a Security System Operational Test Plan. Include procedures for operational testing of each component and security subsystem, to include performance of an integrated system test.

G. Submit manufacture’s certification of Underwriters Laboratories, Inc. (UL) listing as specified. Provide all maintenance and operating manuals per Section 01 00 00, GENERAL REQUIREMENTS, and Section 28 05 00 COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY.

H. Completed System Readiness Checklists provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 28 08 00 COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS.

I. General: Submittals shall be in full compliance of the Contract Documents. All submittals shall be provided in accordance with this section. Submittals lacking the breath or depth these requirements will be considered incomplete and rejected. Submissions are considered multidisciplinary and shall require coordination with applicable divisions to provide a complete and comprehensive submission package. Additional general provisions are as follows:

1. The Contractor shall schedule submittals in order to maintain the project schedule. For coordination drawings refer to Specification

Section 01 33 23 - SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, which outline basic submittal requirements and coordination.

2. The Contractor shall identify variations from requirements of Contract Documents and state product and system limitations, which may be detrimental to successful performance of the completed work or system.
3. Each package shall be submitted at one (1) time for each review and include components from applicable disciplines (e.g., electrical work, architectural finishes, door hardware, etc.) which are required to produce an accurate and detailed depiction of the project.
4. Manufacturer's information used for submittal shall have pages with items for approval tagged, items on pages shall be identified, and capacities and performance parameters for review shall be clearly marked through use of an arrow or highlighting. Provide space for COR and Contractor review stamps.
5. Technical Data Drawings shall be in the latest version of AutoCAD®, drawn accurately, and in accordance with VA CAD Standards. FREEHAND SKETCHES OR COPIED VERSIONS OF THE CONSTRUCTION DOCUMENTS WILL NOT BE ACCEPTED. The Contractor shall not reproduce Contract Documents or copy standard information as the basis of the Technical Data Drawings. If departures from the technical data drawings are subsequently deemed necessary by the Contractor, details of such departures and the reasons thereof shall be submitted in writing to the COR for approval before the initiation of work.
6. Packaging: The Contractor shall organize the submissions according to the following packaging requirements.
   a. Binders: For each manual, provide heavy duty, commercial quality, durable three (3) ring vinyl covered loose leaf binders, sized to receive 8.5 x 11 in paper, and appropriate capacity to accommodate the contents. Provide a clear plastic sleeve on the spine to hold labels describing the contents. Provide pockets in the covers to receive folded sheets.
      1) Where two (2) or more binders are necessary to accommodate data, correlate data in each binder into related groupings according to the Project Manual table of contents. Cross-referencing other binders where necessary to provide essential

information for communication of proper operation and or maintenance of the component or system.

2) Identify each binder on the front and spine with printed binder title, Project title or name, and subject matter covered. Indicate the volume number if applicable.

b. Dividers: Provide heavy paper dividers with celluloid tabs for each Section. Mark each tab to indicate contents.

c. Protective Plastic Jackets: Provide protective transparent plastic jackets designed to enclose diagnostic software for computerized electronic equipment.

d. Text Material: Where written material is required as part of the manual use the manufacturer's standard printed material, or if not available, specially prepared data, neatly typewritten on 8.5 inches by 11 inches 20 pound white bond paper.

e. Drawings: Where drawings and/or diagrams are required as part of the manual, provide reinforced punched binder tabs on the drawings and bind them with the text.

1) Where oversized drawings are necessary, fold the drawings to the same size as the text pages and use as a foldout.

2) If drawings are too large to be used practically as a foldout, place the drawing, neatly folded, in the front or rear pocket of the binder. Insert a type written page indicating the drawing title, description of contents and drawing location at the appropriate location of the manual.

3) Drawings shall be sized to ensure details and text is of legible size. Text shall be no less than 1/16” tall.

f. Manual Content: In each manual include information specified in the individual Specification section, and the following information for each major component of building equipment and controls:

1) General system or equipment description.

2) Design factors and assumptions.

3) Copies of applicable Shop Drawings and Product Data.

4) System or equipment identification including: manufacturer, model and serial numbers of each component, operating instructions, emergency instructions, wiring diagrams, inspection and test procedures, maintenance procedures and

schedules, precautions against improper use and maintenance, repair instructions, sources of required maintenance materials and related services, and a manual index.

g. Binder Organization: Organize each manual into separate sections for each piece of related equipment. At a minimum, each manual shall contain a title page, table of contents, copies of Product Data supplemented by drawings and written text, and copies of each warranty, bond, certifications, and service Contract issued. Refer to Group I through V Technical Data Package Submittal requirements for required section content.

h. Title Page: Provide a title page as the first sheet of each manual to include the following information; project name and address, subject matter covered by the manual, name and address of the Project, date of the submittal, name, address, and telephone number of the Contractor, and cross references to related systems in other operating and/or maintenance manuals.

i. Table of Contents: After the title page, include a type written table of contents for each volume, arranged systematically according to the Project Manual format. Provide a list of each product included, identified by product name or other appropriate identifying symbols and indexed to the content of the volume. Where more than one (1) volume is required to hold data for a particular system, provide a comprehensive table of contents for all volumes in each volume of the set.

j. General Information Section: Provide a general information section immediately following the table of contents, listing each product included in the manual, identified by product name. Under each product, list the name, address, and telephone number of the installer and maintenance Contractor. In addition, list a local source for replacement parts and equipment.

k. Drawings: Provide specially prepared drawings where necessary to supplement the manufacturers printed data to illustrate the relationship between components of equipment or systems, or provide control or flow diagrams. Coordinate these drawings with information contained in Project Record Drawings to assure correct illustration of the completed installation.

l. Manufacturer's Data: Where manufacturer's standard printed data is included in the manuals, include only those sheets that are pertinent to the part or product installed. Mark each sheet to identify each part or product included in the installation. Where more than one (1) item in tabular format is included, identify each item, using appropriate references from the Contract Documents. Identify data that is applicable to the installation and delete references to information which is not applicable.

m. Where manufacturer's standard printed data is not available and the information is necessary for proper operation and maintenance of equipment or systems, or it is necessary to provide additional information to supplement the data included in the manual, prepare written text to provide the necessary information. Organize the text in a consistent format under a separate heading for different procedures. Where necessary, provide a logical sequence of instruction for each operating or maintenance procedure. Where similar or more than one product is listed on the submittal the Contractor shall differentiate by highlighting the specific product to be utilized.

n. Calculations: Provide a section for circuit and panel calculations.

o. Loading Sheets: Provide a section for DGP Loading Sheets.

p. Certifications: Provide section for Contractor's manufacturer certifications.

7. Contractor Review: Review submittals prior to transmittal. Determine and verify field measurements and field construction criteria. Verify manufacturer's catalog numbers and conformance of submittal with requirements of contract documents. Return non-conforming or incomplete submittals with requirements of the work and contract documents. Apply Contractor's stamp with signature certifying the review and verification of products occurred, and the field dimensions, adjacent construction, and coordination of information is in accordance with the requirements of the contract documents.

8. Resubmission: Revise and resubmit submittals as required within 15 calendar days of return of submittal. Make resubmissions under

procedures specified for initial submittals. Identify all changes made since previous submittal.

9. Product Data: Within 15 calendar days after execution of the contract, the Contractor shall submit for approval a complete list of all of major products proposed for use. The data shall include name of manufacturer, trade name, model number, the associated contract document section number, paragraph number, and the referenced standards for each listed product.

J. Group 1 Technical Data Package: Group I Technical Data Package shall be one submittal consisting of the following content and organization. Refer to VA Special Conditions Document for drawing format and content requirements. The data package shall include the following:

1. Section I - Drawings:
   a. General – Drawings shall conform to VA Special Conditions and CAD Standards Documents. All text associated with security details shall be 1/8” tall and meet VA text standard for AutoCAD™ drawings.
   b. Cover Sheet – Cover sheet shall consist of Project Title and Address, Project Number, Area and Vicinity Maps.
   c. General Information Sheets – General Information Sheets shall consist of General Notes, Abbreviations, Symbols, Wire and Cable Schedule, Project Phasing, and Sheet Index.
   d. Floor Plans – Floor plans shall be produced from the Architectural backgrounds issued in the Construction Documents. The contractor shall receive floor plans from the prime A/E to develop these drawing sets. Security devices shall be placed on drawings in scale. All text associated with security details shall be 1/8” tall and meet VA text standard for AutoCAD™ drawings. Floor plans shall identify the following:
      1) security devices by symbol,
      2) the associated device point number (derived from the loading sheets),
      3) wire & cable types and counts
      4) conduit sizing and routing
      5) conduit riser systems
      6) device and area detail call outs

e. Architectural details – Architectural details shall be produced for each device mounting type (door details for doors with physical access control, reader pedestals and mounts, security panel and power supply details).

f. Riser Diagrams – Contractor shall provide a riser diagram indicating riser architecture and distribution of the physical access control system throughout the facility (or area in scope).

g. Block Diagrams – Contractor shall provide a block diagram for the entire system architecture and interconnections with SMS subsystems. Block diagram shall identify SMS subsystem (e.g., physical access control, intrusion detection, closed circuit television, intercom, and other associated subsystems) integration; and data transmission and media conversion methodologies.

h. Interconnection Diagrams – Contractor shall provide interconnection diagram for each sensor, and device component. Interconnection diagram shall identify termination locations, standard wire detail to include termination schedule. Diagram shall also identify interfaces to other systems such as elevator control, fire alarm systems, and security management systems.

i. Security Details:

1) Panel Assembly Detail – For each panel assembly, a panel assembly details shall be provided identifying individual panel component size and content.

2) Panel Details – Provide security panel details identify general arrangement of the security system components, backboard size, wire through size and location, and power circuit requirements.

3) Device Mounting Details – Provide mounting detailed drawing for each security device (physical access control system, intrusion detection, video surveillance and assessment, and intercom systems) for each type of wall and ceiling configuration in project. Device details shall include device, mounting detail, wiring and conduit routing.

4) Details of connections to power supplies and grounding

5) Details of surge protection device installation

6) Sensor detection patterns – Each system sensor shall have associated detection patterns.
7) Equipment Rack Detail – For each equipment rack, provide a scaled detail of the equipment rack location and rack space utilization. Use of BISCI wire management standards shall be employed to identify wire management methodology. Transitions between equipment racks shall be shown to include use vertical and horizontal latter rack system.
8) Security Control Room – The contractor shall provide a layout plan for the Security Control Room. The layout plan shall identify all equipment and details associated with the installation.
9) Operator Console – The contractor shall provide a layout plan for the Operator Console. The layout plan shall identify all equipment and details associated with the installation. Equipment room - the contractor shall provide a layout plan for the equipment room. The layout plan shall identify all equipment and details associated with the installation.
10) Equipment Room – Equipment room details shall provide architectural, electrical, mechanical, plumbing, IT/Data and associated equipment and device placements both vertical and horizontally.

j. Electrical Panel Schedule – Electrical Panel Details shall be provided for all SMS systems electrical power circuits. Panel details shall be provided identifying panel type (Standard, Emergency Power, Emergency/Uninterrupted Power Source, and Uninterrupted Power Source Only), panel location, circuit number, and circuit amperage rating.

k. Door Schedule – A door schedule shall be developed for each door equipped with electronic security components. At a minimum, the door schedule shall be coordinated with Division 08 work and include the following information:
1) Item Number
2) Door Number (Derived from A/E Drawings)
3) Floor Plan Sheet Number
4) Standard Detail Number
5) Door Description (Derived from Loading Sheets)

6) Data Gathering Panel Input Number
7) Door Position or Monitoring Device Type & Model Number
8) Lock Type, Model Number & Power Input/Draw (standby/active)
9) Card Reader Type & Model Number
10) Shunting Device Type & Model Number
11) Sounder Type & Model Number
12) Manufacturer
13) Misc. devices as required
    a) Delayed Egress Type & Model Number
    b) Intercom
    c) Camera
    d) Electric Transfer Hinge
    e) Electric Pass-through device
14) Remarks column indicating special notes or door configurations

2. Camera Schedule - A camera schedule shall be developed for each camera. Contractors shall coordinate with the COR to determine camera starting numbers and naming conventions. All drawings shall identify wire and cable standardization methodology. Color coding of all wiring conductors and jackets is required and shall be communicated consistently throughout the drawings package submittal. At a minimum, the camera schedule shall include the following information:
   a. Item Number
   b. Camera Number
   c. Naming Conventions
   d. Description of Camera Coverage
   e. Camera Location
   f. Floor Plan Sheet Number
   g. Camera Type
   h. Mounting Type
   i. Standard Detail Reference
   j. Power Input & Draw
   k. Power Panel Location
   l. Remarks Column for Camera
3. Section II – Data Gathering Panel Documentation Package
   a. Contractor shall provide Data Gathering Panel (DGP) input and output documentation packages for review at the Shop Drawing

submittal stage and also with the as-built documentation package. The documentation packages shall be provided in both printed and magnetic form at both review stages.

b. The Contractor shall provide loading sheet documentation package for the associated DGP, including input and output boards for all field panels associated with the project. Documentation shall be provided in current version Microsoft Excel spreadsheets following the format currently utilized by VA. A separate spreadsheet file shall be generated for each DGP and associated field panels.

c. The spreadsheet names shall follow a sequence that shall display the spreadsheets in numerical order according to the DGP system number. The spreadsheet shall include the prefix in the file name that uniquely identifies the project site. The spreadsheet shall detail all connected items such as card readers, alarm inputs, and relay output connections. The spreadsheet shall include an individual section (row) for each panel input, output and card reader. The spreadsheet shall automatically calculate the system numbers for card readers, inputs, and outputs based upon data entered in initialization fields.

d. All entries must be verified against the field devices. Copies of the floor plans shall be forwarded under separate cover.

e. The DGP spreadsheet shall include an entry section for the following information:

1) DGP number
2) First Reader Number
3) First Monitor Point Number
4) First Relay Number
5) DGP, input or output Location
6) DGP Chain Number
7) DGP Cabinet Tamper Input Number
8) DGP Power Fail Input Number
9) Number of Monitor Points Reserved For Expansion Boards
10) Number of Control Points (Relays) Reserved For Expansion Boards

f. The DGP, input module and output module spreadsheets shall automatically calculate the following information based upon the associated entries in the above fields:
   1) System Numbers for Card Readers
   2) System Numbers for Monitor Point Inputs
   3) System Numbers for Control Points (Relays)
   4) Next DGP or input module First Monitor Point Number
   5) Next DGP or output module First Control Point Number
g. The DGP spreadsheet shall provide the following information for each card reader:
   1) DGP Reader Number
   2) System Reader Number
   3) Cable ID Number
   4) Description Field (Room Number)
   5) Description Field (Device Type i.e.: In Reader, Out Reader, etc.)
   6) Description Field
   7) DGP Input Location
   8) Date Test
   9) Date Passed
   10) Cable Type
   11) Camera Numbers (of cameras viewing the reader location)
h. The DGP and input module spreadsheet shall provide the following information for each monitor point (alarm input).
   1) DGP Monitor Point Input Number
   2) System Monitor Point Number
   3) Cable ID Number
   4) Description Field (Room Number)
   5) Description Field (Device Type i.e.: Door Contact, Motion Detector, etc.)
   6) DGP or input module Input Location
   7) Date Test
   8) Date Passed
   9) Cable Type
   10) Camera Numbers (of associated alarm event preset call-ups)
i. The DGP and output module spreadsheet shall provide the following information for each control point (output relay).

1) DGP Control Point (Relay) Number
2) System (Control Point) Number
3) Cable ID Number
4) Description Field (Room Number)
5) Description Field (Device: Lock Control, Local Sounder, etc.)
6) Description Field
7) DGP or OUTPUT MODULE Output Location
8) Date Test
9) Date Passed Cable Type
10) Camera Number (of associated alarm event preset call-ups)

j. The DGP, input module and output module spreadsheet shall include the following information or directions in the header and footer:
   1) Header
      a) DGP Input and Output Worksheet
      b) Enter Beginning Reader, Input, and Output Starting Numbers and Sheet Will Automatically Calculate the Remaining System Numbers.
   2) Footer
      a) File Name
      b) Date Printed
      c) Page Number

4. Section III - Construction Mock-up: In areas with exposed EMT/Conduit Raceways, contractor shall conceal raceway as much as practical and unobtrusively. In addition, historic significance must be considered to determine installation means and methods for approval by the owner.
5. Section IV - Manufacturers' Data: The data package shall include manufacturers' data for all materials and equipment, including sensors, local processors and console equipment provided under this specification.
6. Section V - System Description and Analysis: The data package shall include system descriptions, analysis, and calculations used in sizing equipment required by these specifications. Descriptions and calculations shall show how the equipment will operate as a system to meet the performance requirements of this specification. The data package shall include the following:

a. Central processor memory size; communication speed and protocol description; rigid disk system size and configuration; flexible disk system size and configuration; back-up media size and configuration; alarm response time calculations; command response time calculations; start-up operations; expansion capability and method of implementation; sample copy of each report specified; and color photographs representative of typical graphics.

b. Software Data: The data package shall consist of descriptions of the operation and capability of the system, and application software as specified.

c. Overall System Reliability Calculations: The data package shall include all manufacturers' reliability data and calculations required to show compliance with the specified reliability.

7. Section VI – Certifications & References: All specified manufacturer's certifications shall be included with the data package. Contractor shall provide Project references as outlined in Paragraph 1.4 "Quality Assurance".

K. Group II Technical Data Package

1. The Contractor shall prepare a report of "Current Site Conditions" and submit a report to the COR documenting changes to the site, particularly those conditions that affect performance of the system to be installed. The Contractor shall provide specification sheets, or written functional requirements to support the findings, and a cost estimate to correct those site changes or conditions which affect the installation of the system or its performance. The Contractor shall not correct any deficiency without written permission from the COR.

2. System Configuration and Functionality: The contractor shall provide the results of the meeting with VA to develop system requirements and functionality including but not limited to:

a. Baseline configuration

b. Access levels

c. Schedules (intrusion detection, physical access control, holidays, etc.)

d. Badge database

e. System monitoring and reporting (unit level and central control)

f. Naming conventions and descriptors

L. Group III Technical Data Package

1. Development of Test Procedures: The Contractor will prepare performance test procedures for the system testing. The test procedures shall follow the format of the VA Testing procedures and be customized to the contract requirements. The Contractor will deliver the test procedures to the COR for approval at least 60 calendar days prior to the requested test date.

M. Group IV Technical Data Package

1. Performance Verification Test

a. Based on the successful completion of the pre-delivery test, the Contractor shall finalize the test procedures and report forms for the performance verification test (PVT) and the endurance test. The PVT shall follow the format, layout and content of the pre-delivery test. The Contractor shall deliver the PVT and endurance test procedures to the COR for approval. The Contractor may schedule the PVT after receiving written approval of the test procedures. The Contractor shall deliver the final PVT and endurance test reports within 14 calendar days from completion of the tests. Refer to Part 3 of this section for System Testing and Acceptance requirements.

2. Training Documentation

a. New Facilities and Major Renovations: Familiarization training shall be provided for new equipment or systems. Training can include site familiarization training for VA technicians and administrative personnel. Training shall include general information on new system layout including closet locations, turnover of the completed system including all documentation, including manuals, software, key systems, and full system administration rights. Lesson plans and training manuals training shall be oriented to type of training to be provided.

b. New Unit Control Room:

1) Provide the security personnel with training in the use, operation, and maintenance of the entire control room system (Unit Control and Equipment Rooms). The training documentation must include the operation and maintenance. The first of the training sessions shall take place prior to system turnover and the second immediately after turnover.

Coordinate the training sessions with the Owner. Completed classroom sessions will be witnessed and documented by the Architect/Engineer, and approved by the COR. Instruction is not to begin until the system is operational as designed.

2) The training documents will cover the operation and the maintenance manuals and the control console operators' manuals and service manuals in detail, stressing all important operational and service diagnostic information necessary for the maintenance and operations personnel to efficiently use and maintain all systems.

3) Provide an illustrated control console operator's manual and service manual. The operator's manual shall be written in laymen's language and printed so as to become a permanent reference document for the operators, describing all control panel switch operations, graphic symbol definitions and all indicating functions and a complete explanation of all software.

4) The service manual shall be written in laymen's language and printed so as to become a permanent reference document for maintenance personnel, describing how to run internal self diagnostic software programs, troubleshoot head end hardware and field devices with a complete scenario simulation of all possible system malfunctions and the appropriate corrective measures.

5) Provide a professional color DVD instructional recording of all the operational procedures described in the operator's manual. All charts used in the training session shall be clearly presented on the video. Any DVD found to be inferior in recording or material content shall be reproduced at no cost until an acceptable DVD is submitted. Provide four copies of the training DVD, one to the architect/engineer and three to the owner.

3. System Configuration and Data Entry:

a. The contractor is responsible for providing all system configuration and data entry for the SMS and subsystems (e.g., video matrix switch, intercom, digital video recorders, network video recorders). All data entry shall be performed per VA

standards & guidelines. The Contractor is responsible for participating in all meetings with the client to compile the information needed for data entry. These meetings shall be established at the beginning of the project and incorporated in to the project schedule as a milestone task. The contractor shall be responsible for all data collection, data entry, and system configuration. The contractor shall collect, enter, & program and/or configure the following components:

1) Physical Access control system components,
2) All intrusion detection system components,
3) Video surveillance, control and recording systems,
4) Intercom systems components,
5) All other security subsystems shown in the contract documents.

b. The Contractor is responsible for compiling the card access database for the VA employees, including programming reader configurations, access shifts, schedules, exceptions, card classes and card enrollment databases.

c. Refer to Part 3 for system programming requirements and planning guidelines.

4. Graphics: Based on CAD as-built drawings developed for the construction project, create all map sets showing locations of all alarms and field devices. Graphical maps of all alarm points installed under this contract including perimeter and exterior alarm points shall be delivered with the system. The Contractor shall create and install all graphics needed to make the system operational. The Contractor shall utilize data from the contract documents, Contractor’s field surveys, and all other pertinent information in the Contractor’s possession to complete the graphics. The Contractor shall identify and request from the COR, any additional data needed to provide a complete graphics package. Graphics shall have sufficient level of detail for the system operator to assess the alarm. The Contractor shall supply hard copy, color examples at least 203.2 x 254 mm (8 x 10 in) of each type of graphic to be used for the completed Security system. The graphics examples shall be delivered to the COR for review and approval at least 90 calendar days prior to the scheduled date the Contractor requires them.

N. Group V Technical Data Package: Final copies of the manuals shall be delivered to the COR as part of the acceptance test. The draft copy used during site testing shall be updated with any changes required prior to final delivery of the manuals. Each manual's contents shall be identified on the cover. The manual shall include names, addresses, and telephone numbers of each sub-contractor installing equipment or systems, as well as the nearest service representatives for each item of equipment for each system. The manuals shall include a table of contents and tab sheets. Tab sheets shall be placed at the beginning of each chapter or section and at the beginning of each appendix. The final copies delivered after completion of the endurance test shall include all modifications made during installation, checkout, and acceptance. Six (6) hard-copies and one (1) soft copy on CD of each item listed below shall be delivered as a part of final systems acceptance.

1. Functional Design Manual: The functional design manual shall identify the operational requirements for the entire system and explain the theory of operation, design philosophy, and specific functions. A description of hardware and software functions, interfaces, and requirements shall be included for all system operating modes. Manufacturer developed literature may be used; however, shall be produced to match the project requirements.
2. Equipment Manual: A manual describing all equipment furnished including:
   a. General description and specifications; installation and checkout procedures; equipment electrical schematics and layout drawings; system schematics and layout drawings; alignment and calibration procedures; manufacturer's repair list indicating sources of supply; and interface definition.
3. Software Manual: The software manual shall describe the functions of all software and include all other information necessary to enable proper loading, testing, and operation. The manual shall include:
   a. Definition of terms and functions; use of system and applications software; procedures for system initialization, start-up, and shutdown; alarm reports; reports generation, database format and data entry requirements; directory of all disk files; and

description of all communications protocols including data formats, command characters, and a sample of each type of data transfer.

4. Operator's Manual: The operator's manual shall fully explain all procedures and instructions for the operation of the system, including:
   a. Computers and peripherals; system start-up and shutdown procedures; use of system, command, and applications software; recovery and restart procedures; graphic alarm presentation; use of report generator and generation of reports; data entry; operator commands' alarm messages, and printing formats; and system access requirements.
5. Maintenance Manual: The maintenance manual shall include descriptions of maintenance for all equipment including inspection, recommend schedules, periodic preventive maintenance, fault diagnosis, and repair or replacement of defective components.
6. Spare Parts & Components Data: At the conclusion of the Contractor's work, the Contractor shall submit to the COR a complete list of the manufacturer's recommended spare parts and components required to satisfactorily maintain and service the systems, as well as unit pricing for those parts and components.
7. Operation, Maintenance & Service Manuals: The Contractor shall provide two (2) complete sets of operating and maintenance manuals in the form of an instructional manual for use by the VA Security Guard Force personnel. The manuals shall be organized into suitable sets of manageable size. Where possible, assemble instructions for similar equipment into a single binder. If multiple volumes are required, each volume shall be fully indexed and coordinated.
8. Equipment and Systems Maintenance Manual: The Contractor shall provide the following descriptive information for each piece of equipment, operating system, and electronic system:
   a. Equipment and/or system function.
   b. Operating characteristics.
   c. Limiting conditions.
   d. Performance curves.
   e. Engineering data and test.
   f. Complete nomenclature and number of replacement parts.

g. Provide operating and maintenance instructions including assembly drawings and diagrams required for maintenance and a list of items recommended to stock as spare parts.
h. Provide information detailing essential maintenance procedures including the following: routine operations, trouble shooting guide, disassembly, repair and re-assembly, alignment, adjusting, and checking.
i. Provide information on equipment and system operating procedures, including the following; start-up procedures, routine and normal operating instructions, regulation and control procedures, instructions on stopping, shut-down and emergency instructions, required sequences for electric and electronic systems, and special operating instructions.
j. Manufacturer equipment and systems maintenance manuals are permissible.

9. Project Redlines: During construction, the Contractor shall maintain an up-to-date set of construction redlines detailing current location and configuration of the project components. The redline documents shall be marked with the words 'Master Redlines' on the cover sheet and be maintained by the Contractor in the project office. The Contractor will provide access to redline documents anytime during the project for review and inspection by the COR or authorized Office of Protection Services representative. Master redlines shall be neatly maintained throughout the project and secured under lock and key in the contractor's onsite project office. Any project component or assembly that is not installed in strict accordance with the drawings shall be so noted on the drawings. Prior to producing Record Construction Documents, the contractor will submit the Master Redline document to the COR for review and approval of all changes or modifications to the documents. Each sheet shall have COR initials indicating authorization to produce "As Built" documents. Field drawings shall be used for data gathering & field changes. These changes shall be made to the master redline documents daily. Field drawings shall not be considered "master redlines".
10. Record Specifications: The Contractor shall maintain one (1) copy of the Project Specifications, including addenda and modifications

issued, for Project Record Documents. The Contractor shall mark the Specifications to indicate the actual installation where the installation varies substantially from that indicated in the Contract Specifications and modifications issued. (Note related Project Record Drawing information where applicable). The Contractor shall pay particular attention to substitutions, selection of product options, and information on concealed installations that would be difficult to identify or measure and record later. Upon completion of the mark ups, the Contractor shall submit record Specifications to the COR. As with master relines, Contractor shall maintain record specifications for COR review and inspection at anytime.

11. Record Product Data: The Contractor shall maintain one (1) copy of each Product Data submittal for Project Record Document purposes. The Data shall be marked to indicate the actual product installed where the installation varies substantially from that indicated in the Product Data submitted. Significant changes in the product delivered to the site and changes in manufacturer's instructions and recommendations for installation shall be included. Particular attention will be given to information on concealed products and installations that cannot be readily identified or recorded later. Note related Change Orders and mark up of Record Construction Documents, where applicable. Upon completion of mark up, submit a complete set of Record Product Data to the COR.
12. Miscellaneous Records: The Contractor shall maintain one (1) copy of miscellaneous records for Project Record Document purposes. Refer to other Specifications for miscellaneous record-keeping requirements and submittals concerning various construction activities. Before substantial completion, complete miscellaneous records and place in good order, properly identified and bound or filed, ready for use and reference. Categories of requirements resulting in miscellaneous records include, a minimum of the following:
    a. Certificates received instead of labels on bulk products.
    b. Testing and qualification of tradesmen. (“Contractor’s Qualifications”)
    c. Documented qualification of installation firms.

d. Load and performance testing.

e. Inspections and certifications.

f. Final inspection and correction procedures.

g. Project schedule

13. Record Construction Documents (Record As-Built)

a. Upon project completion, the contractor shall submit the project master redlines to the COR prior to development of Record construction documents. The COR shall be given a minimum of a thirty (30) day review period to determine the adequacy of the master redlines. If the master redlines are found suitable by the COR, the COR will initial and date each sheet and turn redlines over to the contractor for as built development.

b. The Contractor shall provide the COR a complete set of "as-built" drawings and original master redlined marked "as-built" blue-line in the latest version of AutoCAD drawings unlocked on CD or DVD. The as-built drawing shall include security device number, security closet connection location, data gathering panel number, and input or output number as applicable. All corrective notations made by the Contractor shall be legible when submitted to the COR. If, in the opinion of the COR, any redlined notation is not legible, it shall be returned to the Contractor for re-submission at no extra cost to the Owner. The Contractor shall organize the Record Drawing sheets into manageable sets bound with durable paper cover sheets with suitable titles, dates, and other identifications printed on the cover. The submitted as built shall be in editable formats and the ownership of the drawings shall be fully relinquished to the owner.

c. Where feasible, the individual or entity that obtained record data, whether the individual or entity is the installer, sub-contractor, or similar entity, is required to prepare the mark up on Record Drawings. Accurately record the information in a comprehensive drawing technique. Record the data when possible after it has been obtained. For concealed installations, record and check the mark up before concealment. At the time of substantial completion, submit the Record Construction Documents to the COR. The Contractor shall organize into bound and labeled sets for the COR's continued usage. Provide device, conduit, and

cable lengths on the conduit drawings. Exact in-field conduit placement/routings shall be shown. All conduits shall be illustrated in their entire length from termination in security closets; no arrowed conduit runs shall be shown. Pull box and junction box sizes are to be shown if larger than 100mm (4 inch).

O. FIPS 201 Compliance Certificates

1. Provide Certificates for all software components and device types utilizing credential verification. Provide certificates for:
   a. Fingerprint Capture Station
   b. Card Readers
   c. Facial Image Capturing Camera
   d. PIV Middelware
   e. Template Matcher
   f. Electromagnetically Opaque Sleeve
   g. Certificate Management
      1) CAK Authentication System
      2) PIV Authentication System
      3) Certificate Validator
      4) Cryptographic Module

P. Approvals will be based on complete submission of manuals together with shop drawings.

Q. Completed System Readiness Checklists provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 28 08 00 COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS.

1.5 APPLICABLE PUBLICATIONS

A. The publications listed below (including amendments, addenda, revisions, supplement, and errata) form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American National Standards Institute (ANSI)/ Security Industry Association (SIA):

AC-03.....Access Control: Access Control Guideline Dye Sublimation Printing Practices for PVC Access Control Cards

TVAC-01.....CCTV to Access Control Standard - Message Set for System Integration

C. American National Standards Institute (ANSI)/ International Code Council (ICC):

A117.1.....Standard on Accessible and Usable Buildings and Facilities

D. Department of Justice American Disability Act (ADA)

28 CFR Part 36.....ADA Standards for Accessible Design 2010

E. Department of Veterans Affairs (VA):

PACS-R: Physical Access Control System (PACS) Requirements

VA Handbook 0730 Security and Law Enforcement

F. Government Accountability Office (GAO):

GAO-03-8-02 Security Responsibilities for Federally Owned and Leased Facilities

G. National Electrical Contractors Association

303-2005.....Installing Closed Circuit Television (CCTV) Systems

H. National Electrical Manufactures Association (NEMA):

250-08.....Enclosures for Electrical Equipment (1000 Volts Maximum)

I. National Fire Protection Association (NFPA):

70-20..... National Electrical Code

J. Underwriters Laboratories, Inc. (UL):

294-99.....The Standard of Safety for Access Control System Units

305-08.....Standard for Panic Hardware

639-97.....Standard for Intrusion-Detection Units

752-05.....Standard for Bullet-Resisting Equipment

827-08.....Central Station Alarm Services

1076-95.....Standards for Proprietary Burglar Alarm Units and Systems

1981-03.....Central Station Automation System

2058-05.....High Security Electronic Locks

K. Homeland Security Presidential Directive (HSPD):

HSPD-12.....Policy for a Common Identification Standard for Federal Employees and Contractors

L. Federal Communications Commission (FCC):

(47 CFR 15) Part 15 Limitations on the Use of Wireless Equipment/Systems

M. Federal Information Processing Standards (FIPS):

FIPS-201-1.....Personal Identity Verification (PIV) of Federal Employees and Contractors

N. National Institute of Standards and Technology (NIST):

IR 6887 V2.1.....Government Smart Card Interoperability Specification (GSC-IS)

Special Pub 800-63.....Electronic Authentication Guideline

Special Pub 800-96.....PIV Card Reader Interoperability Guidelines

Special Pub 800-73-3....Interfaces for Personal Identity Verification (4 Parts)

.....Pt. 1- End Point PIV Card Application Namespace, Data Model & Representation

.....Pt. 2- PIV Card Application Card Command Interface

.....Pt. 3- PIV Client Application Programming Interface

.....Pt. 4- The PIV Transitional Interfaces & Data Model Specification

Special Pub 800-76-1....Biometric Data Specification for Personal Identity Verification

Special Pub 800-78-2....Cryptographic Algorithms and Key Sizes for Personal Identity Verification

Special Pub 800-79-1....Guidelines for the Accreditation of Personal Identity Verification Card Issuers

Special Pub 800-85B-1...DRAFTPIV Data Model Test Guidelines

Special Pub 800-85A-2...PIV Card Application and Middleware Interface Test Guidelines (SP 800-73-3 compliance)

Special Pub 800-96.....PIV Card Reader Interoperability Guidelines

Special Pub 800-37.....Guide for Applying the Risk Management Framework to Federal Information Systems

Special Pub 800-96.....PIV Card Reader Interoperability Guidelines

Special Pub 800-96.....PIV Card Reader Interoperability Guidelines

Special Pub 800-104A....Scheme for PIV Visual Card Topography

Special Pub 800-116.....Recommendation for the Use of PIV Credentials in Physical Access Control Systems (PACS)

O. Institute of Electrical and Electronics Engineers (IEEE):

C62.41.....IEEE Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits

P. International Organization for Standardization (ISO):

7810.....Identification cards – Physical characteristics

7811.....Physical Characteristics for Magnetic Stripe Cards

7816-1.....Identification cards - Integrated circuit(s) cards with contacts - Part 1: Physical characteristics

7816-2.....Identification cards - Integrated circuit cards - Part 2: Cards with contacts -Dimensions and location of the contacts

7816-3.....Identification cards - Integrated circuit cards - Part 3: Cards with contacts - Electrical interface and transmission protocols

7816-4.....Identification cards - Integrated circuit cards - Part 11: Personal verification through biometric methods

7816-10.....Identification cards - Integrated circuit cards - Part 4: Organization, security and commands for interchange

14443.....Identification cards - Contactless integrated circuit cards; Contactless Proximity Cards Operating at 13.56 MHz in up to 5 inches distance

15693.....Identification cards -- Contactless integrated circuit cards - Vicinity cards; Contactless Vicinity Cards Operating at 13.56 MHz in up to 50 inches distance

19794.....Information technology - Biometric data interchange formats

Q. Uniform Federal Accessibility Standards (UFAS) 1984

R. ADA Standards for Accessible Design 2010

S. Section 508 of the Rehabilitation Act of 1973

1.6 DEFINITIONS

A. Refer to 25 05 00 COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY, Part 1

B. ABA Track: Magnetic stripe that is encoded on track 2, at 75-bpi density in binary-coded decimal format; for example, 5-bit, 16-character set.

C. Access Control List: A list of (identifier, permissions) pairs associated with a resource or an asset. As an expression of security policy, a person may perform an operation on a resource or asset if and only if the person's identifier is present in the access control list (explicitly or implicitly), and the permissions in the (identifier, permissions) pair include the permission to perform the requested operation.

D. Access Control: A function or a system that restricts access to authorized persons only.

E. API Application Programming Interface

F. Assurance Level (or E-Authentication Assurance Level): A measure of trust or confidence in an authentication mechanism defined in OMB Memorandum M-04-04 and NIST Special Publication (SP) 800-63, in terms of four levels:

1. Level 1: LITTLE OR NO confidence
2. Level 2: SOME confidence
3. Level 3: HIGH confidence
4. Level 4: VERY HIGH confidence

G. Authentication: A process that establishes the origin of information, or determines an entity's identity. In this publication, authentication often means the performance of a PIV authentication mechanism.

H. Authenticator: A memory, possession, or quality of a person that can serve as proof of identity, when presented to a verifier of the appropriate kind. For example, passwords, cryptographic keys, and fingerprints are authenticators.

I. Authorization: A process that associates permission to access a resource or asset with a person and the person's identifier(s).

J. BIO or BIO-A: A FIPS 201 authentication mechanism that is implemented by using a Fingerprint data object sent from the PIV Card to the PACS. Note that the short-hand "BIO (-A)" is used throughout the document to represent both BIO and BIO-A authentication mechanisms.

K. Biometric: An authenticator produced from measurable qualities of a living person.

L. CAC EP – CAC End Point with end point PIV applet

M. CAC NG – CAC Next Generation with transitional PIV applet

N. Card Authentication Key (CAK): A PIV authentication mechanism (or the PIV Card key of the same name) that is implemented by an asymmetric or symmetric key challenge/response protocol. The CAK is an optional mechanism defined in NIST SP 800-73. SP800-73 NIST strongly recommends that every PIV Card contain an asymmetric CAK and corresponding certificate, and that agencies use the asymmetric CAK protocol, rather than a symmetric CAK protocol, whenever the CAK authentication mechanism is used with PACS.

O. CCTV: Closed-circuit television.

P. Central Station: A PC with software designated as the main controlling PC of the PACS. Where this term is presented with initial capital letters, this definition applies.

Q. Controller: An intelligent peripheral control unit that uses a computer for controlling its operation. Where this term is presented with an initial capital letter, this definition applies.

R. CPU: Central processing unit.

S. Credential: Data assigned to an entity and used to identify that entity.

T. File Server: A PC in a network that stores the programs and data files shared by users.

U. FIPS Federal Information Processing Standards

V. FRAC – First Responder Authentication Credential

W. HSPD Homeland Security Presidential Directive

X. I/O: Input/Output.

Y. Identifier: A credential card, keypad personal identification number or code, biometric characteristic, or other unique identification entered as data into the entry-control database for the purpose of identifying an individual. Where this term is presented with an initial capital letter, this definition applies.

Z. IEC International Electrotechnical Commission

AA. ISO International Organization for Standardization

BB. KB Kilobyte

CC. kbit/s Kilobits / second

DD. LAN: Local area network.

EE. LED: Light-emitting diode.

FF. Legacy CAC – Contact only Common Access Card with v1 and v2 applets

GG. Location: A Location on the network having a PC-to-Controller communications link, with additional Controllers at the Location connected to the PC-to-Controller link with RS-485 communications loop. Where this term is presented with an initial capital letter, this definition applies.

HH. NIST: National Institute of Standards and Technology

II. PACS: Physical Access Control System

JJ. PC/SC: Personal Computer / Smart Card

KK. PC: Personal computer. This acronym applies to the Central Station, workstations, and file servers.

LL. PCI Bus: Peripheral component interconnect; a peripheral bus providing a high-speed data path between the CPU and peripheral devices (such as monitor, disk drive, or network).

MM. PDF: (Portable Document Format.) The file format used by the Acrobat document exchange system software from Adobe.

NN. PIV: Personal Identification Verification

OO. PIV-I – PIV Interoperable credential

PP. PPS: Protocol and Parameters Selection

QQ. RF: Radio frequency.

RR. ROM: Read-only memory. ROM data are maintained through losses of power.

SS. RS-232: An TIA/EIA standard for asynchronous serial data communications between terminal devices. This standard defines a 25-pin connector and certain signal characteristics for interfacing computer equipment.

TT. RS-485: An TIA/EIA standard for multipoint communications.

UU. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.

VV. TPDU: Transport Protocol Data Unit

WW. TWIC – Transportation Worker Identification Credential

XX. UPS: Uninterruptible power supply.

YY. XX. Vcc: Voltage at the Common Collector

ZZ. WAN: Wide area network.

AAA. WAV: The digital audio format used in Microsoft Windows.

BBB. Wiegand: Patented magnetic principle that uses specially treated wires embedded in the credential card.

CCC. Windows: Operating system by Microsoft Corporation.

DDD. Workstation: A PC with software that is configured for specific limited security system functions.

1.7 COORDINATION

A. Refer to 25 05 00 COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY, Part 1

B. Coordinate arrangement, mounting, and support of electronic safety and security equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

C. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

D. Coordinate location of access panels and doors for electronic safety and security items that are behind finished surfaces or otherwise concealed.

1.8 MAINTENANCE & SERVICE

A. General Requirements

1. The Contractor shall provide all services required and equipment necessary to maintain the entire integrated electronic security system in an operational state as specified for a period of one (1) year after formal written acceptance of the system. The Contractor shall provide all necessary material required for performing scheduled adjustments or other non-scheduled work. Impacts on facility operations shall be minimized when performing scheduled adjustments or other non-scheduled work. See also General Project Requirements.

B. Description of Work

1. The adjustment and repair of the security system includes all software updates, panel firmware, and the following new items computers equipment, communications transmission equipment and data transmission media (DTM), local processors, security system sensors, physical access control equipment, facility interface, signal transmission equipment, and video equipment.

C. Personnel

1. Service personnel shall be certified in the maintenance and repair of the selected type of equipment and qualified to accomplish all work promptly and satisfactorily. The COR shall be advised in writing of the name of the designated service representative, and of any change in personnel. The COR shall be provided copies of system manufacturer certification for the designated service representative.

D. Schedule of Work

1. The work shall be performed during regular working ours, Monday through Friday, excluding federal holidays. These inspections shall include:
   a) The Contractor shall perform two (2) minor inspections at six (6) month intervals or more if required by the manufacturer, and two (2) major inspections offset equally between the minor inspections to effect quarterly inspection of alternating magnitude.
      1) Minor Inspections shall include visual checks and operational tests of all console equipment, peripheral equipment, local processors, sensors, electrical and mechanical controls, and adjustments on printers.
      2) Major Inspections shall include all work described for Minor Inspections and the following: clean all system equipment and local processors including interior and exterior surfaces; perform diagnostics on all equipment; operational tests of the CPU, switcher, peripheral equipment, recording devices, monitors, picture quality from each camera; check, walk test, and calibrate each sensor; run all system software diagnostics and correct all problems; and resolve any previous outstanding problems.

E. Emergency Service

1. The owner shall initiate service calls whenever the system is not functioning properly. The Contractor shall provide the Owner with an emergency service center telephone number. The emergency service center shall be staffed 24 hours a day 365 days a year. The Owner shall have sole authority for determining catastrophic and non-catastrophic system failures within parameters stated in General Project Requirements.
   a. For catastrophic system failures, the Contractor shall provide same day four (4) hour service response with a defect correction time not to exceed eight (8) hours from notification. Catastrophic system failures are defined as any system failure that the Owner determines will place the facility(s) at increased risk.
   b. For non-catastrophic failures, the Contractor within eight (8) hours with a defect correction time not to exceed 24 hours from notification.

F. Operation
1. Performance of scheduled adjustments and repair shall verify operation of the system as demonstrated by the applicable portions of the performance verification test.

G. Records & Logs
1. The Contractor shall maintain records and logs of each task and organize cumulative records for each component and for the complete system chronologically. A continuous log shall be submitted for all devices. The log shall contain all initial settings, calibration, repair, and programming data. Complete logs shall be maintained and available for inspection on site, demonstrating planned and systematic adjustments and repairs have been accomplished for the system.

H. Work Request
1. The Contractor shall separately record each service call request, as received. The record shall include the serial number identifying the component involved, its location, date and time the call was received, specific nature of trouble, names of service personnel assigned to the task, instructions describing the action taken, the amount and nature of the materials used, and the date and time of commencement and completion. The Contractor shall deliver a record

of the work performed within five (5) working days after the work was completed.

I. System Modifications

1. The Contractor shall make any recommendations for system modification in writing to the COR. No system modifications, including operating parameters and control settings, shall be made without prior written approval from the COR. Any modifications made to the system shall be incorporated into the operation and maintenance manuals and other documentation affected.

J. Software

1. The Contractor shall provide all software updates when approved by the Owner from the manufacturer during the installation and 12-month warranty period and verify operation of the system. These updates shall be accomplished in a timely manner, fully coordinated with the system operators, and incorporated into the operations and maintenance manuals and software documentation. There shall be at least one (1) scheduled update near the end of the first year's warranty period, at which time the Contractor shall install and validate the latest released version of the Manufacturer's software. All software changes shall be recorded in a log maintained in the unit control room. An electronic copy of the software update shall be maintained within the log. At a minimum, the contractor shall provide a description of the modification, when the modification occurred, and name and contact information of the individual performing the modification. The log shall be maintained in a white 3 ring binder and the cover marked "SOFTWARE CHANGE LOG".

1.9 PERFORMANCE REQUIREMENTS

A. PACS shall provide support for multiple authentication modes and bidirectional communication with the reader. PACS shall provide implementation capability for enterprise security policy and incident response.

B. All processing of authentication information must occur on the "safe side" of a door

C. Physical Access Control System shall provide access to following Security Areas:

1. Controlled
2. Limited

3. Exclusion

D. PACS shall provide:

1. One authentication factor for access to Controlled security areas
2. Two authentication factors for access to Limited security areas
3. Three authentication factors for access to Exclusion security areas

E. PACS shall provide Credential Validation and Path Validation per NIST 800-116.

F. The PACS System shall have an Enterprise Path Validation Module (PVM) component that processes X.509 certification paths composed of X.509 v3 certificates and X.509 v2 CRLs. The PVM component MUST support the following features:

1. Name chaining;
2. Signature chaining;
3. Certificate validity;
4. Key usage, basic constraints, and certificate policies certificate extensions;
5. Full CRLs; and
6. CRLs segmented on names.

G. Distributed Processing: System shall be a fully distributed processing system so that information, including time, date, valid codes, access levels, and similar data, is downloaded to Controllers so that each Controller makes access-control decisions for that Location. Do not use intermediate Controllers for physical access control. If communications to Central Station are lost, all Controllers shall automatically buffer event transactions until communications are restored, at which time buffered events shall be uploaded to the Central Station.

H. Number of Locations: Support unlimited number of separate Locations using a single PC with combinations of direct-connect, dial-up, or TCP/IP LAN connections to each Location.

1. Each Location shall have its own database and history in the Central Station. Locations may be combined to share a common database.

I. Data Capacity:

1. 130 different card-reader formats.
2. 999 comments.
3. 16 graphic file types for importing maps.

J. Location Capacity:

1. 128 reader-controlled doors.
2. 50,000 total access credentials.
3. 2048 supervised alarm inputs.
4. 2048 programmable outputs.
5. 32,000 custom action messages per Location to instruct operator on action required when alarm is received.

K. System Network Requirements:

1. Interconnect system components and provide automatic communication of status changes, commands, field-initiated interrupts, and other communications required for proper system operation.
2. Communication shall not require operator initiation or response, and shall return to normal after partial or total network interruption such as power loss or transient upset.
3. System shall automatically annunciate communication failures to the operator and identify the communication link that has experienced a partial or total failure.
4. Communications Controller may be used as an interface between the Central Station display systems and the field device network. Communications Controller shall provide functions required to attain the specified network communications performance.

L. Central Station shall provide operator interface, interaction, display, control, and dynamic and real-time monitoring. Central Station shall control system networks to interconnect all system components, including workstations and field-installed Controllers.

M. Field equipment shall include Controllers, sensors, and controls. Controllers shall serve as an interface between the Central Station and sensors and controls. Data exchange between the Central Station and the Controllers shall include down-line transmission of commands, software, and databases to Controllers. The up-line data exchange from the Controller to the Central Station shall include status data such as intrusion alarms, status reports, and entry-control records. Controllers are classified as alarm-annunciation or entry-control type.

N. System Response to Alarms: Field device network shall provide a system end-to-end response time of 1 second(s) or less for every device connected to the system. Alarms shall be annunciated at the Central Station within 1 second of the alarm occurring at a Controller or device controlled by a local Controller, and within 100 ms if the alarm

occurs at the Central Station. Alarm and status changes shall be displayed within 100 ms after receipt of data by the Central Station. All graphics shall be displayed, including graphics-generated map displays, on the console monitor within 5 seconds of alarm receipt at the security console. This response time shall be maintained during system heavy load.

O. False Alarm Reduction: The design of Central Station and Controllers shall contain features to reduce false alarms. Equipment and software shall comply with SIA CP-01.

P. Error Detection: A cyclic code error detection method shall be used between Controllers and the Central Station, which shall detect single- and double-bit errors, burst errors of eight bits or less, and at least 99 percent of all other multibit and burst error conditions. Interactive or product error detection codes alone will not be acceptable. A message shall be in error if one bit is received incorrectly. System shall retransmit messages with detected errors. A two-digit decimal number shall be operator assignable to each communication link representing the number of retransmission attempts. When the number of consecutive retransmission attempts equals the assigned quantity, the Central Station shall print a communication failure alarm message. System shall monitor the frequency of data transmission failure for display and logging.

Q. Data Line Supervision: System shall initiate an alarm in response to opening, closing, shorting, or grounding of data transmission lines.

R. Door Hardware Interface: Coordinate with Division 08 Sections that specify door hardware required to be monitored or controlled by the PACS. The Controllers in this Section shall have electrical characteristics that match the signal and power requirements of door hardware. Integrate door hardware specified in Division 08 Sections to function with the controls and PC-based software and hardware in this Section.

S. References to industry and trade association standards and codes are minimum installation requirement standards.

T. Drawings and other specification sections shall govern in those instances where requirements are greater than those specified in the above standards.

1.10 EQUIPMENT AND MATERIALS

A. Refer to 25 05 00 COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY, Part 1

B. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, for which replacement parts shall be available.

C. When more than one unit of the same class of equipment is required, such units shall be the product of a single manufacturer.

D. 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.

E. Factory wiring shall be identified on the equipment being furnished and on all wiring diagrams.

F. When Factory Testing Is Specified:

1. The Government shall have the option of witnessing factory tests. The contractor shall notify the VA through the COR a minimum of 15 working days prior to the manufacturers making the factory tests.
2. Four copies of certified test reports containing all test data shall be furnished to the COR prior to final inspection and not more than 90 days after completion of the tests.
3. When equipment fails to meet factory test and re-inspection is required, the contractor shall be liable for all additional expenses, including expenses of the Government.

1.11 WARRANTY OF CONSTRUCTION.

A. Warrant PACS work subject to the Article “Warranty of Construction” of FAR clause 52.246-21.

B. Demonstration and training shall be performed prior to system acceptance.

1.12 GENERAL REQUIREMENTS

A. For general requirements that are common to more than one section in Division 28 refer to Section 28 05 00, REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATIONS.

B. General requirements applicable to this section include:

1. General Arrangement Of Contract Documents,
2. Delivery, Handling and Storage,
3. Project Conditions,
4. Electrical Power,
5. Lightning, Power Surge Suppression, and Grounding,
6. Electronic Components,
7. Substitute Materials and Equipment, and
8. Like Items.

PART 2 – PRODUCTS

2.1 GENERAL

A. All equipment and materials for the system will be compatible to ensure correct operation as outlined in FIPS 201, March 2006 and HSPD-12.

B. The security system characteristics listed in this section will serve as a guide in selection of equipment and materials for the PACS. If updated or more suitable versions are available then the Contracting Officer will approve the acceptance of prior to an installation.

C. PACS equipment shall meet or exceed all requirements listed below.

D. A PACS shall be comprised of, but not limited to, the following components:

1. Physical Access Control System
2. Application Software
3. System Database
4. Surge and Tamper Protection
5. Standard Workstation Hardware
6. Communications Workstation
7. Controllers (Data Gathering Panel)
8. Secondary Alarm Annunciator
9. Keypads
10. Card Readers
11. Credential Cards
12. Biometric Identity Verification Equipment

13. Enrolment Center (To be provided in accordance with the VA PIV enrollment and issuance system.)
14. System Sensors and Related Equipment
15. Push Button Switches
16. Interfaces
17. Door and Gate Hardware interface
18. RS-232 ASCII Interface
19. Floor Select Elevator Control
20. After-Hours HVAC Control
21. Real Time Guard Tour
22. Video and Camera Control
23. Cables
24. Transformers

2.2 SURGE AND TAMPER PROTECTION

A. Refer to 28 05 00 COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY

B. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor-entry connection to components.

1. Minimum Protection for Power Connections 120 V and More: Auxiliary panel suppressors complying with requirements in Division 26 Section "Transient-Voltage Suppression for Low-Voltage Electrical Power Circuits."
2. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Connections: Comply with requirements in Division 26 Section "Transient-Voltage Suppression for Low-Voltage Electrical Power Circuits" as recommended by manufacturer for type of line being protected.

C. Tamper Protection: Tamper switches on enclosures, control units, pull boxes, junction boxes, cabinets, and other system components shall initiate a tamper-alarm signal when unit is opened or partially disassembled. Control-station control-unit alarm display shall identify tamper alarms and indicate locations.

2.3 CONTROLLERS

A. Controllers: Intelligent peripheral control unit, complying with UL 294, that stores time, date, valid codes, access levels, and similar data downloaded from the Central Station or workstation for controlling its operation.

B. Subject to compliance with requirements in this Article, manufacturers may use multipurpose Controllers.

C. Battery Backup: Sealed, lead acid; sized to provide run time during a power outage of 90 minutes, complying with UL 924.

D. Alarm Annunciation Controller:

1. The Controller shall automatically restore communication within 10 seconds after an interruption with the field device network with dc line supervision on each of its alarm inputs.

a. Inputs: Monitor dry contacts for changes of state that reflect alarm conditions. Provides at least eight alarm inputs, which are suitable for wiring as normally open or normally closed contacts for alarm conditions.

b. Alarm-Line Supervision:

1) Supervise the alarm lines by monitoring each circuit for changes or disturbances in the signal, and for conditions as described in UL 1076 for line security equipment by monitoring for abnormal open, grounded, or shorted conditions using dc change measurements. System shall initiate an alarm in response to an abnormal current, which is a dc change of 5 percent or more for longer than 500 ms.

2) Transmit alarm-line-supervision alarm to the Central Station during the next interrogation cycle after the abnormal current condition.

c. Outputs: Managed by Central Station software.

2. Auxiliary Equipment Power: A GFI service outlet inside the Controller enclosure.

E. Entry-Control Controller:

1. Function: Provide local entry-control functions including one- and two-way communications with access-control devices such as card readers, keypads, biometric personal identity verification devices, door strikes, magnetic latches, gate and door operators, and exit push-buttons.

a. Operate as a stand-alone portal Controller using the downloaded database during periods of communication loss between the Controller and the field-device network.
b. Accept information generated by the entry-control devices; automatically process this information to determine valid identification of the individual present at the portal:
   1) On authentication of the credentials or information presented, check privileges of the identified individual, allowing only those actions granted as privileges.
   2) Privileges shall include, but not be limited to, time of day control, day of week control, group control, and visitor escort control.
c. Maintain a date-, time-, and Location-stamped record of each transaction. A transaction is defined as any successful or unsuccessful attempt to gain access through a controlled portal by the presentation of credentials or other identifying information.

2. Inputs:
   a. Data from entry-control devices; use this input to change modes between access and secure.
   b. Database downloads and updates from the Central Station that include enrollment and privilege information.
3. Outputs:
   a. Indicate success or failure of attempts to use entry-control devices and make comparisons of presented information with stored identification information.
   b. Grant or deny entry by sending control signals to portal-control devices and mask intrusion alarm annunciation from sensors stimulated by authorized entries.
   c. Maintain a date-, time-, and Location-stamped record of each transaction and transmit transaction records to the Central Station.
   d. Door Prop Alarm: If a portal is held open for longer than 20 seconds, alarm sounds.
4. With power supplies sufficient to power at voltage and frequency required for field devices and portal-control devices.

5. Data Line Problems: For periods of loss of communications with Central Station, or when data transmission is degraded and generating continuous checksum errors, the Controller shall continue to control entry by accepting identifying information, making authentication decisions, checking privileges, and controlling portal-control devices.
   a. Store up to 1000 transactions during periods of communication loss between the Controller and access-control devices for subsequent upload to the Central Station on restoration of communication.
6. Controller Power: NFPA 70, Class II power supply transformer, with 12- or 24-V ac secondary, backup battery and charger.
   a. Backup Battery: Premium, valve-regulated, recombinant-sealed, lead-calcium battery; spill proof; with a full 1-year warranty and a pro rata 19-year warranty. With single-stage, constant-voltage-current, limited battery charger, comply with battery manufacturer's written instructions for battery terminal voltage and charging current recommendations for maximum battery life.
   b. Backup Battery: Valve-regulated, recombinant-sealed, lead-acid battery; spill proof. With single-stage, constant-voltage-current, limited battery charger, comply with battery manufacturer's written instructions for battery terminal voltage and charging current recommendations for maximum battery life.
   c. Backup Power Supply Capacity: 5 minutes of battery supply. Submit battery and charger calculations.
   d. Power Monitoring: Provide manual dynamic battery load test, initiated and monitored at the control center; with automatic disconnection of the Controller when battery voltage drops below Controller limits. Report by using local Controller-mounted LEDs and by communicating status to Central Station. Indicate normal power on and battery charger on trickle charge. Indicate and report the following:
      1) Trouble Alarm: Normal power off load assumed by battery.
      2) Trouble Alarm: Low battery.
      3) Alarm: Power off.

2.4 CARD READERS

A. Product: Match existing installed throughout facility, HID pivCLASS.

B. Power: Card reader shall be powered from its associated Controller, including its standby power source.

C. Response Time: Card reader shall respond to passage requests by generating a signal that is sent to the Controller. Response time shall be 800ms or less, from the time the card reader finishes reading the credential card until a response signal is generated.

D. Enclosure: Suitable for surface, semiflush, or pedestal mounting. Mounting types shall additionally be suitable for installation in the following locations:
   1. Indoors, controlled environment.
   2. Indoors, uncontrolled environment.
   3. Outdoors, with built-in heaters or other cold-weather equipment to extend the operating temperature range as needed for operation at the site.

E. Display: LED or other type of visual indicator display shall provide visual and audible status indications and user prompts. Indicate power on/off, whether user passage requests have been accepted or rejected, and whether the door is locked or unlocked.

F. Shall be utilized for controlling the locking hardware on a door and allows for reporting back to the main control panel with the time/date the door was accessed, the name of the person accessing the point of entry, and its location.

G. Will be fully programmable and addressable, locally and remotely, and hardwired to the system.

H. Shall be individually home run to the main panel.

I. Shall be installed in a manner that they comply with:
   1. The Uniform Federal Accessibility Standards (UFAS)
   2. The Americans with Disabilities Act (ADA)
   3. The ADA Standards for Accessible Design

J. Shall support a variety of card readers that must encompass a wide functional range. The PACS may combine any of the card readers described below for installations requiring multiple types of card reader capability (i.e., card only, card and/or PIN, card and/or biometrics, card and/or pin and/or biometrics, supervised inputs, etc.). These card readers shall be available in the approved technology to meet FIPS 201, and is ISO 14443 A or B, ISO/IEC 7816 compliant. The reader output can be Wiegand, RS-22, 485 or TCP/IP.

K. Shall be housed in an aluminum bezel with a wide lead-in for easy card entry.

L. Shall contain read head electronics, and a sender to encode digital door control signals.

M. LED’s shall be utilized to indicate card reader status and access status.

N. Shall be able to support a user defined downloadable off-line mode of operation (e.g. locked, unlocked), which will go in effect during loss of communication with the main control panel.

O. Shall provide audible feedback to indicate access granted/denied decisions. Upon a card swipe, two audible tones or beeps shall indicate access granted and three tones or beeps shall indicate access denied. All keypad buttons shall provide tactile audible feedback.

P. Shall have a minimum of two programmable inputs and two programmable outputs.

Q. All card readers that utilize keypad controls along with a reader and shall meet the following specifications:

1. Entry control keypads shall use a unique combination of alphanumeric and other symbols as an identifier. Keypads shall contain an integral alphanumeric/special symbols keyboard with symbols arranged in ascending ASCII code ordinal sequence. Communications protocol shall be compatible with the local processor.

R. Shall include a Light Emitting Diode (LED) or other type of visual indicator display and provide visual or visual and audible status indications and user prompts. The display shall indicate power on/off, and whether user passage requests have been accepted or rejected. The design of the keypad display or keypad enclosure shall limit the maximum horizontal and vertical viewing angles of the keypad. The maximum horizontal viewing angle shall be plus and minus five (5) degrees or less off a vertical plane perpendicular to the plane of the face of the keypad display. The maximum vertical viewing angle shall be plus and minus 15 degrees or less off a horizontal plane perpendicular to the plane of the face of the keypad display.

1. Shall respond to passage requests by generating a signal to the local processor. The response time shall be 800 milliseconds or less from the time the last alphanumeric symbol is entered until a response signal is generated.

2. Shall be powered from the source as designed and shall not dissipate more than 150 Watts.
3. Shall be suitable for surface, semi-flush, pedestal, or weatherproof mounting as required.
4. Shall provide a means for users to indicate a duress situation by entering a special code.

S. PIV Contact Card Reader

1. Application Protocol Data Unit (APDU) Support: At a minimum, the contact interface shall support all card commands for contact based access specified in Section 7, End-point PIV Card Application Card Command Interface of SP 800-73-1, Interfaces for Personal Identity Verification.
2. Buffer Size: The reader must contain a buffer large enough to receive the maximum size frame permitted by International Organization for Standardization International Electrotechnical Commission (ISO/IEC) 7816-3:1997, Section 9.4.
3. Programming Voltage: PIV Readers shall not generate a Programming Voltage.
4. Support for Operating Class: PIV Readers shall support cards with Class A Vccs as defined in ISO/IEC 7816-3:1997 and ISO/IEC 7816-3:1997/Amd 1:2002.
5. Retrieval Time: Retrieval time for 12.5 kilobytes (KB) of data through the contact interface of the reader shall not exceed 2.0 seconds.
6. Transmission Protocol: The PIV Reader shall support both the character-based T=0 protocol and block-based T=1 protocol as defined in ISO/IEC 7816-3:1997.
7. Support for PPS Procedure: The reader shall support Protocol and Parameters Selection (PPS) procedure by having the ability to read character TA1 of the Answer to Reset (ATR) sent by the card as defined in ISO/IEC 7816-3:1997.

T. Contactless Smart Cards and Readers

1. Smart card readers shall read credential cards whose characteristics of size and technology meet those defined by ISO/IEC 7816, 14443, 15693.
2. The readers shall have "flash" download capability to accommodate card format changes.

3. The card reader shall have the capability of reading the card data and transmitting the data to the main monitoring panel.
4. The card reader shall be contactless and meet or exceed the following technical characteristics:
   a. Data Output Formats: FIPS 201 low outputs the FASC-N in an assortment of Wiegand bit formats from 40 – 200 bits. FIPS 201 medium outputs a combination FASC-N and HMAC in an assortment of Wiegand bit formats from 32 – 232 bits. All Wiegand formats or the upgradeability from Low to Medium Levels can be field configured with the use of a command card.
   b. FIPS 201 readers shall be able to read, but not be limited to, DESfire and iCLASS cards.
   c. Reader range shall comply with ISO standards 7816, 14443, and 15693, and also take into consideration conditions, are at a minimum 1” to 2” (2.5 – 5 cm).
   d. APDU Support: At a minimum, the contactless interface shall support all card commands for contactless based access specified in Section 7, End-point PIV Card Application Card Command Interface of SP 800-73-1, Interfaces for Personal Identity Verification.
   e. Buffer Size: The reader shall contain a buffer large enough to receive the maximum size frame permitted by ISO/IEC 7816-3, Section 9.4.
   f. ISO 14443 Support: The PIV Reader shall support parts (1 through 4) of ISO/IEC 14443 as amended in the References of this publication.
   g. Type A and B Communication Signal Interfaces: The contactless interface of the reader shall support both the Type A and Type B communication signal interfaces as defined in ISO/IEC 14443-2:2001.
   h. Type A and B Initialization and Anti-Collision The contactless interface of the reader shall support both Type A and Type B initialization and anti-collision methods as defined in ISO/IEC 14443-3:2001.
   i. Type A and B Transmission Protocols: The contactless interface of the reader shall support both Type A and Type B transmission protocols as defined in ISO/IEC 14443-4:2001.

j. Retrieval Time: Retrieval time for 4 KB of data through the contactless interface of the reader shall not exceed 2.0 seconds.

k. Transmission Speeds: The contactless interface of the reader shall support bit rates of fc/128 (~106 kbits/s), fc/64(~212 kbits/s), and configurable to allow activation/deactivation.

l. Readibility Range: The reader shall not be able to read PIV card more than 10cm(4inch) from the reader

2.5 KEYPADS

A. Designed for use with unique combinations of alphanumeric and other symbols as an Identifier. Keys of keypads shall contain an integral alphanumeric/special symbol keyboard with symbols arranged in ascending ASCII-code ordinal sequence. Communications protocol shall be compatible with Controller.

1. Keypad display or enclosure shall limit viewing angles of the keypad as follows:

a. Maximum Horizontal Viewing Angle: 5 degrees or less off in either direction of a vertical plane perpendicular to the plane of the face of the keypad display.

b. Maximum Vertical Viewing Angle: 15 degrees or less off in either direction of a horizontal plane perpendicular to the plane of the face of the keypad display.

2. Duress Codes: Provide duress situation indication by entering a special code.

2.6 CREDENTIAL CARDS

A. Personal Identity Verification (PIV) credential cards shall comply to Federal Information Processing Standards Publication (FIPS) 201.

B. Visual Card Topography shall be compliant with NIST 800-104.

C. PIV logical credentials shall contain multiple data elements for the purpose of verifying the cardholder's identity at graduated assurance levels. These mandatory data elements shall collectively comprise the data model for PIV logical credentials, and include the following:

1. CHUID
2. PIN
3. PIV authentication data (one asymmetric key pair and corresponding certificate)
4. + Two biometric fingerprints.

D. The credential card (PIV) shall be an ISO 14443 type smart card with contactless interface that operates at 13.56 MHZ.

E. The credential card (PIV) shall be an ISO 7816 type smart card.

2.7 SYSTEM SENSORS AND RELATED EQUIPMENT

A. The PACS (Physical Access Control System) and related Equipment provided by the Contractor shall meet or exceed the following performer specifications:

B. Request to Exit Detectors:

1. Passive Infrared Request to Exit Motion Detector (REX PIR) (1) The Contractor shall provide a surface mounted motion detector to signal the physical access control system request to exit input. The motion detector shall be a passive infrared sensor designed for wall or ceiling mounting 2134 to 4572 mm (7 to 15 ft) height. The detector shall provide two (2) form "C" (SPDT) relays rated one (1) Amp. @ 30 VDC for DC resistive loads. The detectors relays shall be user adjustable with a latch time from 1-60 seconds. The detector shall also include a selectable relay reset mode to follow the timer or absence of motion. The detection pattern shall be adjustable plus or minus fourteen (± 14) degrees. The detector shall operate on 12 VDC with approximately 26 mA continuous current draw. The detector shall have an externally visible activation LED. The motion detector shall measure approximately 38 mm H x 158 mm W x 38 mm D (1.5 x 6.25 x 1.5 in). The detector shall be immune to radio frequency interference. The detector shall not activate or set-up on critical frequencies in the range 26 to 950 Megahertz using a 50 watt transmitter located 30.5 cm (1 ft) from the unit or attached wiring. The detector shall be available on gray or black enclosures. The color of the housing shall be coordinated with the surrounding surface.

C. Guard tour stations:

1. The guard tour station shall be single gang brushed steel plate flush mounted in a single gang box. The switch shall be a normally open momentary keyed switch.

D. Delayed Egress (DE)

1. General:

a. The delay egress locking hardware shall provide a method to secure emergency exits and provide an approved delayed emergency

exit method. The package shall be Underwriters Laboratories listed as a delay egress-locking device. The delay egress device shall be available to support configurations with both rated and non-rated fire doors. The delay egress device shall comply with Life Safety Codes (NFPA-101, BOCA) as it applies to special locking arrangements for delay egress locks. Unless specifically identified as a non-fire rated opening, all doors shall be equipped with fire rated door hardware. The Contractor shall be responsible for providing all equipment and installation to provide a fully functioning system. Need to amend to use crashbars type mechanical release switches.

2. The delay-locking device shall include all of the following features:
   a. Delay Egress Mode
      1) The delayed egress device shall be a SDC 101V Series Exit Check with wall mounted control module. Upon activation of an approved panic bar the delay locking device shall begin a delay sequence of 30 seconds; a flush mounted wall LED panel adjacent to the door will indicate initiation of the countdown time. During the 30 second delay period, a local sounding device shall annunciate a tone activation of the delay cycle and verbal exit instructions. At the end of the delay cycle the locking device shall unlock and allow free egress. The reset of the local sounding device shall be user definable and include options to select either local sound until silenced by reset or local sounder silenced upon opening of the door. Unless otherwise indicated the local delay sounder shall be silenced upon opening of the door. The SDC’s device trigger output shall be connected to the SMS DGP alarm panel for pre-activation warning. The contractor shall specify the bond sensor option when ordering the delayed egress hardware; this output shall be wired to the SMS DGP to activate an alarm if the door does not lock. Use of reset panel not top mounted device.
      2) Delayed egress doors will have bond sensors.
      3) Delayed egress activation shall also trigger CCTV call –up.
   b. Fire Alarm Mode

1) Upon activation of the facility's fire evacuation and water flow alarm signal the delay locking devices shall immediately unlock and provide free egress. The Contractor shall provide any required fire alarm relays or interface devices.

c. Reset Mode

1) The delay egress device shall be manually reset by the Delayed Egress controller located at the door via key switch.
2) The delay egress device shall automatically reset upon fire alarm system reset.
3) The delayed egress shall be resettable through the SMS.

d. The Contractor shall provide a Master Open Switch for all the facility's delayed egress hardware, with protective cover and permanent labeling in the Unit Control Room. The switch shall be wired into the fire alarm system to activate the evacuation alarms. When the switch is pressed all delayed egress or evacuation doors shall unlock and generate an alarm at the security console monitor showing and recording time and date of when the switch was pressed. The contractor is responsible for coordinating the wiring and connection with the fire alarm contactor. The Master Open Switch shall be linked to the fire alarm panel for the release of doors locks.

e. Each individual delayed egress door shall have the ability to unlock through a manual action on the SMS.

f. Unless otherwise indicated the Contractor shall provide all of the above reset methods for each door. All signs will meet the latest ADA requirements.

g. Signs

1) The delay egress package shall be provided with a warning sign complying with local code requirements. The warning sign shall be attached to the interior side of the controlled door. The sign shall be located on the interior side of the door above and within 304 mm (12 in) of the panic bar. The sign shall read:

EMERGENCY EXIT.
PUSH UNTIL
ALARM SOUNDS
DOOR CAN BE OPENED,

IN 30 SECONDS.

2) Signs shall be coordinated and comply with the building's existing sign specifications. Signs shall include grade 2 Braille.

3) Signs shall meet the current ADA requirements.

4) In instances of code and specification conflicts, the life safety code requirement shall prevail.

5) The Division 10 Contractor shall provide samples for approval with their submittal package.

3. Physical Access Control Interface

a. The delay egress device shall be capable of interface with card access control systems.

b. The system shall include a bypass feature that is activated via a dry contact relay output from the physical access control system. This bypass shall allow authorized personnel to pass through the controlled portal without creating an alarm condition or activating the delay egress cycle. The bypass shall include internal electronic shunts or door switches to prevent activation (re-arming) until the door returns to the closed position. An unused access event shall not cause a false alarm and shall automatically rearm the delay egress lock upon expiration of the programmed shunt time. The delay egress physical access control interface shall support extended periods of automated and/or manual lock and unlock cycles.

E. Crash Bar:

1. Emergency Exit with Alarm (Panic):

a. Entry control portals shall include panic bar emergency exit hardware as designed.

b. Panic bar emergency exit hardware shall provide an alarm shunt signal to the PACS and SMS.

c. The panic bar shall include a conspicuous warning sign with one (1) inch (2.5 cm) high, red lettering notifying personnel that an alarm will be annunciated if the panic bar is operated.

d. Operation of the panic bar hardware shall generate an intrusion alarm that reports to both the SMS and Intrusion Detection System. The use of a micro switch installed within the panic bar shall be utilized for this.

e. The panic bar shall utilize a fully mechanical connection only and shall not depend upon electric power for operation.

f. The panic bar shall be compatible with mortise or rim mount door hardware and shall operate by retracting the bolt manually by either pressing the panic bar or with a key by-pass. Refer to Section 2.2.I.9 for key-bypass specifications.

g. Normal Exit:

1) Entry control portals shall include panic bar non-emergency exit hardware as designed.

2) Panic bar non-emergency exit hardware shall be monitored by and report to the SMS.

3) Operation of the panic bar hardware shall not generate a locally audible or an intrusion alarm within the IDS.

4) When exiting, the panic bar shall depend upon a mechanical connection only. The exterior, non-secure side of the door shall be provided with an electrified thumb latch or lever to provide access after the credential I.D. authentication by the SMS.

5) The panic bar shall be compatible with mortise or rim mount door hardware and shall operate by retracting the bolt manually by either pressing the panic bar or with a key by-pass. Refer to Section 2.2.I.9 for key-bypass specifications. The strikes/bolts shall include a micro switch to indicate to the system when the bolt is not engaged or the strike mechanism is unlocked. The signal switches shall report a forced entry to the system in the event the door is left open or accessed without the identification credentials.

F. Key Bypass:

1. Shall be utilized for all doors that have a mortise or rim mounted door hardware.

2. Each door shall be individually keyed with one master key per secured area.

3. Cylinders shall be six (6)-pin and made of brass or equivalent. Keys for the cylinders shall be constructed of solid material and produced and cut by the same distributor. Keys shall not be purchased, cut, and supplied by multiple dealers.

4. All keys shall have a serial number cut into the key. No two serial numbers shall be the same.
5. All keys and cylinders shall be stored in a secure area that is monitored by the Intrusion Detection System.

G. Automatic Door Opener and Closer:
1. Shall be low energy operators.
2. Door closing force shall be adjustable to ensure adequate closing control.
3. Shall have an adjustable back-check feature to cushion the door opening speed if opened violently.
4. Motor assist shall be adjustable from 0 to 30 seconds in five (5) second increments. Motor assist shall restart the time cycle with each new activation of the initiating device.
5. Unit shall have a three-position selector mode switch that shall permit unit to be switched “ON” to monitor for function activation, switched to “H/O” for indefinite hold open function or switched to “OFF,” which shall deactivate all control functions but will allow standard door operation by means of the internal mechanical closer.
6. Door control shall be adjustable to provide compliance with the requirements of the Americans with Disabilities Act (ADA) and ANSI standards A117.1.
7. All automatic door openers and closers shall:
   a. Meet UL standards.
   b. Be fire rated.
   c. Have push and go function to activate power operator or power assist function.
   d. Have push button controls for setting door close and door open positions.
   e. Have open obstruction detection and close obstruction detection built into the unit.
   f. Have door closer assembly with adjustable spring size, back-check valve, sweep valve, latch valve, speed control valve and pressure adjustment valve to control door closing.
   g. Have motor start-up delay, vestibule interface delay; electric lock delay and door hold open delay up to 30 seconds. All operators shall close door under full spring power when power is removed.

h. Are to be hard wired with power input of 120 VAC, 60Hz and connected to a dedicated circuit breaker located on a power panel reserved for security equipment.

H. Door Status Indicators:

1. Shall monitor and report door status to the SMS.
2. Door Position Sensor:
   a. Shall provide an open or closed indication for all doors operated on the PACS and report directly to the SMS.
   b. Shall also provide alarm input to the Intrusion Detection System for all doors operated by the PACS and all other doors that require monitoring by the intrusion detection system.
   c. Switches for doors operated by the PACS shall be double pole double throw (DPDT). One side of the switch shall monitor door position and the other side if the switch shall report to the intrusion detection system. For doors with electromagnetic locks a magnetic bonding sensor (MBS) can be used in place of one side of a DPDT switch, in turn allowing for the use of a single pole double throw (SPDT) switch in it place of a DPDT switch.
   d. Switches for doors not operated by the PACS shall be SPDT and report directly to the IDS.
   e. Shall be surface or flush mounted and wide gap with the ability to operate at a maximum distance of up to 2” (5 cm).

2.8 PUSH BUTTON SWITCHES

A. Push-Button Switches: Momentary-contact back-lighted push buttons, with stainless-steel switch enclosures.

1. Electrical Ratings:
   a. Minimum continuous current rating of 10 A at 120 V ac or 5 A at 240-V ac.
   b. Contacts that will make 720 VA at 60 A and that will break at 720 VA at 10 A.
2. Enclosures: Flush or surface mounting. Push buttons shall be suitable for flush mounting in the switch enclosures.
3. Enclosures shall additionally be suitable for installation in the following locations:
   a. Indoors, controlled environment.
   b. Indoors, uncontrolled environment.
   c. Outdoors.

4. Power: Push-button switches shall be powered from their associated Controller, using dc control.

2.9 PORTAL CONTROL DEVICES

A. Shall be used to assist the PACS.

B. Such devices shall:

1. Provide a means of monitoring the doors status.
2. Allow for exiting a space via either a push button, request to exit, or panic/crash bar.
3. Provide a means of override to the PACS via a keypad or key bypass.
4. Assist door operations utilizing automatic openers and closures.
5. Provide a secondary means of access to a space via a keypad.

C. Shall be connected to and monitored by the main PACS panel.

D. Shall be installed in a manner that they comply with:

1. The Uniform Federal Accessibility Standards (UFAS)
2. The Americans with Disabilities Act (ADA)
3. The ADA Standards for Accessible Design

E. Shall provide a secondary means of physical access control within a secure area.

F. Push-Button Switches:

1. Shall be momentary contact, back lighted push buttons, and stainless steel switch enclosures for each push button as shown. Buttons are to be utilized for secondary means of releasing a locking mechanism.
   a. In an area where a push button is being utilized for remote access of the locking device then no more than two (2) buttons shall operate one door from within one secure space. Buttons will not be wired in series with one other.
   b. In an area where locally stationed guards control entry to multiple secure points via remote switches. An interface board shall be designed and constructed for only the amount of buttons it shall house. These buttons shall be flush mounted and clearly labeled for ease of use. All buttons shall be connected to the PACS and SMS system for monitoring purposes.
   c. Shall have double-break silver contacts that will make 720 VA at 60 amperes and break 720 VA at 10 amperes.

G. Entry Control Devices:

1. Shall be hardwired to the PACS main control panel and operated by either a card reader or a biometric device via a relay on the main control panel.
2. Shall be fail-safe in the event of power failure to the PACS system.
3. Shall operate at 24 VCD, with the exception of turnstiles and be powered by a separate power supply dedicated to the door control system. Each power supply shall be rated to operate a minimum of two doors simultaneously without error to the system or overload the power supply unit.
4. Shall have a diode or metal-oxide veristor (MOV) to protect the controller and power supply from reverse current surges or back-check.
5. Electric Strikes/Bolts: Shall be:
   a. Made of heavy-duty construction and tamper resistant design.
   b. Tested to over one million cycles.
   c. Rated for a minimum of 1000 lbs. holding strength.
   d. Utilize an actuating solenoid for the strike/bolt. The solenoid shall move from fully open to fully closed position and back in not more than 500 milliseconds and be rated for continuous duty.
   e. Utilize a signal switch that will indicate to the system if the strike/bolt is not engaged or is unlocked when it should be secured.
   f. Flush mounted within the door frame.
6. Electric Mortise Locks: Shall be installed within the door and an electric transfer hinge shall be utilized to allow the wires to be transferred from the door frame to the lock. If utilized with a double door then the lock shall be installed inside the active leaf. Electric Mortise Locks shall:
   a. These locks shall be provided and installed by the Division 8 “DOOR HARDWARE” Contractor.
   b. Have integrated Request to Exit switch for new doors receiving physical access control devices.
   b. Provide integration of the Electric Mortise Locks with the PACS for:
      1) Lock Power
      2) Request to Exit switch.

7. Electromagnetic Locks:
   a. These locks shall be without mechanical linkage utilizing no moving parts, and securing the door to its frame solely on electromagnetic force.
   b. Shall be comprised of two pieces, the mag-lock and the door plate. The electromagnetic locks shall be surface mounted to the door frame and the door plate shall be surface mounted to the door.
   c. Ensure a diode is installed in line with the DC voltage supplying power to the unit in order to prevent back-check on the system when the electromagnetic lock is powered.
   d. Shall utilize a magnetic bonding sensor (MBS) to monitor the door status and report that status to the SMS.
   e. Electromagnetic locks shall meet the following minimum technical characteristics:

Operating Voltage		24 VDC
Current Draw		.5A
Holding Force	Swing Doors	675 kg (1500 lbs)
	Sliding Doors	225 kg (500 lbs)

8. Turnstiles:
   a. Shall operate at 110 VAC, 60 Hz or 220 VAC, 50 Hz supplied from a dedicated circuit breaker on a security power panel. This device does not require a back-up power source.
   b. Shall be utilized as a means of monitoring and controlling access in a lobby.
   c. Shall meet the following minimum requirements:
      1) Be UFAS compliant.
      2) Provide either an audible or visual confirmation that access has been granted to a cleared individual.
      3) Provide an audible alarm in the event a non-cleared individual is attempting to gain access.
      4) Interface with the SMS and utilize a card reader for accessing and exiting a facility, and provide a recorded event of personnel accessing these points.
      5) Have a built-in step-down transformer to provide power to a card reader unit.

6) Have built-in signal wiring chassis to allow for plug and play capabilities with the PACS.
7) Have the ability to detect tailgating within one quarter on an inch to prevent unauthorized access to a facility.

9. Vehicle Gate Operator: Interface electrical operation of gate with controls of this Section. Vehicle gate operators shall be connected, monitored, and controlled, by the security access Controllers. Vehicle gate and accessories are specified in Division 32 Section "Chain Link Fences and Gates."

2.10 SECONDARY ALARM ANNUNCIATOR

A. Secondary Alarm Annunciation Site: A workstation with limited I/O capacity, consisting of a secondary alarm annunciation workstation to allow the operator to duplicate functions of the main operator interface, and to show system status changes.

2.11 INTERFACES

A. CCTV System Interface
1. An RS232 Ethernet interface associated driver, and controller shall be provided for connection of the SMS Central Computer to the CCTV Alarm interface and switcher. The interface shall provide alarm data to the CCTV Alarm interface for automatic camera call-up. If required the Security Contractor shall be responsible for programming the command strings into the SMS Server.

B. Power Supplies:
1. Shall be UL rated and able to adequately power (enter number) entry control devices on a continuous base without failure.
2. Shall meet the following minimum technical characteristics:

INPUT POWER	110 VAC 60 HZ (enter amperage)A
OUTPUT VOLTAGE	12 VDC Nominal (13.8 VDC) 24 VDC Nominal (27.6 VDC) Filtered and Regulated
BATTERY	Dependant on Output Voltage shall provide up to 5.1 Ah
OUTPUT CURRENT	10 amp max. @ 13.8 VDC 5 amp max. @ 27.6 VDC
PRIMARY FUSE SIZE	6.3 amp (non-removable)

BATTERY FUSE SIZE	12 amp, 3AG
CHARGING CIRCUIT	Built-in standard

2.12 REAL TIME GUARD TOUR

A. Guard tour module shall provide the ability to plan, track, and route tours. Module shall input an alarm during tour if guard fails to make a station. Tours can be programmed for sequential or random tour-station order.

1. Guard tour setup shall define specific routes or tours for the guard to take, with time restrictions in which to reach every predefined tour station.
2. Guard tour activity shall be automatically logged to the central-station PC's hard drive.
3. If the guard is early or late to a tour station, a unique alarm per station shall appear at the Central Station to indicate the time and station.
4. Guard tour setup shall allow the tours to be executed sequentially or in a random order with an overall time limit set for the entire tour instead of individual times for each tour station.
5. Setup shall allow recording of predefined responses that will display for the operator at the control station should a "Failed to Check-in" alarm occur.

B. A tour station is a physical location a guard shall reach and perform an action indicating that the guard has arrived. This action, performed at the tour station, shall be 1 of 13 different events with any combination of station types within the same tour. A tour station shall be one of the following event types:

1. Access Granted.
2. Access Denied Code.
3. Access Denied Card plus PIN.
4. Access Denied Time Zone.
5. Access Denied Level.
6. Access Denied Facility.
7. Access Denied Code Timer.
8. Access Denied Anti-Passback.
9. Access Granted Passback Violation.
10. Alarm.

11. Restored.
12. Input Normal.
13. Input Abnormal.

C. Guard tour and other system features shall operate simultaneously with no interference.

D. Guard Tour Module Capacity: 999 possible guard tour definitions with each tour having up to 99 tour stations. System shall allow all 999 tours to be running at same time.

2.13 VIDEO AND CAMERA CONTROL

A. Control station or designated workstation displays live video from a CCTV source.

1. Control Buttons: On the display window, with separate control buttons to represent Left, Right, Up, Down, Zoom In, Zoom Out, Scan, and a minimum of two custom command auxiliary controls.
2. Provide at least seven icons to represent different types of cameras, with ability to import custom icons. Provide option for display of icons on graphic maps to represent their physical location.
3. Provide the alarm-handling window with a command button that will display the camera associated with the alarm point.

B. Display mouse-selectable icons representing each camera source, to select source to be displayed. For CCTV sources that are connected to a video switcher, control station shall automatically send control commands through a COM port to display the requested camera when the camera icon is selected.

C. Allow cameras with preset positioning to be defined by displaying a different icon for each of the presets. Provide control with Next and Previous buttons to allow operator to cycle quickly through the preset positions.

2.14 WIRES AND CABLES

A. Refer to section 280513 "CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY".

B. Comply with Division 28 Section "CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY."

C. PVC-Jacketed, RS-232 Cable: Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, polypropylene insulation, and individual aluminum foil-polyester tape shielded pairs with 100 percent

shield coverage; PVC jacket. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.

1. NFPA 70, Type CM.
2. Flame Resistance: UL 1581 Vertical Tray.

D. Plenum-Type, RS-232 Cable: Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, plastic insulation, and individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage; plastic jacket. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.

1. NFPA 70, Type CMP.
2. Flame Resistance: NFPA 262 Flame Test.

E. RS-485 communications require 2 twisted pairs, with a distance limitation of 4000 feet (1220 m).

F. PVC-Jacketed, RS-485 Cable: Paired, 2 pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors, PVC insulation, unshielded, PVC jacket, and NFPA 70, Type CMG.

G. Plenum-Type, RS-485 Cable: Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, fluorinated-ethylene-propylene insulation, unshielded, and fluorinated-ethylene-propylene jacket.

1. NFPA 70, Type CMP.
2. Flame Resistance: NFPA 262 Flame Test.

H. Multiconductor, Readers and Wiegand Keypads Cables: No. 22 AWG, paired and twisted multiple conductors, stranded (7x30) tinned copper conductors, semirigid PVC insulation, overall aluminum foil-polyester tape shield with 100 percent shield coverage, plus tinned copper braid shield with 65 percent shield coverage, and PVC jacket.

1. NFPA 70, Type CMG.
2. Flame Resistance: UL 1581 Vertical Tray.
3. For TIA/EIA-RS-232 applications.

I. Paired Readers and Wiegand Keypads Cables: Paired, 3 pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors, polypropylene insulation, individual aluminum foil-polyester tape shielded pairs each with No. 22 AWG, stranded tinned copper drain wire, 100 percent shield coverage, and PVC jacket.

1. NFPA 70, Type CM.
2. Flame Resistance: UL 1581 Vertical Tray.

J. Paired Readers and Wiegand Keypads Cable: Paired, 3 pairs, twisted, No. 20 AWG, stranded (7x28) tinned copper conductors, polyethylene (polyolefin) insulation, individual aluminum foil-polyester tape shielded pairs each with No. 22 AWG, stranded (19x34) tinned copper drain wire, 100 percent shield coverage, and PVC jacket.
   1. NFPA 70, Type CM.
   2. Flame Resistance: UL 1581 Vertical Tray.

K. Plenum-Type, Paired, Readers and Wiegand Keypads Cable: Paired, 3 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, plastic insulation, individual aluminum foil-polypropylene tape shielded pairs each with No. 22 AWG, stranded tinned copper drain wire, 100 percent shield coverage, and fluorinated-ethylene-propylene jacket.
   1. NFPA 70, Type CMP.
   2. Flame Resistance: NFPA 262 Flame Test.

L. Plenum-Type, Multiconductor, Readers and Keypads Cable: 6 conductors, No. 20 AWG, stranded (7x28) tinned copper conductors, fluorinated-ethylene-propylene insulation, overall aluminum foil-polyester tape shield with 100 percent shield coverage plus tinned copper braid shield with 85 percent shield coverage, and fluorinated-ethylene-propylene jacket.
   1. NFPA 70, Type CMP.
   2. Flame Resistance: NFPA 262 Flame Test.

M. Paired Lock Cable: 1 pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors, PVC insulation, unshielded, and PVC jacket.
   1. NFPA 70, Type CMG.
   2. Flame Resistance: UL 1581 Vertical Tray.

N. Plenum-Type, Paired Lock Cable: 1 pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors, PVC insulation, unshielded, and PVC jacket.
   1. NFPA 70, Type CMP.
   2. Flame Resistance: NFPA 262 Flame Test.

O. Paired Lock Cable: 1 pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors, PVC insulation, unshielded, and PVC jacket.
   1. NFPA 70, Type CMG.
   2. Flame Resistance: UL 1581 Vertical Tray.

P. Plenum-Type, Paired Lock Cable: 1 pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors, fluorinated-ethylene-propylene insulation, unshielded, and plastic jacket.
   1. NFPA 70, Type CMP.
   2. Flame Resistance: NFPA 262 Flame Test.
Q. Paired Input Cable: 1 pair, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors, polypropylene insulation, overall aluminum foil-polyester tape shield with No. 22 AWG, stranded (7x30) tinned copper drain wire, 100 percent shield coverage, and PVC jacket.
   1. NFPA 70, Type CMR.
   2. Flame Resistance: UL 1666 Riser Flame Test.
R. Plenum-Type, Paired Input Cable: 1 pair, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors, fluorinated-ethylene-propylene insulation, aluminum foil-polyester tape shield (foil side out), with No. 22 AWG drain wire, 100 percent shield coverage, and plastic jacket.
   1. NFPA 70, Type CMP.
   2. Flame Resistance: NFPA 262 Flame Test.
S. Paired AC Transformer Cable: 1 pair, twisted, No. 18 AWG, stranded (7x26) tinned copper conductors, PVC insulation, unshielded, and PVC jacket.
   1. NFPA 70, Type CMG.
T. Plenum-Type, Paired AC Transformer Cable: 1 pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors, fluorinated-ethylene-propylene insulation, unshielded, and plastic jacket.
   1. NFPA 70, Type CMP.
   2. Flame Resistance: NFPA 262 Flame Test.
U. Elevator Travel Cable: Steel center core, with shielded, twisted pairs, No. 20 AWG conductor size.
   1. Steel Center Core Support: Preformed, flexible, low-torsion, zinc-coated, steel wire rope; insulated with 60 deg C flame-resistant PVC and covered with a nylon or cotton braid.
   2. Shielded Pairs: Insulated copper conductors; color-coded, insulated with 60 deg C flame-resistant PVC; each pair shielded with bare copper braid for 85 percent coverage.
   3. Jute Filler: Electrical grade, dry.
   4. Binder: Helically wound synthetic fiber.
   5. Braid: Rayon or cotton braid applied with 95 percent coverage.

6. Jacket: 60 deg C PVC specifically compounded for flexibility and abrasion resistance. UL VW-1 and CSA FT1 flame rated.

V. LAN (Ethernet) Cabling: Comply with Division 28 Section "Conductors and Cables for Electronic Safety and Security."

PART 3 - EXECUTION

3.1 GENERAL

A. The Contractor shall install all system components and appurtenances in accordance with the manufacturers' instructions, ANSI C2, and shall furnish all necessary interconnections, services, and adjustments required for a complete and operable system as specified. Control signals, communications, and data transmission lines grounding shall be installed as necessary to preclude ground loops, noise, and surges from affecting system operation. Equipment, materials, installation, workmanship, inspection, and testing shall be in accordance with manufacturers' recommendations and as modified herein.

B. Consult the manufacturers' installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation. Refer to the Riser/Connection diagram for all schematic system installation/termination/wiring data.

C. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., sensors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

3.2 CURRENT SITE CONDITIONS

A. The Contractor shall visit the site and verify that site conditions are in agreement with the design package. The Contractor shall report all changes to the site or conditions which will affect performance of the system to the Owner in a report as defined in paragraph Group II Technical Data Package. The Contractor shall not take any corrective action without written permission from the Owner.

3.3 EXAMINATION

A. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation.

B. Examine roughing-in for LAN and control cable conduit systems to PCs, Controllers, card readers, and other cable-connected devices to verify actual locations of conduit and back boxes before device installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.4 PREPARATION

A. Comply with recommendations in SIA CP-01.

B. Comply with EIA/TIA-606, "Administration Standard for the Telecommunications Infrastructure of Commercial Buildings."

C. Obtain detailed Project planning forms from manufacturer of access-control system; develop custom forms to suit Project. Fill in all data available from Project plans and specifications and publish as Project planning documents for review and approval.

1. Record setup data for control station and workstations.
2. For each Location, record setup of Controller features and access requirements.
3. Propose start and stop times for time zones and holidays, and match up access levels for doors.
4. Set up groups, linking, and list inputs and outputs for each Controller.
5. Assign action message names and compose messages.
6. Set up alarms. Establish interlocks between alarms, intruder detection, and video surveillance features.
7. Prepare and install alarm graphic maps.
8. Develop user-defined fields.
9. Develop screen layout formats.
10. Propose setups for guard tours and key control.
11. Discuss badge layout options; design badges.
12. Complete system diagnostics and operation verification.
13. Prepare a specific plan for system testing, startup, and demonstration.
14. Develop acceptance test concept and, on approval, develop specifics of the test.
15. Develop cable and asset management system details; input data from construction documents. Include system schematics and Technical Drawings.

D. In meetings with Architect and Owner, present Project planning documents and review, adjust, and prepare final setup documents. Use final documents to set up system software.

3.5 CABLING

A. Comply with NECA 1, "Good Workmanship in Electrical Contracting."

B. Install cables and wiring according to requirements in Division 28 Section "Conductors and Cables for Electronic Safety and Security."

C. Wiring Method: Install wiring in raceway and cable tray except within consoles, cabinets, desks, and counters. Conceal raceway and wiring except in unfinished spaces.

D. Wiring Method: Install wiring in raceway and cable tray except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Use NRTL-listed plenum cable in environmental air spaces, including plenum ceilings. Conceal raceway and cables except in unfinished spaces.

E. Install LAN cables using techniques, practices, and methods that are consistent with Category 5E rating of components and that ensure Category 5E performance of completed and linked signal paths, end to end.

F. Install cables without damaging conductors, shield, or jacket.

G. Boxes and enclosures containing security system components or cabling, and which are easily accessible to employees or to the public, shall be provided with a lock. Boxes above ceiling level in occupied areas of the building shall not be considered to be accessible. Junction boxes and small device enclosures below ceiling level and easily accessible to employees or the public shall be covered with a suitable cover plate and secured with tamperproof screws.

H. Install end-of-line resistors at the field device location and not at the Controller or panel location.

3.6 CABLE APPLICATION

A. Comply with EIA/TIA-569, "Commercial Building Standard for Telecommunications Pathways and Spaces."

B. Cable application requirements are minimum requirements and shall be exceeded if recommended or required by manufacturer of system hardware.

C. RS-232 Cabling: Install at a maximum distance of 50 feet (15 m).

D. RS-485 Cabling: Install at a maximum distance of 4000 feet (1220 m).

E. Card Readers and Keypads:
   1. Install number of conductor pairs recommended by manufacturer for the functions specified.
   2. Unless manufacturer recommends larger conductors, install No. 22 AWG wire if maximum distance from Controller to the reader is 250 feet (75 m), and install No. 20 AWG wire if maximum distance is 500 feet (150 m).
   3. For greater distances, install "extender" or "repeater" modules recommended by manufacturer of the Controller.
   4. Install minimum No. 18 AWG shielded cable to readers and keypads that draw 50 mA or more.
F. Install minimum No. 16 AWG cable from Controller to electrically powered locks. Do not exceed 250 feet (75 m).
G. Install minimum No. 18 AWG ac power wire from transformer to Controller, with a maximum distance of 25 feet (8 m).

3.7 GROUNDING

A. Comply with Division 26 Section "Grounding and Bonding for Electrical Systems."
B. Comply with IEEE 1100, "Power and Grounding Sensitive Electronic Equipment."
C. 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.
D. Signal Ground:
   1. Terminal: Locate in each equipment room and wiring closet; isolate from power system and equipment grounding.
   2. Bus: Mount on wall of main equipment room with standoff insulators.
   3. Backbone Cable: Extend from signal ground bus to signal ground terminal in each equipment room and wiring closet.

3.8 INSTALLATION

A. System installation shall be in accordance with UL 294, manufacturer and related documents and references, for each type of security subsystem designed, engineered and installed.
B. Components shall be configured with appropriate “service points” to pinpoint system trouble in less than 30 minutes.
C. The Contractor shall install all system components including Government furnished equipment, and appurtenances in accordance with the

manufacturer's instructions, documentation listed in Sections 1.4 and 1.5 of this document, and shall furnish all necessary connectors, terminators, interconnections, services, and adjustments required for a operable system.

D. The PACS will be designed, engineered, installed, and tested to ensure all components are fully compatible as a system and can be integrated with all associated security subsystems, whether the system is a stand alone or a network.

E. For integration purposes, the PACS shall be integrated where appropriate with the following associated security subsystems:

1. CCTV:
   a. Provide 24 hour coverage of all entry points to the perimeter and agency buildings. As well as all emergency exits utilizing a fixed color camera.
   b. Be able to monitor, control and record cameras on a 24 hours basis.
   c. Be programmed automatically call up a camera when an access point is but into an alarm state.
   d. For additional PACS system requirements as they relate to the CCTV, refer to Section 28 23 00, VIDEO SURVEILLANCE.
2. IDS:
   a. Be able monitor door control sensors.
   b. Be able to monitor and control the IDS on a 24 hours basis.
   c. Be programmed to go into an alarm state when an IDS device is put into an alarm state, and notify the operator via an audible alarm.
3. Security Access Detection:
   a. Be able to monitor all objects that have been screened with an x-ray machine and be able to monitor all data acquired by the bomb detection unit.
   b. For additional PACS system requirements as they relate to the Security Access Detection, refer to Section 28 13 53, SECURITY ACCESS DETECTION.
4. EPPS:
   a. Be programmed to go into an alarm state when an emergency call box or duress alarm/panic device is activated, and notify the

Physical Access Control System and Database Management of an alarm event.

b. For additional PACS requirements as they relate to the EPPS, refer to Section 28 26 00, ELECTRONIC PERSONAL PROTECTION SYSTEM.

F. Integration with these security subsystems shall be achieved by computer programming or the direct hardwiring of the systems.

G. For programming purposes refer to the manufacturers requirements for correct system operations. Ensure computers being utilized for system integration meet or exceed the minimum system requirements outlined on the systems software packages.

H. The Contractor shall visit the site and verify that site conditions are in agreement with the design package. The Contractor shall report all changes to the site or conditions that will affect performance of the system. The Contractor shall not take any corrective action without written permission from the Government.

I. The Contractor shall visit the site and verify that site conditions are in agreement/compliance with the design package. The Contractor shall report all changes to the site or conditions that will affect performance of the system to the Contracting Officer in the form of a report. The Contractor shall not take any corrective action without written permission received from the Contracting Officer.

J. Existing Equipment:

1. The Contractor shall connect to and utilize existing door equipment, control signal transmission lines, and devices as outlined in the design package. Door equipment and signal lines that are usable in their original configuration without modification may be reused with Contracting Officer approval.

2. The Contractor shall perform a field survey, including testing and inspection of all existing door equipment and signal lines intended to be incorporated into the PACS, and furnish a report to the Contracting Officer as part of the site survey report. For those items considered nonfunctioning, provide (with the report) specification sheets, or written functional requirements to support the findings and the estimated cost to correct the deficiency. As part of the report, the Contractor shall include a schedule for connection to all existing equipment.

3. The Contractor shall make written requests and obtain approval prior to disconnecting any signal lines and equipment, and creating equipment downtime. Such work shall proceed only after receiving Contracting Officer approval of these requests. If any device fails after the Contractor has commenced work on that device, signal or control line, the Contractor shall diagnose the failure and perform any necessary corrections to the equipment.
4. The Contractor shall be held responsible for repair costs due to Contractor negligence, abuse, or improper installation of equipment.
5. The Contracting Officer shall be provided a full list of all equipment that is to be removed or replaced by the Contractor, to include description and serial/manufacturer numbers where possible. The Contractor shall dispose of all equipment that has been removed or replaced based upon approval of the Contracting Officer after reviewing the equipment removal list. In all areas where equipment is removed or replaced the Contractor shall repair those areas to match the current existing conditions.

K. Enclosure Penetrations: All enclosure penetrations shall be from the bottom of the enclosure unless the system design requires penetrations from other directions. Penetrations of interior enclosures involving transitions of conduit from interior to exterior, and all penetrations on exterior enclosures shall be sealed with rubber silicone sealant to preclude the entry of water and will comply with VA Master Specification 07 84 00, Firestopping. The conduit riser shall terminate in a hot-dipped galvanized metal cable terminator. The terminator shall be filled with an approved sealant as recommended by the cable manufacturer and in such a manner that the cable is not damaged.

L. Cold Galvanizing: All field welds and brazing on factory galvanized boxes, enclosures, and conduits shall be coated with a cold galvanized paint containing at least 95 percent zinc by weight.

M. Control Panels:
1. Connect power and signal lines to the controller.
2. Program the panel as outlined by the design and per the manufacturer’s programming guidelines.

N. SMS:
1. Coordinate with the VA agency’s IT personnel to place the computer on the local LAN or Intranet and provide the security system

protection levels required to insure only authorized VA personnel have access to the system.

2. Program and set-up the SMS to ensure it is in fully operation.

O. Card Readers:

1. Connect all signal inputs and outputs as shown and specified.
2. Terminate input signals as required.
3. Program and address the reader as per the design package.
4. Readers shall be surface or flushed mounted and all appropriate hardware shall be provided to ensure the unit is installed in an enclosed conduit system.

P. Biometrics:

1. Connect all signal input and output cables along with all power cables.
2. Program and ensure the device is in operating order.

Q. Portal Control Devices:

1. Install all signal input and output cables as well as all power cables.
2. Devices shall be surface or flush mounted as per the design package.
3. Program all devices and ensure they are working.

R. Door Status Indicators:

1. Install all signal input and output cables as well as all power cables.
2. RTE’s shall be surface mounted and angled in a manner that they cannot be compromised from the non-secure side of a windowed door, or allow for easy release of the locking device from a distance no greater than 6 feet from the base of the door.
3. Door position sensors shall be surface or flush mounted and wide gap with the ability to operate at a maximum distance of up to 2” (5 cm).

S. Entry Control Devices:

1. Install all signal input and power cables.
2. Strikes and bolts shall be mounted within the door frame.
3. Mortise locks shall be mounted within the door and an electric transfer hinge shall be utilized to transfer the wire from within the door frame to the mortise lock inside the door.
4. Electromagnetic locks shall be installed with the mag-lock mounted to the door frame and the metal plate mounted to the door.

T. System Start-Up:

1. The Contractor shall not apply power to the PACS until the following items have been completed:
   a. PACS equipment items and have been set up in accordance with manufacturer's instructions.
   b. A visual inspection of the PACS has been conducted to ensure that defective equipment items have not been installed and that there are no loose connections.
   c. System wiring has been tested and verified as correctly connected as indicated.
   d. All system grounding and transient protection systems have been verified as installed and connected as indicated.
   e. Power supplies to be connected to the PACS have been verified as the correct voltage, phasing, and frequency as indicated.
2. Satisfaction of the above requirements shall not relieve the Contractor of responsibility for incorrect installation, defective equipment items, or collateral damage as a result of Contractor work efforts.
3. The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and Commissioning Agent. Provide a minimum of 7 days prior notice.

U. Supplemental Contractor Quality Control:

1. The Contractor shall provide the services of technical representatives who are familiar with all components and installation procedures of the installed PACS; and are approved by the Contracting Officer.
2. The Contractor will be present on the job site during the preparatory and initial phases of quality control to provide technical assistance.
3. The Contractor shall also be available on an as needed basis to provide assistance with follow-up phases of quality control.
4. The Contractor shall participate in the testing and validation of the system and shall provide certification that the system installed is fully operational as all construction document requirements have been fulfilled.

3.9 SYSTEM SOFTWARE

A. Install, configure, and test software and databases for the complete and proper operation of systems involved. Assign software license to Owner.

3.10 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Testing Agency: Engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports:

C. Perform the following field tests and inspections and prepare test reports:

1. LAN Cable Procedures: Inspect for physical damage and test each conductor signal path for continuity and shorts. Use Class 2, bidirectional, Category 5 tester. Test for faulty connectors, splices, and terminations. Test according to TIA/EIA-568-1, "Commercial Building Telecommunications Cabling Standards - Part 1 General Requirements." Link performance for UTP cables must comply with minimum criteria in TIA/EIA-568-B.
2. Test each circuit and component of each system. Tests shall include, but are not limited to, measurements of power supply output under maximum load, signal loop resistance, and leakage to ground where applicable. System components with battery backup shall be operated on battery power for a period of not less than 10 percent of the calculated battery operating time. Provide special equipment and software if testing requires special or dedicated equipment.
3. Operational Test: After installation of cables and connectors, demonstrate product capability and compliance with requirements. Test each signal path for end-to-end performance from each end of all pairs installed. Remove temporary connections when tests have been satisfactorily completed.

3.11 PROTECTION

A. Maintain strict security during the installation of equipment and software. Rooms housing the control station, and workstations that have been powered up shall be locked and secured, with an activated burglar alarm and access-control system reporting to a Central Station

complying with UL 1610, "Central-Station Burglar-Alarm Units," during periods when a qualified operator in the employ of Contractor is not present.

3.12 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 28 08 00 – COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.

B. Components provided under this section of the specification will be tested as part of a larger system. Refer to Section 28 08 00 – COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS and related sections for contractor responsibilities for system commissioning.

3.13 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer’s technical representative for four hours to instruct VA personnel in operation and maintenance of units.

B. Submit training plans and instructor qualifications in accordance with the requirements of Section 28 08 00 – COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS.

C. Develop separate training modules for the following:

1. Computer system administration personnel to manage and repair the LAN and databases and to update and maintain software.
2. Operators who prepare and input credentials to man the control station and workstations and to enroll personnel.
3. Security personnel.
4. Hardware maintenance personnel.
5. Corporate management.

D. All testing and training shall be compliant with the VA General Requirements, Section 01 00 00, GENERAL REQUIREMENTS.

---END---

SECTION 28 23 00

VIDEO SURVEILLANCE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Provide and install a complete Video Surveillance System, which is identified as the Video Assessment and Surveillance System hereinafter referred to as the VASS System as specified in this section.

B. This Section includes video surveillance system consisting of cameras, data transmission wiring, and a control station with its associated equipment.

1.2 RELATED WORK

A. Section 01 00 00 - GENERAL REQUIREMENTS. For General Requirements.

B. Section 07 84 00 - FIRESTOPPING. Requirements for firestopping application and use.

C. Section 10 14 00 - SIGNAGE. Requirements for labeling and signs.

D. Section 26 05 11 - REQUIREMENTS FOR ELECTRICAL INSTALLATIONS. Requirements for connection of high voltage.

E. Section 26 05 19 - LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES. Requirements for power cables.

F. Section 28 05 00 – COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY. Requirements for general requirements that are common to more than one section in Division 28.

G. Section 28 05 13 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for conductors and cables.

H. Section 28 05 26 - GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY. Requirements for grounding of equipment.

I. Section 28 05 28.33 - CONDUITS AND BACKBOXES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for infrastructure.

J. Section 28 08 00 - COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY. Requirements for commissioning, systems readiness checklists, and training.

K. Section 28 13 00 - PHYSICAL ACCESS CONTROL SYSTEM. Requirements for physical access control system integration.

1.3 DEFINITIONS

A. AGC: Automatic gain control.

B. B/W: Black and white.

C. CCD: Charge-coupled device.

D. CIF: Common Intermediate Format CIF images are 352 pixels wide and 88/240 (PAL/NTSC) pixels tall (352 x 288/240).

E. 4CIF: resolution is 704 pixels wide and 576/480 (PAL/NTSC) pixels tall (704 x 576/480).

F. H.264 (also known as MPEG4 Part 10): a encoding format that compresses video much more effectively than older (MPEG4) standards.

G. ips: Images per second.

H. MPEG: Moving picture experts group.

I. MPEG4: a video encoding and compression standard that uses inter-frame encoding to significantly reduce the size of the video stream being transmitted.

J. NTSC: National Television System Committee.

K. UPS: Uninterruptible power supply.

L. PTZ: refers to a movable camera that has the ability to pan left and right, tilt up and down, and zoom or magnify a scene.

1.4 QUALITY ASSURANCE

A. The Contractor shall be responsible for providing, installing, and the operation of the VASS System as shown. The Contractor shall also provide certification as required.

B. The security system shall be installed and tested to ensure all components are fully compatible as a system and can be integrated with all associated security subsystems, whether the security system is stand-alone or a part of a complete Information Technology (IT) computer network.

C. The Contractor or security sub-contractor shall be a licensed security Contractor as required within the state or jurisdiction of where the installation work is being conducted.

D. Manufacturers Qualifications: The manufacturer shall regularly and presently produce, as one of the manufacturer's principal products, the equipment and material specified for this project, and shall have manufactured the item for at least three years.

E. Product Qualification:

1. Manufacturer's product shall have been in satisfactory operation, on three installations of similar size and type as this project, for approximately three years.

2. The Government reserves the right to require the Contractor to submit a list of installations where the products have been in operation before approval.

F. Contractor Qualification:

1. The Contractor or security sub-contractor shall be a licensed security Contractor with a minimum of five (5) years experience installing and servicing systems of similar scope and complexity. The Contractor shall be an authorized regional representative of the Video Assessment and Surveillance System's (VASS) manufacturer. The Contractor shall provide four (4) current references from clients with systems of similar scope and complexity which became operational in the past three (3) years. At least three (3) of the references shall be utilizing the same system components, in a similar configuration as the proposed system. The references must include a current point of contact, company or agency name, address, telephone number, complete system description, date of completion, and approximate cost of the project. The owner reserves the option to visit the reference sites, with the site owner's permission and representative, to verify the quality of installation and the references' level of satisfaction with the system. The Contractor shall provide copies of system manufacturer certification for all technicians. The Contractor shall only utilize factory-trained technicians to install, program, and service the VASS. The Contractor shall only utilize factory-trained technicians to install, terminate and service cameras, control, and recording equipment. The technicians shall have a minimum of five (5) continuous years of technical experience in electronic security systems. The Contractor shall have a local service facility. The facility shall be located within 60 miles of the project site. The local facility shall include sufficient spare parts inventory to support the service requirements associated with this contract. The facility shall also include appropriate diagnostic equipment to perform diagnostic procedures. The COR reserves the option of surveying the company's facility to verify the service inventory and presence of a local service organization.

2. The Contractor shall provide proof project superintendent with BICSI Certified Commercial Installer Level 1, Level 2, or Technician to provide oversight of the project.
3. Cable installer must have on staff a Registered Communication Distribution Designer (RCDD) certified by Building Industry Consulting Service International. The staff member shall provide consistent oversight of the project cabling throughout design, layout, installation, termination and testing.

G. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within four eight hours of receipt of notification that service is needed. Submit name and address of service organizations.

1.5 SUBMITTALS

A. Submit below items in conjunction with Master Specification Sections 01 33 23, Shop Drawings, Product Data, and Samples.

B. Provide certificates of compliance with Section 1.4, Quality Assurance.

C. Provide a pre-installation and as-built design package in both electronic format and on paper, minimum size 1220 x 1220 millimeters (48 x 48 inches); drawing submittals shall be per the established project schedule.

D. Pre-installation design and as-built packages shall include, but not be limited to:

1. Index Sheet that shall:
   a. Define each page of the design package to include facility name, building name, floor, and sheet number.
   b. Provide a list of all security abbreviations and symbols.
   c. Reference all general notes that are utilized within the design package.
   d. Specification and scope of work pages for all security systems that are applicable to the design package that will:
      1) Outline all general and job specific work required within the design package.
      2) Provide a device identification table outlining device Identification (ID) and use for all security systems equipment utilized in the design package.
2. Floor plans, site plans, and enlarged plans shall:

a. Include a title block as defined above.
b. Define the drawings scale in both standard and metric measurements.
c. Provide device identification and location.
d. Address all signal and power conduit runs and sizes that are associated with the design of the electronic security system and other security elements (e.g., barriers, etc.).
e. Identify all pull box and conduit locations, sizes, and fill capacities.
f. Address all general and drawing specific notes for a particular drawing sheet.

3. A riser drawing for each applicable security subsystem shall:
   a. Indicate the sequence of operation.
   b. Relationship of integrated components on one diagram.
   c. Include the number, size, identification, and maximum lengths of interconnecting wires.
   d. Wire/cable types shall be defined by a wire and cable schedule. The schedule shall utilize a lettering system that will correspond to the wire/cable it represents (example: A = 18 AWG/1 Pair Twisted, Unshielded). This schedule shall also provide the manufacturer’s name and part number for the wire/cable being installed.
4. A system drawing for each applicable security system shall:
   a. Identify how all equipment within the system, from main panel to device, shall be laid out and connected.
   b. Provide full detail of all system components wiring from point-to-point.
   c. Identify wire types utilized for connection, interconnection with associate security subsystems.
   d. Show device locations that correspond to the floor plans.
   e. All general and drawing specific notes shall be included with the system drawings.
5. A schedule for all of the applicable security subsystems shall be included. All schedules shall provide the following information:
   a. Device ID.
   b. Device Location (e.g. site, building, floor, room number, location, and description).

c. Mounting type (e.g. flush, wall, surface, etc.).

d. Power supply or circuit breaker and power panel number.

e. In addition, for the VASS Systems, provide the camera ID, camera type (e.g. fixed or pan/tilt/zoom (P/T/Z), lens type (e.g. for fixed cameras only) and housing model number.

6. Detail and elevation drawings for all devices that define how they were installed and mounted.

E. Pre-installation design packages shall be reviewed by the Contractor along with a VA representative to ensure all work has been clearly defined and completed. All reviews shall be conducted in accordance with the project schedule. There shall be four (4) stages to the review process:

1. 35 percent
2. 65 percent
3. 90 percent
4. 100 percent

F. Provide manufacturer security system product cut-sheets. Submit for approval at least 30 days prior to commencement of formal testing, a Security System Operational Test Plan. Include procedures for operational testing of each component and security subsystem, to include performance of an integrated system test.

G. Submit manufacture’s certification of Underwriters Laboratories, Inc. (UL) listing as specified. Provide all maintenance and operating manuals per the VA General Requirements, Section 01 00 00, GENERAL REQUIREMENTS.

H. Submit completed System Readiness Checklists provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 28 08 00 COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS.

1.6 APPLICABLE PUBLICATIONS

A. The publications listed below (including amendments, addenda, revisions, supplement, and errata) form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American National Standards Institute (ANSI)/Electronic Industries Alliance (EIA):

330-09.....Electrical Performance Standards for CCTV Cameras

375A-76.....Electrical Performance Standards for CCTV Monitors

C. Institute of Electrical and Electronics Engineers (IEEE):

C62.41-02.....IEEE Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits

802.3af-08.....Power over Ethernet Standard

D. Federal Communications Commision (FCC):

(47 CFR 15) Part 15 Limitations on the Use of Wireless Equipment/Systems

E. National Electrical Contractors Association (NECA):

303-2005.....Installing Closed Circuit Television (CCTV) Systems

F. National Fire Protection Association (NFPA):

70-20.....Article 780-National Electrical Code

G. Federal Information Processing Standard (FIPS):

140-2-02.....Security Requirements for Cryptographic Modules

H. Underwriters Laboratories, Inc. (UL):

983-06.....Standard for Surveillance Camera Units

3044-01.....Standard for Surveillance Closed Circuit Television Equipment

1.7 COORDINATION

A. Coordinate arrangement, mounting, and support of video surveillance equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for video surveillance items that are behind finished surfaces or otherwise concealed.

1.8 WARRANTY OF CONSTRUCTION

A. Warrant VASS System work subject to the Article "Warranty of Construction" of FAR clause 52.246-21.

B. Demonstration and training shall be performed prior to system acceptance.

PART 2 - PRODUCTS

2.1 GENERAL

A. Video signal format shall comply with the NTSC standard composite video, interlaced. Composite video signal termination shall be 75 ohms.

B. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor entry connection to components.

C. Power Connections: Comply with requirements in Section 28 05 00 COMMON WORK REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY, Part 2, as recommended by manufacturer for type of line being protected.

D. Tamper Protection: Tamper switches on enclosures, control units, pull boxes, junction boxes, cabinets, and other system components shall initiate a tamper-alarm signal when unit is opened or partially disassembled. Control-station, control-unit alarm display shall identify tamper alarms and indicate locations.

2.2 CAMERAS

A. All Cameras will be EIA 330 and UL 1.Minimum Protection for Power Connections 120 V and more: Auxiliary panel suppressors shall comply with requirements in Section 28 05 00 COMMON WORK REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY, Part 2.

B. Minimum Protection for Communication, Signal, Control, and Low-Voltage 983 compliant as well as:

1. Will be charge coupled device (CCD cameras and shall conform to National Television System Committee (NTSC) formatting.
2. Fixed cameras shall be color and the primary choice for monitoring following the activities described below. Pan/Tilt/Zoom (P/T/Z)

cameras shall be color and are to be utilized to complement the fixed cameras.

3. Shall be powered by either 12 volts direct current (VDC) or 24 volts alternate current (VAC). Power supplies shall be Class 2 and UL compliant and have a back-up power source to ensure cameras are still operational in the event of loss of primary power to the VASS System.
4. Shall be powered over Ethernet. Network switches supporting PoE cameras shall have a back-up power source to ensure cameras are still operational in the event of loss of primary power to the VASS System.
5. Shall be rated for continuous operation under the environmental conditions listed in Part 1, Project Conditions.
6. Will be home run to a monitoring and recording device via a controlling device such as a matrix switcher or network server and monitored on a 24 hour basis at a designated Security Management System location.
7. Each function and activity shall be addressed within the system by a unique user defined name, with minimum of twenty (20) characters. The use of codes or mnemonics identifying the VASS action shall not be accepted.
8. Shall come with built-in video motion detection that shall automatically monitor and process information from each camera. The camera motion detection shall detect motion within the camera's field of view and provide automatic visual, remote alarms as a result of detected motion.
9. Shall be programmed to digitally flip from color to black and white at dusk and vice versa at low light conditions.
10. Will be fitted with AI/DC lenses to ensure the image quality under different light conditions.
11. P/T/Z cameras shall be utilized in a manner that they complement fixed cameras and shall not be used as a primary means of monitoring activity.
12. Dummy or fake cameras will not be utilized at any time.
13. Appropriate signage shall be designed, provided, and posted that notifies people that an area is under camera surveillance.

2.3 DIGITAL BASED VIDEO MANAGEMENT SYSTEM

A. Key Features

1. Open Platform: Open API/SDK, supports seamless integration with third party applications.
2. Multi-server and multi-site video surveillance solution: Unlimited recording of video from IP cameras, IP video encoders and selected DVRs with analog cameras.
3. Optimized Recording Storage Management: Unique data storage and archiving solution that combines superior performance and scalability and cost efficient long-term video storage
4. Wide IP camera and device support: Supports connection of more than 839 IP cameras, IP video encoders and selected DVR models from over 79 different vendors through dedicated device integration
5. ONVIF™ and PSIA compliant: Supports ONVIF™ and PSIA compliant cameras and devices
6. Wide compression technology support: Supports the news compression methods; MPEG4 ASP, MxPEG and H.264, besides MJEPG and MPEG4
7. System configuration wizards: Guides the user through the process of adding cameras, configuring video and recording, adjustment of motion detection and user configuration
8. Sequence Explorer: Displaying sequences and time intervals in thumbnail pre-views, the Sequence Explorer gives unparalleled visual overview of recorded video combined with smooth navigation
9. Overlay buttons: Intuitive control of cameras, camera-integrated devices and other integrated systems- directly from the camera view
10. Independent Playback: Instant and independent playback function allows you to independently playback recorded video for one or more cameras, while in live viewing or playback mode
11. Built-in Video Motion Detection: Independent of camera model and supporting up to 64 cameras simultaneously per server
12. Multiple language support: Let operators use the system in their native language with support for 20 different languages
13. Multi-channel, two-way audio: Communicate with people at gates/entrances or broadcast messages to many people at once with multichannel, two-way audio

14. Fast evidence export: Quickly deliver authentic evidence to public authorities by exporting video to various formats, including video from multiple cameras with viewer, logs, and user notes included

B. Administration Features

1. Single Management Application: A new Management Application provides a consolidated single point management access to Recording Servers.
2. System configuration wizards: Guides the user through the process of adding cameras, configuring video and recording, adjustment of motion detection and user configuration.
3. Automated device discovery: Enables fast discovery of camera devices using methods such as Universal Plug And Play, Broadcast and IP Range scanning.
4. Smart bulk configuration option: Change settings across multiple devices simultaneously and in a very few clicks.
5. Adaptable application behavior: Guides novice users, while expert users can optimize the application for efficient use.
6. Export/import of system and user configuration data: System backup for reliable system operation and fast system recovery. System cloning for efficient rollout of multiple systems with the same, or similar, configuration.
7. Import of off-line configuration data: Enabling off-line editing of configuration data, including camera and device definitions.
8. Automatic system restore points: A 'Restore Point' is created each time a configuration change is confirmed.
9. Enables easy rollback to previously defined system configuration points and enables cancelation of undesired configuration changes and restoration of earlier valid configurations.

C. Integration Options

1. Open Software Development Kit (SDK) makes it possible to video enable your business processes, through seamless integration of third party applications, such as video analytics, access systems, etc.
2. Compatible with Central for alarm overviews and operational status in larger video surveillance installations.
3. Integrate with physical access control systems, alarms, gates, building management systems, etc. using hardware I/O, internal events and TCP/IP events

4. Create, import and use HTML pages for navigation between views or to trigger a Smart Wall preset
5. Develop third party plug-ins for the Smart Client to expand with new functionality

D. Server Modules

1. Recording Server
   a. Simultaneous digital multi-channel video and audio recording and live viewing (relaying).
   b. Two-way audio enables integrated control of microphones and speakers connected to IP devices.
   c. Bandwidth optimized multi-streaming by splitting a single camera video stream to differentiated streams for live view and recording, where each can be optimized independently with respect to frame rate and resolution.
   d. Connectivity to cameras, video encoders and selected DVRs supports MJPEG, MPEG4, MPEG4 ASP*, H.264* and MxPEG.
   e. Auto-detect camera models during setup.
2. Flexible multi-site, multi-server license structure charged per camera.
3. Unlimited number of installed cameras; simultaneous recording and live view of up to 64 cameras per server.
4. Recording technology: secure high speed database holding JPEG images or MPEG4 and MxPEG streams including audio.
5. Recording speed: 30+ frames per second per camera, limited only by hardware.
6. Recording quality depends entirely on camera and video encoder capabilities: no software limitation.
7. Start cameras on live view requests from clients.
8. Unlimited recording capacity with multiple archives possible per day.
9. Hourly to daily database archiving with optional automatic move to network drive saves storage capacity on the local server – with images still available transparently for playback
10. Built-in, real-time, camera independent motion detection (VMD); fully adjustable sensitivity, zone exclusions, recording activation with frame rate speed up, and alert activation through email or SMS.
11. Start recording on event.

12. Client initiated start of recording based on pre-defined recording time and access privileges.
13. Pan Tilt Zoom (PTZ) preset positions, up to 50 per camera.
14. Absolute* and relative PTZ positioning.
15. PTZ go-to preset position on events.
16. Combine PTZ patrolling and go-to positions on events.
17. Set multiple patrolling schedules per camera per day: i.e. different for day/night/weekend.
18. PTZ scanning on supported devices: viewing or recording while moving slowly between PTZ positions.
19. VMD-sensitive PTZ patrolling among selected presets allows sending of Wipe and Wash commands to supported PTZ models.
20. On pre-defined events Matrix remote commands are automatically sent to display live video remotely on computers running the Matrix Monitor or the Smart
21. Client with Matrix Plug-in.
    a. Flexible notification (sound, e-mail and SMS) and camera patrolling scheduling, triggered by time or event.

E. Recording Server Manager
1. Local console management of the Recording Server accessible from the notification area.
2. Start and stop Recording Server service.
3. Access to Recording Server configuration settings.
4. Access to Recording Server help system.
5. View system status and log information.

F. Image Server
1. Remote access for Smart and Remote Clients.
2. Built-in web server for download and launch of clients and plug-ins.
3. Set up one Master and multiple Slave Servers.
4. Authenticate access based on Microsoft Active Directory user account, or user name and password.
5. Authorize access privileges per Microsoft Active Directory user account/group, user profile or grant full access.
6. User profiles control access to: Live view, PTZ, PTZ presets, Output control, Events, Listen to microphone, Talk to speaker, Manual recording; Playback, AVI export, JPG export, DB export, Sequences,

Smart Search and audio. As well as Set up views, Edit private views and Edit shared public views.

7. Audit logs of exported evidence by user and file.
8. Audit logs of client user activity by time, locations and cameras.

G. Recording Viewer

1. Playback recorded video and audio locally on the

H. Recording Server.

1. View up to 16 cameras time-synched during playback.
2. Scrollable activity timeline with magnifying feature.
3. Instant search on recordings based on date/time and activity/alarm (Video Motion Detection).
4. 'Smart Search' for highlighted image zones and objects.
5. Evidence can be generated as a printed report, a JPEG image, an AVI film or in the native database format.
6. Export audio recordings in WAV or AVI format.
7. Export video digitally zoomed to view area of interest only and to minimize export footprint size.
8. Export 'Evidence CD' containing native database and Recording Viewer for instant, easy viewing by authorities.
9. Encryption & password protection option for exported recordings and files.
10. Ability to add comments to exported evidence, also encrypted.
11. Option to send email.
12. De-interlacing of video from analog cameras.
13. IPIX technology for PTZ in 360° recorded images.

I. PDA Server

1. Remote access for PDA Client.
2. Handle login and session requests between PDA clients and Image Server.
3. Resize video surveillance images to fit the screen layout of PDA Client.

J. Smart Client Module

1. Smart Client includes all the features of Remote Client plus more:
2. Installed per default on Recording Server for local viewing and playback of video and audio.
3. Start recording on cameras for a pre-defined time (default 5 minutes). Subject to privileges set by administrator.

4. Independent Playback capability allows for instant playback of recorded video for one or more cameras, while in live and playback mode
5. Live view digital zoom allows zoomed-out recordings while the operator digitally can zoom in to see details.
6. Update On Motion Only' optimizes CPU usage by letting motion detection control whether the image should be decoded and displayed or not. The visual effect is a still image in the view until motion is detected.
7. Shared and private camera views offer 1x1 up to 10x10 layouts in addition to asymmetric views.
8. Views optimized for both 4:3 and 16:9 screen ratios.
9. Multiple computer monitor support with a main window and any number of either windowed or full screen views.
10. Hotspot function for working in details with a camera selected from a view containing multiple cameras.
11. Carousel function allows a specified view to rotate between pre-defined cameras with individual timing and order with multiple appearances. Carousel function can be controlled allowing the operator to pause carousel function and to switch to previous or next camera.
12. Overlay buttons provides intuitive control of cameras, camera-integrated devices and other integrated systems- directly from the camera view
13. Matrix function to view live video from multiple cameras through the Image Server in any view layout with customizable rotation path, remotely controlled by Smart
14. Clients or Recording Servers sending Matrix remote commands
15. Send Matrix remote commands to display live video remotely on computers running the Matrix Monitor or the Smart Client with Matrix Plug-in.
16. Cameras' built-in audio sources available in live and in playback.
17. Separate pop-up window displaying sequences and time intervals in thumbnail pre-views, the Sequence Explorer gives unparalleled visual overview of recorded video combined with smooth navigation
18. Presents recorded sequences for individual cameras, or all cameras in a view

19. Seamlessly available in both Live and Playback modes
20. Smooth navigation with sliding preview and "drag-andthrow" function for video thumbnails
21. Instant playback of video sequences
22. Application Options allows users to adapt the layout and personalize the application to their particular preferences

K. Remote Client

1. View live video or playback recordings for 1-16 cameras simultaneously; from the same or different servers.
2. Advanced video navigation including fast/slow playback, jump to date/time, single step and video motion search.
3. Individual views can be user-defined in various layouts: view or playback camera images from multiple servers simultaneously in the same view.
4. Shared views can be managed centrally via the server with admin/user rights and user groups.
5. Import static or active HTML maps for fast navigation to cameras and good premise overviews.
6. Control output port relay operation, for example control of gates.
7. Quick overview of sequences with detected motion and preview window.
8. Quick overview of events/alerts.
9. Control PTZ cameras remotely, also using preset positions.
10. Remote PTZ Point-and-Click control
11. Remote PTZ zoom to a marked rectangle.
12. Take manual control over a PTZ camera that runs a patrolling scheme; after a timeout with no activity the camera reverts to its scheduled patrolling.
13. IPIX 1x2 or 2x2 'Quad View' for viewing all 360° at once.
14. Optional video compression in streaming from server to client gives better use of bandwidth.
15. Create AVI files or save JPEG images.
16. Print incident reports with free-text user comments.
17. System logon using user name and password.
18. System logon using Microsoft Active Directory user accounts.

L. PDA Client

1. View live or playback video from a single server or from multiple servers in half-screen or full-screen formats.

2. In live view you can control Pan/Tilt/Zoom cameras manually or use preset positions, and control the cameras' output relays to trigger external actions like opening doors or gates, turning on lights, etc.
3. To find recordings, you can jump to specific time/date or to next detected motion, or use motion detection sequence overviews.
4. When viewing recordings, you can playback at variable speed or single step image by image.
5. The PDA client shall connect to the VMS server using any IP connection; typically wireless LAN, GPRS, etc.
6. Video compression from the server to PDA optimizes bandwidth usage.
7. System logon using user name and password.

M. Matrix Monitor

1. Virtual Matrix showing live video directly from up to 4 cameras at a time triggered remotely by Matrix remote commands.
2. Camera view shifts by FIFO (first-in-first-out)
3. Multiple events can control a single Matrix monitor and single events can control multiple monitors.

N. Minimum System Requirements VMS Server

1. HW Platform:
   a. Minimum 2.4 GHz CPU and 1 GB RAM (2.4 GHz dual core processor and 2 GB RAM or more recommended).
   b. Minimum 1 GB disk space available, excluding space needed for recordings.
2. OS:
   a. Microsoft® Windows® XP Professional (32 bit or 64 bit*), Windows Server 2003 (32 bit or 64 bit*), Windows Server 2008 R1/R2 (32 bit or 64 bit*), Windows Vista™ Business (32 bit or 64 bit*), Windows Vista Enterprise (32 bit or 64 bit*), Windows Vista Ultimate (32 bit or 64 bit*), Windows 7 Professional (32 bit or 64 bit*), Windows 7 Enterprise (32 bit or 64 bit*) and Windows 7 Ultimate (32 bit or 64 bit*).
3. Software:
   a. Microsoft .NET 3.5 Framework SP1, or newer.
   b. DirectX 9.0 or newer required to run Playback Viewer application.

O. Minimum System Requirements PDA Server

1. HW Platform:
    a. Minimum 2.4 GHz CPU and 1 GB RAM (2.4 GHz dual core processor and 2 GB RAM or more recommended).
    b. Minimum 1 GB disk space available.
2. OS:
    a. Microsoft Windows XP Professional (32 bit or 64 bit*), Windows Server 2003 (32 bit or 64 bit*).
3. Software:
    a. Microsoft .NET 2.0 (not compatible with newer versions). Internet Information Server (IIS) 5.1.

P. Minimum System Requirements VMS Client

1. HW Platform:
    a. Minimum 2.4 GHz CPU, 1 GB RAM (more powerful CPU and higher RAM recommended for Smart Clients running high number of cameras and multiple views and displays).
2. Graphics Card:
    a. AGP or PCI-Express, minimum 1024 x 768 (1280 x 1024 recommended), 16 bit colors.
3. OS:
    a. Microsoft Windows XP Professional (32 bit or 64 bit*), Windows Server 2003 (32 bit or 64 bit*), Windows Server 2008 R1/R2 (32 bit or 64 bit*), Windows Vista Business (32 bit or 64 bit*), Windows Vista Enterprise (32 bit or 64
    b. bit*), Windows Vista Ultimate (32 bit or 64 bit*), Windows 7 Professional (32 bit or 64 bit*), Windows 7 Enterprise (32 bit or 64 bit*) and Windows 7 Ultimate (32 bit or 64 bit*).
4. Software:
    a. DirectX 9.0 or newer required to run Playback Viewer application.
    b. Microsoft .NET 3.5 Framework SP1, or newer.

Q. Minimum System Requirements VMS Remote Client

1. HW Platform:
    a. Minimum 2.4 GHz CPU, RAM 1 GB (2 GB or higher recommended on Microsoft Windows Vista).
2. OS:
    a. Microsoft Windows XP Professional (32 bit or 64 bit*), Windows Server 2003 (32 bit or 64 bit*), Windows Server 2008 R1/R2 (32

bit or 64 bit*), Windows Vista Business (32 bit or 64 bit*), Windows Vista Enterprise (32 bit or 64 bit*) and Windows Vista Ultimate (32 bit or 64 bit*), Windows 7 Professional (32 bit or 64 bit*), Windows 7 Enterprise (32 bit or 64 bit*) and Windows 7 Ultimate (32 bit or 64 bit*).

3. Software:
   a. DirectX 9.0 or newer required to run Playback Viewer Application Microsoft Internet Explorer 6.0, or newer, 32 bit version required

R. Licensing Structure
1. Base Server License
   a. An VMS Base Server license is mandatory for installing the product.
2. The Base Server license contains:
   a. Unlimited numbers of Recording Server licenses
   b. Unlimited numbers of Smart Clients, Remote Clients, PDA Clients and Matrix Monitor licenses
3. Camera License
   a. To connect to a camera, a Device License per camera channel is required
   b. In total, for all copies of the product installed under a given Base Server license, the product may only be used with as many cameras as you have purchased camera licenses for • Video encoders and DVRs with multiple analog cameras require a license per channel to operate
   c. Camera Licenses can be purchased in any numbers. To extend the installation with additional Camera Licenses, the Base Server License number (SLC) is required when ordering.
4. Client License:
   a. All client modules are not licensed and can be installed and used on any number of computers.

S. IP NETWORK DECODER
1. The unit shall be used for video monitoring and surveillance over IP networks. Network decoder shall decode MPEG-4 digital video to analog video.
2. The decoder shall use MPEG-4 compression for efficient distribution of images over a network.

3. The decoder shall be available as a standalone unit that can be horizontally or vertically mounted.
4. The decoder shall include, but not be limited to the following:
   a. The decoder shall use "hybrid" technology in providing both analog and network connections with the purpose of allowing users to integrate existing equipment and digital IP products.
      1) The decoder shall provide one composite video input and output connection.
      2) The decoder shall provide one Ethernet connection.
   b. The decoder shall have the following digital resolution:
      1) D1: 720x576 (NTSC); 720x480 (PAL)
      2) CIF: 352 x 288 (NTSC); 352 x 240 (PAL)
      3) QCIF: 160 x 144 (NTSC); 160 x 112 (PAL)
   c. The decoder shall have a digital frame rate of up to 30 frames per second (NTSC) at 720x480 resolution or 25 fps (PAL) at 720x586 resolution.
   d. The decoder shall use the following protocols:
      1) TCP/IP
      2) UDP/IP
      3) DHCP
      4) Multicast
      5) Data Throttle
      6) Heart beat
   e. The decoder shall have the following connectors:
      1) Power connector: 3-pin male – for connecting the external power supply
      2) I/O connector: 16-pin male – for connecting alarm, audio, RS-232, RS-485 input and output
      3) Video I/O connector: SVHS style – for input and output connection of two composite monitors
      4) Ethernet port: RJ-45 – for connecting to a network
   f. The decoder shall have the following indicators:
      1) Power LED
      2) Link – indicates activity on the Ethernet port
      3) Tx activity
      4) Rx activity
5. The decoder shall have the following additional specifications:

a. Video

1) Video signal output: 1 V p-p into 75 ohms

2) Input termination: 75 ohm

3) Video compression standard: MPEG-4

4) Audio compression standard: MPEG-1 Layer 2

b. Audio

1) Audio input: 315 mV, 40 kOhms, unbalanced

2) Audio output: 315 mV, 600 ohms, unbalanced

c. Electrical

1) External power supply: 100 to 240 VAC

2) Output voltage: 13.5 V, 1.33 A

3) Power consumption: 0.5 W maximum

2.4 CONTROLLING EQUIPMENT

A. Shall be utilized to call up, operate, and program all cameras associated VASS System components.

B. Will have the ability to operate the cameras locally and remotely. A matrix switcher or a network server shall be utilized as the VASS System controller.

C. The controller shall be able to fit into a standard 47.5 cm (19 inch) equipment rack.

D. Control and programming keyboards shall be provided with its own type of switcher. All keyboards shall:

1. Be located at each monitoring station.
2. Be addressable for programming purposes.
3. Provide interface between the operator and the VASS System.
4. Provide full control and programming of the switcher.
5. Have the minimum following controls:

a. programming

b. switching

c. lens function

d. P/T/Z

e. environmental housing

f. annotation

2.5 VIDEO CAMERAS

A. The cameras shall be high-resolution color video cameras with wide dynamic range capturing capability.

B. The camera shall meet or exceed the following specifications:

1. The image capturing device shall be a 1/3-inch image sensor designed for capturing wide dynamic images.
   a. The image capturing device shall have a separate analog-to-digital converter for every pixel.
   b. The image capturing device shall sample each pixel multiple times per second.
   c. The dynamic range shall be 95 dB typical and 120 dB maximum.
2. The camera shall optimize each pixel independently.
3. The camera shall have onscreen display menus for programming of the camera's settings.
4. The signal system shall be NTSC.

C. The camera shall have composite video output.

D. The camera shall come with a manual varifocal lens.

E. The video output shall be composite: 1.0 volts peak-to-peak at 75-ohm load.

F. Fixed Color Camera
1. The camera shall be a high-resolution color video camera with wide dynamic range capturing capability.
2. Comply with UL 639.
3. Pickup Device: 1/3 CCD interline transfer.
4. Signal-to-Noise Ratio: Not less than 50 dB, with the camera AGC off.
5. With AGC, manually selectable on or off.
6. Manually selectable modes for backlight compensation or normal lighting.
7. Scanning Synchronization: Determined by external synch over the coaxial cable. Camera shall revert to internally generated synchronization on loss of external synch signal.
8. White Balance: Auto-tracing white balance, with manually selectable fixed balance option.
9. Fixed Color Cameras Technical Characteristics:

Pickup device	1/3" interline transfer CCD
Total pixels	NTSC: 811(H) x 508(V)
Effective pixels	NTSC: 768(H) x 494(V)
Resolution	500 TV lines
Sync. System	Internal Sync

Scanning system	NTSC: 525 Lines/60 Fields
S/N ratio	More than 48 dB
Electronic shutter	Auto 1/60 (1/50) ~1/100,000 sec.
Min. illumination	0.2 lux F2.0
Video output	Composite 1.0 Vp-p/75 ohm
White balance	Auto
Automatic gain control	ON
Frequency horizontal	NTSC: 15.734 KHz
Frequency vertical	NTSC: 59.94Hz
Lens type	Board lens/DC varifocal lens
Focal length	3-12mm
Power source	DC12V/500mA or AC24/500mA
Power consumption	< 3W (Max)

10. Fixed color camera shall be enclosed in dome and have board mounted varifocal lens.
11. Camera accessories shall include:
    a. Surface mount adapter
    b. Wall mount adapter
    c. Flush mount adapter

2.6 POWER SUPPLIES

A. Power supplies shall be a low-voltage power supplies matched for voltage and current requirements of cameras and accessories, type as recommended by camera, infrared illuminator, and lens manufacturer.

B. Technical specifications:
1. Input: 115VAC, 50/60Hz, 2.7 amps
2. Outputs:
    a. Number of outputs, 16
    b. Fuse/PTC protected, power limited
    c. Output voltage & power:
        1) 24VAC @ 12.5 amps (300VA) or 28VAC @ 10 amp (280VA) supply current
3. Illuminated power disconnect circuit breaker with manual reset
4. Surge suppression
5. Camera synchronization
6. Wall/Rack mount.

7. Enclosure: NEMA 250, Type 1.

2.7 INFRARED ILLUMINATORS

A. Lighting fixtures that emit light only in the infrared spectrum, suitable for use with cameras indicated, for nighttime surveillance, without emitting visible light.
   1. Field-Selectable Beam Patterns: Narrow, medium, and wide.
   2. Rated Lamp Life: More than 8000 hours
   3. Power Supply: 12-VAC/DC.

B. Area Coverage: Illumination to 50 m (150 feet) in a narrow beam pattern.

C. Exterior housings shall be suitable for same environmental conditions as associated camera.

2.8 NETWORK SERVER

A. Allow for the transmission of live video, data, and audio over either an existing Ethernet network or a dedicated security system network, requiring an IP address or Internet Explorer 5.5 or higher, or shall work as an analog-to-Ethernet “bridge” controlling matrices, multiplexers, and pan/tilt/zoom cameras. The network shall operate in a box-to-box configuration allowing for encoded video to be decoded and displayed on an analog monitor.

B. If a VASS System network is going to be utilized as the primary means of monitoring, operating, and recording cameras then the following equipment shall be required as part of the system:
   1. System Server
   2. Computer Workstation
   3. Recording Device
   4. Encoder/Decoder
   5. Monitor
   6. Hub/Switch
   7. Router
   8. Encryptor

C. Shall provide overall control, programming, monitoring, and recording of all cameras and associated devices within the VASS System.

D. All equipment on the network shall be IP addressable.

E. The VASS System network shall meet or exceed the following design and performance specifications:

1. Two MPEG-4 video streams for a total of 40 images per second will be provided.
2. PC Software that manages the installation and maintenance of all hardware transmitters and receivers on the network shall be provided.
3. Video Source that supports any NTSC video source to the computer network shall be addressed.
4. Receivers that could be used to display the video on a standard analog NTSC or PAL monitor will be addressed.

F. The system shall support the following network protocols:
1. Internet connections: RTP, Real Time Control Protocol (RTCP), UDP, IP, TCP, ICMP, HTTP, Simple Network Management Protocol (SNMP), IGMP, DHCP, and ARP.
2. Video Display: MPEG-4, M-JPEG in server push mode only.
3. Have the ability to adjust bandwidth, image quality and image rate.
4. Support image sizes of either 704 x 576 pixels or 352 x 288 pixels.
5. Have an audio coding format of G.711 or G.728.
6. Provide a video frame rate of at least 30 images per second.
7. Support LAN Interface Ethernet 10/100BaseT and be auto sensing.
8. Have a LAN Data Rate of 9.6 Kbps to 5.0 Mbps.
9. Utilize data interface RS-232/RS-422/RS-485.

G. All connections within the system shall be via CAT-5 cable and RJ-45 jacks. If analog equipment is used as part of the system, then either an encoder or a decoder will be utilized to convert the analog signal to a digital one.

H. The VASS network system shall conform to all VA agency wide security standards for administrator and operator use.

I. Server Technical Characteristics:

Hardware	Personal Computer
CPU	Pentium IV, 3.0 GHz or better
Hard Disk Interface	IDE or better
RAM	256 MB
OS	Windows XP Home/XP Professional
Graphic Card	NVIDIA GeForce 6600 NVIDIA Quadro FX 1400 ATI RADEON X600/X800 or better

Ethernet Card	100 Mb
Software	DirectX 9.0c
Free Memory	120 MB

J. Network Switch Technical Characteristics

Protocol and standard	IEEE802.3 IEEE802.3u IEEE802.3ab
Ports	24 10/100/1000M auto-negotiation RJ-45 ports with auto MDI/MDI-X
Network media	Cat 5 UTP for 1,000Mbps Cat 3 UTP for 10Mbps
Transmission method	store-and-forward
LED	indicator power, act/link, speed

K. Router Technical Characteristics

Network Standards	IEEE 802.3, 802.3u 10Base-T Ethernet (WAN) 100Base-T Ethernet (LAN) IEEE 802.3x Flow Control IEEE802.1p Priority Queue ANS/IEEE 802.3 NWay auto-negotiation
Protocol	CSMA/CD, TCP, IP, UDP, PPPoE, AND DHCP (client and server)
VPN Supported	PPTP, IPSec pass-through
Management	Browser
Ports	4 x 10/100Base-T Auto sensing RJ45 ports, and an auto uplink RJ45port(s) 1 x 10Base-T RJ45 port, WAN
LEDs	Power, WAN Activity, LAN Link (10/100), LAN Activity

L. Encryptor Technical Characteristics:

Cryptography	Standard - Triple DES 168-bit (ANSI 9.52) Rijndael - AES (128, 192, 256)
Performance	Throughput (end-to-end) @ 100 Mbps

	line speed: >188 Mbps full duplex (large frames) >200 kfps full duplex (small frames) Latency (end-to-end) @ 100 Mbps
Key Management	Automatic KEK/DEK Exchange Using Signed Diffie-Hellman Unit Authentication Using X.509 Certificates
Physical Interfaces	10BaseT or 10/100BaseT Ethernet (Host and Network Ports) 10BaseT Ethernet Management Port Back and Front-Panel Serial Control Port
Device Management	THALES Element Manager, Front Panel Viewer, and Certificate Manager 10Base T (RJ-45) or 9-pin Serial Control Port SNMP Network Monitoring
Security Features	Tamper Proof Cryptographic Envelope Tamper Evident Chassis Hardware Random Number Generator
Management	Channel Encrypted Using Same Algorithm as Data Traffic
Security Certifications	FIPS 140-2 Level 3 CAPS Baseline and Enhanced Grades Common Criteria EAL4 and EAL5 (under evaluation)
Regulatory	EN60950, FCC, UL, CE, EN 50082-1, and EN 55022

2.9 RECORDING DEVICES

A. All cameras on the VASS System shall be recorded in real time using a Digital Video Recorder (DVR), Network Video Recorder (NVR), or attached storage. The type of recording device utilized should be determined by the size and type of VASS System designed and installed, and to what extent the system is to be utilized.

B. All recording devices shall be 47.5 cm (19 inch) rack-mountable.

C. All DVR’s and NVR’s that are viewable over an Intranet or Internet will be routed through an encryptor.

D. Encryptors shall:

1. Comply with FIPS PUB 140-2.
2. Support TCP/IP.
3. Directly interfaces to low-cost commercial routers.
4. Provide packet-based crypto synchronization.
5. Encrypt source and destination IP addresses.
6. Support web browser based management requiring no additional software.
7. Have a high data sustained throughput — 1.544 Mbps (T1) full duplex data rate.
8. Provide for both bridging and routing network architecture support.
9. Support Electronic Key Management System (EKMS) compatible.
10. Have remote management ability.
11. Automatically reconfigure when secure network or wide area network changes.

E. Digital Video Recorder (DVR)

1. Shall record video to a hard drive-based digital storage medium in either NTSC or MPEG format.
2. Shall meet the following minimum requirements:
   a. Record at minimum rate of 30 images per second (IPS).
   b. Have a minimum of eight (8) to 16 looping inputs.
   c. Have a minimum of eight (8) to 16 alarm inputs and two (2) relay outputs.
   d. Shall provide instantaneous playback of all recorded images.
   e. Be IP addressable, if part of a VASS network.
   f. Have built-in digital motion detection with masking and sensitivity adjustments.
   g. Provide easy playback and forward/reverse search capabilities.
   h. Complete audit trail database, with minimum of a six-month history that tracks all events related to the alarm; specifically who, what, where and when.
   i. DVR management capability providing automatic video routing to a back-up spare recorder in case of failure.
   j. Accessible locally and remotely via the Internet, Intranet, or a personal digital assistant (PDA).
   k. Records all alarm events in real time, ensuring 60 seconds before and after the event are included in the recording.

l. Utilize RS-232 or fiber optic connections for integration with the SMS computer station via a remote port on a network hub.

m. Allow for independently adjustable frame rate settings.

n. Be compatible with the matrix switcher utilized to operate the cameras. The DVR could be utilized as a matrix switcher only if it meets all of the requirements listed in the matrix switcher section.

3. Technical Characteristics:

Compression	MPEG-4
Internal Storage Capacities.	160 GB, 320 GB, 500 GB, 1 TB, and 2 TB. Available USB hard drive up to 250 GB. Optional internal DVD available
Digital Recording	Up to 16 video and 8 audio channels, or 8 video and 4 audio channels.
Full real-time video recording	Up to 400 IPS@352 x 288: PAL Up to 200 IPS@352 x 288: PAL
Multiple simultaneous functions	Live viewing, Recording, playback, network transmission, back-up
Search functions	Date/time search, event search, bookmark search, smart (pixel) Search
PTZ Control	Third party PTZ control
User ID security	3 levels
Connectivity to external devices:	Eight or sixteen video input and looping output channels. VGA and dual monitor BNC outputs. Four or eight audio inputs and one audio output. Ethernet 10/100BaseT network connection. Eight to sixteen alarm inputs and four or eight relay outputs. Biphase connection to control Bosch PTZ cameras. Third party PTZ control via RS-422/RS-485 connection.

	Front and back USB connectors to connect to a PC mouse, or archive video to a USB memory stick or similar device.
PC requirements	Windows 2000 or above; DirectX 8.1 or above. Intel Pentium III or above, AMD Athlon with 800 MHz or faster CPU. 512 MB or more RAM. 50 MB hard drive. AGP VGA with 64 MB video RAM or above. 10/100-BaseT network interface.
Electrical	Power Input: 100 to 240 VAC; 50/60 Hz Power consumption: 120W Max. 1.2 A
Video	Video standard: PAL or NTSC selectable. Resolution: 704 x 576 PAL, 704 x 480 NTSC Compression: MPEG-4 Inputs: 8 or 16 composite video 0.5-2 Vpp, 75 Ohm automatic termination. Outputs 8 or 16 composite video 1 Vpp, 75 Ohm.
Audio	Inputs: 4 or 8 line in, 30 kOhm Output: 1 line, 100 kOhm
Monitors	VGA: analog RGB 800x600 MON A: CVBS 1 Vpp□0.1 V, 75 Ohm, BNC Monitor A multi-screen (VGA or CVBS) MON B: CVBS 1 Vpp□0.1 V, 75 Ohm, BNC Monitor B spot/alarm
Frame Rate and Resolution	16-channels PAL: Up to 400 IPS@352x288, up to 200 IPS@704x288, up to 100 IPS@704x576.
Alarm inputs	8 configurable NO/NC, max. input 5 VDC.
Alarm outputs	4 or 8 relay outputs, configurable NO/NC, max. rated 1A, 125 VAC.

Connections	Ethernet: RJ45 modular jack 8 pins shielded, 10/100 Base-T. Biphase: Screw terminal connector (5 outputs). Maximum 5 controllable cameras per Biphase output. PTZ control interfaces: RS485/RS422. Serial interface: RS232 output signal, DB9 male connector Keyboard: RJ11 modular jack 6 pins
Network:	Transmission speed: up to 120 IPS@352x240 Bandwidth control: Automatic Remote users: Maximum 5 simultaneous connected Control Center users.

Processor	Intel Pentium III 750 MHz
Memory	256 MB RAM
Operating System	Windows 98, NT, ME, 2000, and XP
Video Card	4 MB of RAM capable of 24-bit true color display
Free Hard Disk Space	160 MB for software installation
Network Card	10Base-T network for LAN operation
Archiving	80 GB, 160 GB, 320 GB and 640 GB Hard Drive; CD-RW
Video Input	1.0 Vpp (signal 714mV, sync 286mV) 75 ohms (BNC unbalanced)
Video Output Level	1.0 Vpp +/-10%,75 ohms(BNC unbalanced)
Impedance	75 ohms/Hi- impedance x 16 switchable
Network Interface	Ethernet (RJ-45, 10/100M)
Network Protocol	TCP/IP, DHCP, HTTP, UDP
Network Capabilities	Live/Playback/P/T/Z control
Recording Rate	30 ips for 720 x 240 (NTSC)
Password	Menu Setup, Remote Access

Protection	
Recording Capacity	160 (1 or 2 fixed HDD) 1 CD-RW
Power Interrupt	Auto recovered to recording mode

F. Network Video Recorder (NVR)

1. Shall record video to a hard drive-based digital storage medium in MPEG, MPEG4 or H.264 format.
2. Shall meet the following minimum requirements:
   a. Record at minimum rate of 30 IPS.
   b. Have a minimum of eight (8) to 16 looping inputs.
   c. Have a minimum of eight (8) to 16 alarm inputs and two (2) relay outputs.
   d. Shall provide instantaneous playback of all recorded images.
   e. Be IP addressable, if part of a VASS network.
   f. Have built-in digital motion detection with masking and sensitivity adjustments.
   g. Easy playback and forward/reverse search capabilities.
   h. Complete audit trail database, with minimum of a six-month history that tracks all events related to the alarm; specifically who, what, where and when.
   i. NVR management capability providing automatic video routing to a back-up spare recorder in case of failure.
   j. Accessible locally and remotely via the internet, intranet, or a personal digital assistant (PDA).
   k. Records all alarm events in real time, ensuring 60 seconds before and after the event are included in the recording.
   l. Utilize RS-232 or fiber optic connections for integration with the SMS computer station via a remote port on a network hub.
   m. Allow for independently adjustable frame rate settings.
   n. Be compatible with the matrix switcher utilized to operate the cameras.
3. Technical Characteristics:

Hardware/CPU	Pentium III Xeon or IV, 1.8 GHz
HDD Interface	IDE or better; optional: SCSI II, SCSI Ultra, or Fiber Channel
RAM	1024 MB

Operating System	Windows 2000/XP Professional/Server 2003 Standard
Graphic	Card VGA
Ethernet Card	100/1000 MB
Memory	20 MB
Software Setup	Centralized setup from each authorized PC; access via integrated web server
Storage Media	All storage media possible (e.g., HD, RAID), depending on operating system
Storage Mode	Linear mode, ring mode (capacity-based)
Recording Configuration	Camera name assignment, bandwidth limit, frame rate, video quality
Recording Content	Video and/or audio data
Search Parameters	Time, date, event
Playback	Playback via any IP network (LAN/WAN) simultaneous recording, playback, and backup
Network Interface	Ethernet (RJ-45, 10/100M)
Network Protocol	TCP/IP, DHCP, HTTP, UDP
Network Capabilities	Live/Playback/P/T/Z control
Recording Rate	30 ips for 720 x 240 (NTSC)
Password Protection	Menu Setup, Remote Access
Recording Capacity	160 (1 or 2 fixed HDD) 1 CD-RW
Power Interrupt	Auto recovered to recording mode

2.10 WIRES AND CABLES

A. Shall meet or exceed the manufacturer’s recommendation for power and signal.

B. Will be carried in an enclosed conduit system, utilizing electromagnetic tubing (EMT) to include the equivalent in flexible metal, rigid galvanized steel (RGS) to include the equivalent of liquid tight, polyvinylchloride (PVC) schedule 40 or 80.

C. All conduits will be sized and installed per the NEC. All security system signal and power cables that traverse or originate in a high security office space will contained in either EMT or RGS conduit.

D. All conduit, pull boxes, and junction boxes shall be clearly marked with colored permanent tape or paint that will allow it to be distinguished from all other conduit and infrastructure.

E. Conduit fills shall not exceed 50 percent unless otherwise documented.

F. A pull string shall be pulled along and provided with signal and power cables to assist in future installations.

G. At all locations where there is a wall penetration or core drilling is conducted to allow for conduit to be installed, fire stopping materials shall be applied to that area

H. High voltage and signal cables shall not share the same conduit and shall be kept separate up to the point of connection. High voltage for the security system shall be defined as any cable or sets of cables carrying 30 VDC/VAC or higher.

I. For all equipment that is carrying digital data between the Physical Access Control System and Database Management or at a remote monitoring station, shall not be less that 20 AWG and stranded copper wire for each conductor. The cable or each individual conductor within the cable shall have a shield that provides 100% coverage. Cables with a single overall shield shall have a tinned copper shield drain wire.

J. All cables and conductors, except fiber optic cables, that act as a control, communication, or signal lines shall include surge protection. Surge protection shall be furnished at the equipment end and additional triple electrode gas surge protectors rated for the application on each wire line circuit shall be installed within 1 m. (3 ft.) of the building cable entrance. The inputs and outputs shall be tested in both normal and common mode using the following wave forms:

   1. A 10 microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 watts and peak current of 60 amperes.
   2. An 8 microsecond rise time by 20 microsecond pulse width wave form with a peak voltage of 1000 volts and peak current of 500 amperes.

K. The surge suppression device shall not attenuate or reduce the video or sync signal under normal conditions. Fuses and relays shall not be used as a means of surge protection.

L. Coaxial Cables

   1. All video signal cables for the VASS System, with exception to the PoE cameras, shall be a coaxial cable and have a characteristic impedance of 75 ohms plus or minus 3 ohms.

2. For runs up to 750 feet use of an RG-59/U is required. The RG-59/U shall be shielded which provides a minimum of 95 percent coverage, with a stranded copper center conductor of a minimum 23 AWG, polyethylene insulation, and black non-conductive polyvinylchloride (PVC) jacket.
3. For runs between 750 feet and 1250 feet, RG-6/U is required. RG-6/U shall be shielded which provides a minimum of 95 percent coverage, with a stranded copper center conductor of a minimum 18 AWG, polyethylene insulation, and black non-conductive polyvinylchloride (PVC) jacket.
4. For runs of 1250 to 2750 feet, RG-11/U is required. RG-11/U shall be shielded which provides a minimum of 95 percent coverage, with a stranded copper center conductor of a minimum 14 AWG, polyethylene insulation, and black non-conductive polyvinylchloride (PVC) jacket.
5. All runs greater than 2750 feet will be substituted with a fiber optic cable. If using fiber optics as a signal carrier then the following equipment will be utilized:
   a. Multimode fiber optic cable a minimum size of 62 microns
   b. Video transmitter, installed at the camera that utilizes 12 VDC or 24 VAC for power.
   c. Video receiver, installed at the switcher.
6. RG-59/U Technical Characteristics

AWG	22
Stranding	7x29
Conductor Diameter	.031 in.
Conductor Material	BCC
Insulation Material	Gas-injected FHDPE
Insulation Diameter	.145 in.
Outer Shield Type	Braid/Braid
Outer Jacket Material	PVC
Overall Nominal Diameter	.242 in.
UL Temperature Rating	75°C
Nom. Characteristic Impedance	75 Ohms
Nom. Inductance	0.094 µH/ft
Nom. Capacitance	Conductor to Shield 17.0 pF/ft
Nom. Velocity of Propagation	80 %

Nom. Delay	1.3 ns/ft
Nom. Conductor DC Resistance @ 20°C	12.2 Ohms/1000 ft
Nom. Outer Shield DC Resistance @ 20°C	2.4 Ohms/1000 ft
Max. Operating Voltage	UL 300 V RMS

7. RG-6/U Technical Characteristics:

AWG	18
Stranding	7x27
Conductor Diameter	.040 in.
Conductor Material	BC
Insulation Material	Gas-injected FHDPE
Insulation Diameter	.180 in.
Outer Shield Material	Trade Name Duofoil
Outer Shield Type	Tape/Braid
Outer Shield %Coverage	100 %
Outer Jacket Material	PVC
Overall Nominal Diameter	.274 in.
Nom. Characteristic Impedance	75 Ohms
Nom. Inductance	0.106 µH/ft
Nom. Capacitance	Conductor to Shield 16.2 pF/ft
Nom. Velocity of Propagation	82 %
Nom. Delay	1.24 ns/ft
Nom. Conductor DC Resistance	6.4 Ohms/1000 ft
Nominal Outer Shield DC Resistance @ 20°C	2.8 Ohms/1000 ft
Max. Operating Voltage	UL 300 V RMS

8. RG-11/U Technical Characteristics:

AWG	15

Stranding	19x27
Conductor Diameter	.064 in.
Conductor Material	BC
Insulation Material	Gas-injected FHDPE
Insulation Diameter	.312 in.
Inner Shield Type	Braid
Inner Shield Material	BC - Bare Copper
Inner Shield %Coverage	95 %
Inner Jacket Material	PE – Polyethylene
Inner Jacket Diameter	.391 in.
Outer Shield Type	Braid
Outer Shield Material	BC - Bare Copper
Outer Shield %Coverage	95 %
Outer Jacket Material	Trade Name Belflex
Outer Jacket Material	PVC Blend
Overall Nominal Diameter	.520 in.
Operating Temperature Range	-35°C To +75°C
Non-UL Temperature Rating	75°C
Nom. Characteristic Impedance	75 Ohms
Nom. Inductance	0.097 µH/ft
Nom. Capacitance	Conductor to Shield 17.3 pF/ft
Nom. Velocity of Propagation	78 %
Nom. Delay	1.30 ns/ft
Nom. Conductor DC Resistance	3.1 Ohms/1000 ft
Nom. Inner Shield DC Resistance	1.8 Ohms/1000 ft
Nom. Outer Shield DC Resistance	1.4 Ohms/1000 ft
Max. Operating Voltage Non-UL	300 V RMS

9. Signal Cables:
   a. Signal wiring for PoE cameras depends on the distance the camera is being installed from either a hub or the server.
   b. If the camera is up to 300 ft from a hub or the server, then use a shielded UTP category 5 (CAT-V) cable a with standard RJ-

45 connector at each end. The cable with comply with the Power over Ethernet, IEEE802.3af, Standard.

c. If the camera is over 300 ft from a hub or server then utilize a multimode fiber optic cable with a minimum size of 62 microns.

d. Provide a separate cable for power.

e. CAT-5 Technical Characteristics:

Number of Pairs	4
Total Number of Conductors	8
AWG	24
Stranding	Solid
Conductor Material	BC - Bare Copper
Insulation Material	PO – Polyolefin
Overall Nominal Diameter	.230 in.
IEC Specification	11801 Category 5
TIA/EIA Specification	568-B.2 Category 5e
Max. Capacitance Unbalance	(pF/100 m) 150 pF/100 m
Nom. Velocity of Propagation	70 %
Max. Delay	(ns/100 m) 538 @ 100MHz
Max. Delay Skew	(ns/100m) 45 ns/100 m
Max. Conductor DC Resistance	9.38 Ohms/100
Max. DCR Unbalance@ 20°C	3 %
Max. Operating Voltage	UL 300 V RMS

10. Fiber Optic Cables Technical Characteristics:

Fiber Type	62.5 Micron
Number of Fibers	4
Core Diameter 6	2.5 +/- 2.5 microns
Core Non-Circularity	5% Maximum
Clad Diameter	125 +/- 2 microns
Clad Non-Circularity	1% Maximum
Core-clad Offset	1.5 Microns Maximum
Primary Coating Material	Acrylate
Primary Coating Diameter	245 +/- 10 microns
Secondary Coating Material	Engineering Thermoplastic
Secondary Coating Diameter	900 +/- 50 microns

Strength Member Material	Aramid Yarn
Outer Jacket Material	PVC
Outer Jacket Color	Orange
Overall Diameter	.200 in.
Numerical Aperture	.275
Maximum Gigabit Ethernet	300 meters
Maximum Gigabit Ethernet	550 meters

11. Power Cables
    a. Will be sized accordingly and shall comply with the NEC. High voltage power cables will be a minimum of three conductors, 14 AWG, stranded, and coated with a non-conductive polyvinylchloride (PVC) jacket. Low voltage cables will be a minimum of 18 AWG, stranded and non-conductive polyvinylchloride (PVC) jacket.
    b. Will be utilized for all components of the VASS System that require either a 110 VAC 60 Hz or 220 VAC 50 Hz input. Each feed will be connected to a dedicated circuit breaker at a power panel that is primarily for the security system.
    c. All equipment connected to AC power shall be protected from surges. Equipment protection shall withstand surge test waveforms described in IEEE C62.41. Fuses shall not be used as a means of surge protection.
    d. Shall be rated for either 110 or 220 VAC, 50 or 60 Hz, and shall comply with VA Master Spec 26 05 21 Low Voltage Electrical Power Conductors and Cables (600 Volts and Below).
    e. Low Voltage Power Cables
        1) Shall be a minimum of 18 AWG, Stranded and have a polyvinylchloride outer jacket.
        2) Cable size shall determined using a basic voltage over distance calculation and shall comply with the NEC’s requirements for low voltage cables.

PART 3 - EXECUTION

3.1 GENERAL

A. Installation: The Contractor shall install all system components including Owner furnished equipment, and appurtenances in accordance with the manufacturer’s instructions, ANSI C2 and as shown, and shall

furnish all necessary connectors, terminators, interconnections, services, and adjustments required for a complete and operable data transmission system.

B. Identification and Labeling: The Contractor shall supply permanent identification labels for each cable at each end that will appear on the as-built drawings. The labeling format shall be identified and a complete record shall be provided to the Owner with the final documentation. Each cable shall be identified by type or signal being carried and termination points. The labels shall be printed on letter size label sheets that are self laminated vinyl that can be printed from a computer data base or spread sheet. The labels shall be E-Z code WES12112 or equivalent.

1. The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform all testing.

C. Transient Voltage Surge Suppressors (TVSS): The Contractor shall mount TVSS within 3 m (118 in) of equipment to be protected inside terminal cabinets or suitable NEMA 1 enclosures. Terminate off-premise conductors on input side of device. Connect the output side of the device to the equipment to be protected. Connect ground lug to a low impedance earth ground (less than 10 ohms) via Number 12 AWG insulated, stranded copper conductor.

D. Contractor’s Field Test: The Contractor shall verify the complete operation of the data transmission system during the Contractor’s Field Testing. Field test shall include a bit error rate test. The Contractor shall perform the test by sending a minimum of 1,000,000 bits of data on each DTM circuit and measuring the bit error rate. The bit error rate shall not be greater than one (1) bit out of each 100,000 bits sent for each dial-up DTM circuit, and one (1) bit out of 1,000,000 bits sent for each leased or private DTM circuit. The Contractor shall submit a report containing results of the field test.

E. Acceptance Test and Endurance Test: The wire line data transmission system shall be tested as a part of the completed IDS and EECS during the Acceptance test and Endurance Test as specified.

F. Identification and Labeling: The Contractor shall supply identification tags or labels for each cable. Cable shall be labeled at both end points and at intermediate hand holes, manholes, and junction boxes. The labeling format shall be identified and a complete

record shall be provided to the Owner with the final documentation. Each cable shall be identified with type of signal being carried and termination points.

3.2 INSTALLATION

A. System installation shall be in accordance with NECA 303, manufacturer and related documents and references, for each type of security subsystem designed, engineered and installed.

B. Components shall be configured with appropriate "service points" to pinpoint system trouble in less than 30 minutes.

C. The Contractor shall install all system components including Government furnished equipment, and appurtenances in accordance with the manufacturer's instructions, documentation listed in Sections 1.5 of this document, and shall furnish all necessary connectors, terminators, interconnections, services, and adjustments required for a complete and operable system.

D. The VASS System will be designed, engineered, installed, and tested to ensure all components are fully compatible as a system and can be integrated with all associated security subsystems, whether the system is a stand alone or a complete network.

E. For integration purposes, the VASS System shall be integrated where appropriate with the following associated security subsystems:

1. PACS:
   a. Provide 24 hour coverage of all entry points to the perimeter and agency buildings, as well as all emergency exits utilizing a fixed color camera.
   b. Record cameras on a 24 hours basis.
   c. Be programmed go into an alarm state when an emergency exit is opened, and notify the Physical Access Control System and Database Management of an alarm event.
2. IDS:
   a. Provide a recorded alarm event via a color camera that is connected to the IDS system by either direct hardwire or a security system computer network.
   b. Record cameras on a 24 hours basis.
   c. Be programmed to go into an alarm state when an IDS device is put into an alarm state, and notify the PACS.

d. For additional VASS System requirements as they relate to the IDS, refer to Section 28 16 00 "INTRUSION DETECTION".

3. Security Access Detection:
   a. Provide full coverage of all vehicle and lobby entrance screening areas utilizing a fixed color camera.
   b. Record cameras on a 24 hours basis.
   c. The VASS System should have facial recognition software to assist in identifying individuals for current and future purposes.
4. EPPS:
   a. Provide a recorded alarm event via a color camera that is connected to the EPPS system by either direct hardwire or a security system computer network.
   b. Record cameras on a 24 hours basis.
   c. Be programmed to go into an alarm state when an emergency call box or duress alarm/panic device is activated, and notify the Physical Access Control System and Database Management of an alarm event.

F. Integration with these security subsystems shall be achieved by computer programming or the direct hardwiring of the systems.

G. For programming purposes refer to the manufacturers requirements for correct system operations. Ensure computers being utilized for system integration meet or exceed the minimum system requirements outlined on the systems software packages.

H. A complete VASS System shall be comprised of, but not limited to, the following components:
   1. Cameras
   2. Lenses
   3. Video Display Equipment
   4. Camera Housings and Mounts
   5. Controlling Equipment
   6. Recording Devices
   7. Wiring and Cables

I. The Contractor shall visit the site and verify that site conditions are in agreement/compliance with the design package. The Contractor shall report all changes to the site or conditions that will affect performance of the system to the Contracting Officer in the form of a

report. The Contractor shall not take any corrective action without written permission received from the Contracting Officer.

J. Existing Equipment

1. The Contractor shall connect to and utilize existing video equipment, video and control signal transmission lines, and devices as outlined in the design package. Video equipment and signal lines that are usable in their original configuration without modification may be reused with Contracting Officer approval.
2. The Contractor shall perform a field survey, including testing and inspection of all existing video equipment and signal lines intended to be incorporated into the VASS System, and furnish a report to the Contracting Officer as part of the site survey report. For those items considered nonfunctioning, provide (with the report) specification sheets, or written functional requirements to support the findings and the estimated cost to correct the deficiency. As part of the report, the Contractor shall include a schedule for connection to all existing equipment.
3. The Contractor shall make written requests and obtain approval prior to disconnecting any signal lines and equipment, and creating equipment downtime. Such work shall proceed only after receiving Contracting Officer approval of these requests. If any device fails after the Contractor has commenced work on that device, signal or control line, the Contractor shall diagnose the failure and perform any necessary corrections to the equipment.
4. The Contractor shall be held responsible for repair costs due to Contractor negligence, abuse, or incorrect installation of equipment.
5. The Contracting Officer shall be provided a full list of all equipment that is to be removed or replaced by the Contractor, to include description and serial/manufacturer numbers where possible. The Contractor shall dispose of all equipment that has been removed or replaced based upon approval of the Contracting Officer after reviewing the equipment removal list. In all areas where equipment is removed or replaced the Contractor shall repair those areas to match the current existing conditions.

K. Enclosure Penetrations: All enclosure penetrations shall be from the bottom of the enclosure unless the system design requires penetrations

from other directions. Penetrations of interior enclosures involving transitions of conduit from interior to exterior, and all penetrations on exterior enclosures shall be sealed with rubber silicone sealant to preclude the entry of water and will comply with VA Master Specification 07 84 00, Firestopping. The conduit riser shall terminate in a hot-dipped galvanized metal cable terminator. The terminator shall be filled with an approved sealant as recommended by the cable manufacturer and in such a manner that the cable is not damaged.

L. Cold Galvanizing: All field welds and brazing on factory galvanized boxes, enclosures, and conduits shall be coated with a cold galvanized paint containing at least 95 percent zinc by weight.

M. Interconnection of Console Video Equipment: The Contractor shall connect signal paths between video equipment as specified by the OEM. Cables shall be as short as practicable for each signal path without causing strain at the connectors. Rack mounted equipment on slide mounts shall have cables of sufficient length to allow full extension of the slide rails from the rack.

N. Cameras:
   1. Install the cameras with the focal length lens as indicated for each zone.
   2. Connect power and signal lines to the camera.
   3. Aim camera to give field of view as needed to cover the alarm zone.
   4. Aim fixed mounted cameras installed outdoors facing the rising or setting sun sufficiently below the horizon to preclude the camera looking directly at the sun.
   5. Focus the lens to give a sharp picture (to include checking for day and night focus and image quality) over the entire field of view
   6. Synchronize all cameras so the picture does not roll on the monitor when cameras are selected.
   7. PTZ cameras shall have all preset positions and privacy areas defined and programmed.

O. Monitors:
   1. Install the monitors as shown and specified in design and construction documents.
   2. Connect all signal inputs and outputs as shown and specified.
   3. Terminate video input signals as required.
   4. Connect the monitor to AC power.

P. Switcher:
   1. Install the switcher as shown in the design and construction documents, and according to the OEM.
   2. Connect all subassemblies as specified by the manufacturer and as shown.
   3. Connect video signal inputs and outputs as shown and specified; terminate video inputs as required.
   4. Connect alarm signal inputs and outputs as shown and specified; connect control signal inputs and outputs for ancillary equipment or secondary control/monitoring sites as specified by the manufacturer and as shown.
   5. Connect the switcher CPU and switcher subassemblies to AC power.
   6. Load all software as specified and required for an operational VASS System configured for the site and building requirements, including data bases, operational parameters, and system, command, and application programs.
   7. Provide the original and 2 backup copies for all accepted software upon successful completion of the endurance test.
   8. Program the video annotation for each camera.

Q. Video Encoder/Decoder
   1. Install the Video Encoder/Decoder per design and construction documents, and as specified by the OEM.
   2. Connect analog camera inputs to video encoder.
   3. Connect network camera to video decoder.
   4. Connect video encoder to VASS network.
   5. Connect video decoder to video matrix, DVR, monitor etc.
   6. Connect unit to AC power (UPS).
   7. Configure the video encoder/decoder per manufacturer’s recommendation and project requirements.

R. Video Server:
   1. Install the video server per design and construction documents, and as specified by the OEM.
   2. Connect video server to AC power (UPS).
   3. Connect to VASS network.
   4. Install operating system and Video Management Software.
   5. Provide Video Management Software programming per VA guidance and the requirements provided by the Owner. Programming shall include:

a. Camera names
b. Screen views
c. Camera recording schedules (continuous and event) driven recording. Events include alarms from other systems (sensors), manual input, and video motion detection.
d. Video detection zones for each camera requiring video motion detection
e. Alarm interface
f. Alarm outputs
g. GUI maps, views, icons and actions
h. PTZ controls (presets, time schedules for privacy zones etc.)
i. Reports

S. Video Workstation:
1. Install the video workstation per design and construction documents, and as specified by the OEM.
2. Connect video workstation to AC power (UPS).
3. Connect to VASS network.
4. Install operating system and application software.
5. Provide application software programming per VA guidance and the requirements provided by the Owner. Programming shall include:
a. Screen views
b. Graphical User Interface (GUI) maps, views, icons and actions
c. Alarm outputs
d. Reports

T. Network Switch:
1. Install the network switch per design and construction documents, and as specified by the OEM.
2. Connect network switch to AC power (UPS).
3. Connect network cameras to network switch.
4. Configure the network switch per manufacturer’s recommendation and project requirements.

U. Network Recording Equipment
1. Install the NVR or video storage unit as shown in the design and construction documents, and as specified by the OEM.
2. Connect recording device to AC power (UPS).
3. Connect recording device to network switch as shown and specified.
4. Configure network connections

5. Provide recording unit programming per VA guidance and the requirements provided by the Owner. Programming shall include:
   a. Camera names
   b. Screen views
   c. Camera recording schedules (continuous and event) driven recording. Events include alarms from other systems (sensors), manual input, and video motion detection.
   d. Video detection zones for each camera requiring video motion detection
   e. Alarm interface
   f. Alarm outputs
   g. GUI maps, views, icons and actions
   h. PTZ controls (presets, time schedules for privacy zones etc.)
   i. Reports

V. Video Recording Equipment:
1. Install the video recording equipment as shown in the design and construction documents, and as specified by the OEM.
2. Connect video signal inputs and outputs as shown and specified.
3. Connect alarm signal inputs and outputs as shown and specified.
4. Connect video recording equipment to AC power.
5. Program the video recording equipment;
   a. Recording schedules
   b. Camera caption

W. Video Signal Equipment:
1. Install the video signal equipment as shown in the design and construction documents, and as specified by the OEM.
2. Connect video or signal inputs and outputs as shown and specified.
3. Terminate video inputs as required.
4. Connect alarm signal inputs and outputs as required.
5. Connect control signal inputs and outputs as required
6. Connect electrically powered equipment to AC power.

X. Camera Housings, Mounts, and Poles:
1. Install the camera housings and mounts as specified by the manufacturer and as shown, provide mounting hardware sized appropriately to secure each camera, housing and mount with maximum wind and ice loading encountered at the site.
2. Provide a foundation for each camera pole as specified and shown.

3. Provide a ground rod for each camera pole and connect the camera pole to the ground rod as specified in Division 26 of the VA Master Specification and the VA Electrical Manual 730.
4. Provide electrical and signal transmission cabling to the mount location via a hardened carrier system from the Physical Access Control System and Database Management to the device.
5. Connect signal lines and AC power to the housing interfaces.
6. Connect pole wiring harness to camera.

3.3 SYSTEM START-UP

A. The Contractor shall not apply power to the VASS System until the following items have been completed:
   1. VASS System equipment items and have been set up in accordance with manufacturer's instructions.
   2. A visual inspection of the VASS System has been conducted to ensure that defective equipment items have not been installed and that there are no loose connections.
   3. System wiring has been tested and verified as correctly connected as indicated.
   4. All system grounding and transient protection systems have been verified as installed and connected as indicated.
   5. Power supplies to be connected to the VASS System have been verified as the correct voltage, phasing, and frequency as indicated.
B. The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the Contracting Officers Representative (COR) and Commissioning Agent. Provide a minimum of 7 days prior notice.
C. Satisfaction of the above requirements shall not relieve the Contractor of responsibility for incorrect installation, defective equipment items, or collateral damage as a result of Contractor work efforts.

3.4 SUPPLEMENTAL CONTRACTOR QUALITY CONTROL

A. The Contractor shall provide the services of technical representatives who are familiar with all components and installation procedures of the installed VASS System; and are approved by the Contracting Officer.
B. The Contractor will be present on the job site during the preparatory and initial phases of quality control to provide technical assistance.
C. The Contractor shall also be available on an as needed basis to provide assistance with follow-up phases of quality control.

D. The Contractor shall participate in the testing and validation of the system and shall provide certification that the system installed is fully operational as all construction document requirements have been fulfilled.

3.5 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 28 08 00 – COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.

B. Components provided under this section of the specification will be tested as part of a larger system. Refer to Section 28 08 00 – "COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS" and related sections for contractor responsibilities for system commissioning.

3.6 DEMONSTRATION AND TRAINING

A. All testing and training shall be compliant with the VA General Requirements, Section 01 00 00, "GENERAL REQUIREMENTS".

B. Provide services of manufacturer's technical representative for four hours to instruct VA personnel in operation and maintenance of units.

C. Submit training plans and instructor qualifications in accordance with the requirements of Section 28 08 00 – "COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS".

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SECTION 28 31 00

FIRE DETECTION AND ALARM

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section of the specifications includes the furnishing, installation, and modification of the fire alarm equipment to form a complete coordinated system ready for operation. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, and wiring as shown on the drawings and specified. The fire alarm system shall not be combined with other systems such as building automation, energy management, security, etc.

B. Fire alarm systems shall comply with requirements of the most recent VA FIRE PROTECTION DESIGN MANUAL and NFPA 72 unless variations to NFPA 72 are specifically identified within these contract documents by the following notation: "variation". The design, system layout, document submittal preparation, and supervision of installation and testing shall be provided by a technician that is certified NICET level III or a registered fire protection engineer. The NICET certified technician shall be on site for the supervision and testing of the system. Factory engineers from the equipment manufacturer, thoroughly familiar and knowledgeable with all equipment utilized, shall provide additional technical support at the site as required by the COR or his authorized representative. Installers shall have a minimum of 2 years experience installing fire alarm systems.

C. Fire alarm signals:

1. The existing programming for the Building fire alarm system shall be followed.

D. Alarm signals (by device), supervisory signals (by device) and system trouble signals (by device not reporting) shall be distinctly transmitted to the main fire alarm system control unit located in Room 1A03C.

E. The main fire alarm control unit is a Gamewell E3 Series control panel, and is existing to remain.

1.2 SCOPE

A. A fully addressable fire alarm system as a modification to the existing addressable fire alarm system shall be designed and installed in

accordance with the specifications and drawings. Device location and wiring runs shown on the drawings are for reference only unless specifically dimensioned. Actual locations shall be in accordance with NFPA 72 and this specification.

B. All existing fire alarm equipment, wiring, devices and sub-systems that are not shown to be reused shall be removed. All existing fire alarm conduit not reused shall be removed.

C. Existing fire alarm bells, chimes, door holders, 120VAC duct smoke detectors, valve tamper switches and waterflow/pressure switches may be reused only as specifically indicated on the drawings and provided the equipment:
   1. Meets this specification section
   2. Is UL listed or FM approved
   3. Is compatible with new equipment being installed
   4. Is verified as operable through contractor testing and inspection
   5. Is warranted as new by the contractor.

D. Existing 120 VAC duct smoke detectors, waterflow/pressure switches, and valve tamper switches reused by the Contractor shall be equipped with an addressable interface device compatible with the new equipment being installed.

E. Existing reused equipment shall be covered as new equipment under the Warranty specified herein.

F. Basic Performance:
   1. Alarm and trouble signals from each building fire alarm control panel shall be digitally encoded by UL listed electronic devices onto a multiplexed communication system.
   2. Response time between alarm initiation (contact closure) and recording at the main fire alarm control unit (appearance on alphanumeric read out) shall not exceed 5 seconds.
   3. Initiating device circuits (IDC) shall be wired Class B in accordance with NFPA 72.
   4. Signaling line circuits (SLC) within buildings shall be wired Class B in accordance with NFPA 72. Individual signaling line circuits shall be limited to covering 22,500 square feet (2,090 square meters) of floor space or 3 floors whichever is less.
   5. Notification appliance circuits (NAC) shall be wired Class B in accordance with NFPA 72.

G. Engage the services of the existing fire alarm system contractor to perform device terminations and any programming.

H. Contractor shall verify that the existing fire alarm system is completely operational before making changes or connections. Any pre-existing faults shall be recorded and a report shall be provided to the COR prior to commencing new work

1.3 RELATED WORK

A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. Requirements for procedures for submittals.

B. Section 07 84 00 - FIRESTOPPING. Requirements for fire proofing wall penetrations.

C. Section 21 13 13 - WET-PIPE SPRINKLER SYSTEMS. Requirements for sprinkler systems.

D. Section 28 05 00 – COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY. Requirements for general requirements that are common to more than one section in Division 28.

E. Section 28 05 13 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for conductors and cables.

F. Section 28 05 26 - GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY. Requirements for grounding of equipment.

G. Section 28 05 28.33 - CONDUITS AND BACKBOXES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for infrastructure.

1.4 SUBMITTALS

A. General: Submit 5 copies in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, and Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

B. Drawings:

1. Prepare drawings using AutoCAD Release 14 software and include all contractors information. Layering shall be by VA criteria as provided by the Contracting Officer’s Representative (COR). Bid drawing files on AutoCAD will be provided to the Contractor at the pre-construction meeting. The contractor shall be responsible for verifying all critical dimensions shown on the drawings provided by VA.

2. Floor plans: Provide locations of all devices (with device number at each addressable device corresponding to control unit programming), appliances, panels, equipment, junction/terminal cabinets/boxes,

risers, electrical power connections, individual circuits and raceway routing, system zoning; number, size, and type of raceways and conductors in each raceway; conduit fill calculations with cross section area percent fill for each type and size of conductor and raceway. Only those devices connected and incorporated into the final system shall be on these floor plans. Do not show any removed devices on the floor plans. Show all interfaces for all fire safety functions.

3. Riser diagrams: Provide, for the entire system in the area of work, the number, size and type of riser raceways and conductors in each riser raceway and number of each type device per floor and zone. Show door holder interface, and all other fire safety interfaces. Show wiring styles on the riser diagram for all circuits. Provide diagrams both on a per building and campus wide basis.
4. Detailed wiring diagrams: Provide for control panels, modules, power supplies, electrical power connections, auxiliary relays and annunciators showing termination identifications, size and type conductors, circuit boards, LED lamps, indicators, adjustable controls, switches, ribbon connectors, wiring harnesses, terminal strips and connectors, spare zones/circuits. Diagrams shall be drawn to a scale sufficient to show spatial relationships between components, enclosures and equipment configuration.
5. Two weeks prior to final inspection, the Contractor shall deliver to the COR 3 sets of as-built drawings and one set of the as-built drawing computer files (using AutoCAD 2007 or later). As-built drawings (floor plans) shall show all new and/or existing conduit used for the fire alarm system.

C. Manuals:

1. Submit simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals including technical data sheets for all items used in the system, power requirements, device wiring diagrams, dimensions, and information for ordering replacement parts.
   a. Wiring diagrams shall have their terminals identified to facilitate installation, operation, expansion and maintenance.

b. Wiring diagrams shall indicate internal wiring for each item of equipment and the interconnections between the items of equipment.
c. Include complete listing of all software used and installation and operation instructions including the input/output matrix chart.
d. Provide a clear and concise description of operation that gives, in detail, the information required to properly operate, inspect, test and maintain the equipment and system. Provide all manufacturer's installation limitations including but not limited to circuit length limitations.
e. Complete listing of all digitized voice messages.
f. Provide standby battery calculations under normal operating and alarm modes. Battery calculations shall include the magnets for holding the doors open for one minute.
g. Include information indicating who will provide emergency service and perform post contract maintenance.
h. Provide a replacement parts list with current prices. Include a list of recommended spare parts, tools, and instruments for testing and maintenance purposes.
i. A computerized preventive maintenance schedule for all equipment. The schedule shall be provided on disk in a computer format acceptable to the VAMC and shall describe the protocol for preventive maintenance of all equipment. The schedule shall include the required times for systematic examination, adjustment and cleaning of all equipment. A print out of the schedule shall also be provided in the manual. Provide the disk in a pocket within the manual.
j. Furnish manuals in 3 ring loose-leaf binder or manufacturer's standard binder.
k. A print out for all devices proposed on each signaling line circuit with spare capacity indicated.

2. Two weeks prior to final inspection, deliver 4 copies of the final updated maintenance and operating manual to the COR.
   a. The manual shall be updated to include any information necessitated by the maintenance and operating manual approval.

b. Complete "As installed" wiring and schematic diagrams shall be included that shows all items of equipment and their interconnecting wiring. Show all final terminal identifications.
c. Complete listing of all programming information, including all control events per device including an updated input/output matrix.
d. Certificate of Installation as required by NFPA 72 for each building. The certificate shall identify any variations from the National Fire Alarm Code.
e. Certificate from equipment manufacturer assuring compliance with all manufacturers installation requirements and satisfactory system operation.

D. Certifications:
1. Together with the shop drawing submittal, submit the technician's NICET level III fire alarm certification as well as certification from the control unit manufacturer that the proposed performer of contract maintenance is an authorized representative of the major equipment manufacturer. Include in the certification the names and addresses of the proposed supervisor of installation and the proposed performer of contract maintenance. Also include the name and title of the manufacturer’s representative who makes the certification.
2. Together with the shop drawing submittal, submit a certification from either the control unit manufacturer or the manufacturer of each component (e.g., smoke detector) that the components being furnished are compatible with the control unit.
3. Together with the shop drawing submittal, submit a certification from the major equipment manufacturer that the wiring and connection diagrams meet this specification, UL and NFPA 72 requirements.

1.5 WARRANTY

A. All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of one year from the date of acceptance of the entire installation by the Contracting Officer.

1.6 GUARANTY PERIOD SERVICES

A. Complete inspection, testing, maintenance and repair service for the fire alarm system shall be provided by a factory trained authorized

representative of the manufacturer of the major equipment for a period of 5 years from the date of acceptance of the entire installation by the Contracting Officer.

B. Contractor shall provide all necessary test equipment, parts and labor to perform required inspection, testing, maintenance and repair.

C. All inspection, testing, maintenance and permanent records required by NFPA 72, and recommended by the equipment manufacturer shall be provided by the contractor. Work shall include operation of sprinkler system alarm and supervisory devices as well as all reused existing equipment connected to the fire alarm system. It shall include all interfaced equipment including but not limited to elevators, HVAC shutdown, and extinguishing systems.

D. Maintenance and testing shall be performed in accordance with NFPA 72. A computerized preventive maintenance schedule shall be provided and shall describe the protocol for preventive maintenance of equipment. The schedule shall include a systematic examination, adjustment and cleaning of all equipment.

E. Non-included Work: Repair service shall not include the performance of any work due to improper use, accidents, or negligence for which the contractor is not responsible.

F. Service and emergency personnel shall report to the Engineering Office or their authorized representative upon arrival at the hospital and again upon the completion of the required work. A copy of the work ticket containing a complete description of the work performed and parts replaced shall be provided to the VA COR or his authorized representative.

G. Emergency Service:

1. Warranty Period Service: Service other than the preventative maintenance, inspection, and testing required by NFPA 72 shall be considered emergency call-back service and covered under the warranty of the installation during the first year of the warranty period, unless the required service is a result of abuse or misuse by the Government. Written notification shall not be required for emergency warranty period service and the contractor shall respond as outlined in the following sections on Normal and Overtime Emergency Call-Back Service. Warranty period service can be required

during normal or overtime emergency call-back service time periods at the discretion of the COR or his authorized representative.

2. Normal and overtime emergency call-back service shall consist of an on-site response within 2 hours of notification of a system trouble.
3. Normal emergency call-back service times are between the hours of 7:30 a.m. and 4:00 p.m., Monday through Friday, exclusive of federal holidays. Service performed during all other times shall be considered to be overtime emergency call-back service. The cost of all normal emergency call-back service for years 2 through 5 shall be included in the cost of this contract.
4. Overtime emergency call-back service shall be provided for the system when requested by the Government. The cost of the first 40 manhours per year of overtime call-back service during years 2 through 5 of this contract shall be provided under this contract. Payment for overtime emergency call-back service in excess of the 40 man hours per year requirement will be handled through separate purchase orders. The method of calculating overtime emergency call-back hours is based on actual time spent on site and does not include travel time.

H. The contractor shall maintain a log at each fire alarm control unit. The log shall list the date and time of all examinations and trouble calls, condition of the system, and name of the technician. Each trouble call shall be fully described, including the nature of the trouble, necessary correction performed, and parts replaced.

I. In the event that VA modifies the fire alarm system post-Acceptance but during the 5 year Guaranty Period Service period, Contractor shall be required to verify that the system, as newly modified or added, is consistent with the manufacturer's requirements; any verification performed will be equitably adjusted under the Changes clause. The post-Acceptance modification or addition to the fire alarm system shall not void the continuing requirements under this contract set forth in the Guarantee Period Service provision for the fire alarm system as modified or added. The contract will be equitably adjusted under the Changes clause for such additional performance.

1.7 APPLICABLE PUBLICATIONS

A. The publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to

the extent referenced. The publications are referenced in text by the basic designation only and the latest editions of these publications shall be applicable.

B. National Fire Protection Association (NFPA):

NFPA 13 .....Standard for the Installation of Sprinkler Systems, 2022 edition

NFPA 70.....National Electrical Code (NEC), 2023 edition

NFPA 72.....National Fire Alarm Code, 2022 edition

NFPA 101.....Life Safety Code, 2024 edition

C. International Code Council, International Building Code (IBC), 2024 edition

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS, GENERAL

A. All equipment and components shall be new and the manufacturer's current model. All equipment shall be tested and listed by Underwriters Laboratories, Inc. or Factory Mutual Research Corporation for use as part of a fire alarm system. The authorized representative of the manufacturer of the major equipment shall certify that the installation complies with all manufacturers’ requirements and that satisfactory total system operation has been achieved.

2.2 CONDUIT, BOXES, AND WIRE

A. Conduit shall be in accordance with Section 28 05 28.33 CONDUIT AND BACKBOXES FOR ELECTRONIC SAFETY AND SECURITY and as follows:

1. All new conduits shall be installed in accordance with NFPA 70.
2. Conduit fill shall not exceed 40 percent of interior cross-sectional area.
3. All new conduits shall be 3/4-inch (19 mm) minimum.

B. Wire:

1. Wiring shall be in accordance with NEC article 760, Section 28 05 13, CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY, and as recommended by the manufacturer of the fire alarm system. All wires shall be color coded. Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 18 AWG for initiating device circuits and 14 AWG for notification device circuits.

2. Addressable circuits and wiring used for the multiplex communication loop shall be twisted and shielded unless specifically excepted by the fire alarm equipment manufacturer in writing.
3. Any fire alarm system wiring that extends outside of a building shall have additional power surge protection to protect equipment from physical damage and false signals due to lightning, voltage and current induced transients. Protection devices shall be shown on the submittal drawings and shall be UL listed or in accordance with written manufacturer's requirements.
4. All wire or cable used in underground conduits including those in concrete shall be listed for wet locations.

C. Terminal Boxes, Junction Boxes, and Cabinets:
1. Shall be galvanized steel in accordance with UL requirements.
2. All boxes shall be sized and installed in accordance with NFPA 70.
3. covers shall be repainted red in accordance with Section 09 91 00, PAINTING and shall be identified with white markings as "FA" for junction boxes and as "FIRE ALARM SYSTEM" for cabinets and terminal boxes. Lettering shall be a minimum of 3/4 inch (19 mm) high.
4. Terminal boxes and cabinets shall have a volume 50 percent greater than required by the NFPA 70. Minimum sized wire shall be considered as 14 AWG for calculation purposes.
5. Terminal boxes and cabinets shall have identified pressure type terminal strips and shall be located at the base of each riser. Terminal strips shall be labeled as specified or as approved by the COR.

2.3 FIRE ALARM CONTROL UNIT

A. The fire alarm control unit is a Gamewell E3 Series and is existing to remain.

2.4 ALARM NOTIFICATION APPLIANCES

A. Speakers:
1. Shall operate on either 25 VRMS or 70.7 VRMS with field selectable output taps from 0.5 to 2.0W and originally installed at the 1/2 watt tap. Speakers shall provide a minimum sound output of 80 dBA at 10 feet (3,000 mm) with the 1/2 watt tap.
2. Frequency response shall be a minimum of 400 HZ to 4,000 HZ.

3. Four inches (100 mm) or 8 inches (200 mm) cone type speakers ceiling mounted with white colored baffles in areas with suspended ceilings and wall mounted in areas without ceilings.

B. Strobes:

1. Strobes shall be synchronized where required by the National Fire Alarm Code (NFPA 72).
2. Backplate shall be red with 1/2 inch (13 mm) permanent red letters. Lettering to read "Fire", be oriented on the wall or ceiling properly, and be visible from all viewing directions.
3. Each new strobe circuit shall have a minimum of 20 percent spare capacity.
4. Strobes may be combined with the audible notification appliances specified herein.

2.5 ALARM INITIATING DEVICES

A. Smoke Detectors:

1. General Requirements for System Smoke Detectors:
   a. Comply with UL 268; operating at 24-V dc, nominal.
   b. Detectors shall be two-wire type.
   c. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire alarm control unit.
   d. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
   e. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
   f. Integral Visual-Indicating Light:
      1) Red flashing LED for power status and communication to control panel
      2) Red solid/steady LED for alarm condition
   g. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at fire alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire alarm control unit.

B. Heat Detectors:

1. General Requirements for Heat Detectors: Comply with UL 521.
2. Heat Detector, Combination Type: Heat sensors shall be self-restoring and provide rate compensated, fixed temperature sensing, selectable with or without rate-of-rise temperature sensing. Rate-of-rise temperature detection shall be selectable at the control panel for either 15° F (8.3° C) or 20° F (11.1° C) per minute. Fixed temperature sensing is independent of rate-of-rise sensing and programmable to operate at 135° F (57.2° C) or 155° F (68° C)
3. Mounting: Twist-lock base interchangeable with smoke-detector bases.
4. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire alarm control unit.
5. Heat Detector, Fixed-Temperature Type: Fixed temperature sensing shall be programmable to operate at 135° F (57.2° C) or 155° F (68° C)
6. Mounting: Twist-lock base interchangeable with smoke-detector bases.
7. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire alarm control unit.
8. Rate comp requirements: Rate-of-rise temperature detection shall be selectable at the control panel for either 15° F (8.3° C) or 20° F (11.1° C) per minute. Fixed temperature sensing is independent of rate-of-rise sensing and programmable to operate at 135° F (57.2° C) or 155° F (68° C)

2.6 SPARE AND REPLACEMENT PARTS

A. Provide spare and replacement parts as follows:

1. Fire alarm strobes - 1
2. Fire alarm speaker/strobes – 1
3. Smoke Detector – 1

B. Spare and replacement parts shall be in original packaging and submitted to the COR.

C. Provide to the VA, all hardware, software, programming tools, license and documentation necessary to permanently modify the fire alarm system on site. The minimum level of modification includes addition and

deletion of devices, circuits, zones and changes to system description, system operation, and digitized evacuation and instructional messages.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be in accordance with NFPA 70, 72, and 101 as shown on the drawings, and as recommended by the major equipment manufacturer. Fire alarm wiring shall be installed in conduit. All conduit and wire shall be installed in accordance with, Section 28 05 13 CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY, Section 28 05 26 GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY, Section 28 05 28.33 CONDUIT AND BACKBOXES FOR ELECTRONIC SAFETY AND SECURITY, and all penetrations of smoke and fire barriers shall be protected as required by Section 07 84 00, FIRESTOPPING.

B. All conduits, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas.

C. All new and reused exposed conduits shall be painted in accordance with Section 09 91 00, PAINTING to match surrounding finished areas and red in unfinished areas.

D. All existing accessible fire alarm conduit not reused shall be removed.

E. Existing devices that are reused shall be properly mounted and installed. Where devices are installed on existing shallow backboxes, extension rings of the same material, color and texture of the new fire alarm devices shall be used. Mounting surfaces shall be cut and patched in accordance with Section 01 00 00, GENERAL REQUIREMENTS, Restoration, and be re-painted in accordance with Section 09 91 00, PAINTING as necessary to match existing.

F. All fire detection and alarm system devices shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas. Exact locations are to be approved by the COR.

G. Strobes shall be flush wall mounted with the bottom of the unit located 80 inches (2,000 mm) above the floor or 6 inches (150 mm) below ceiling, whichever is lower. Locate and mount to maintain a minimum 36 inches (900 mm) clearance from side obstructions.

H. Manual pull stations shall be installed not less than 42 inches (1,050 mm) or more than 48 inches (1,200 mm) from finished floor to bottom of device and within 60 inches (1,500 mm) of a stairway or an exit door.

I. Where possible, locate water flow and pressure switches a minimum of 12 inches (300 mm) from a fitting that changes the direction of the flow and a minimum of 36 inches (900 mm) from a valve.

J. Mount valve tamper switches so as not to interfere with the normal operation of the valve and adjust to operate within 2 revolutions toward the closed position of the valve control, or when the stem has moved no more than 1/5 of the distance from its normal position.

3.2 TEMPORARY HEAT DETECTION INSTALLATION

A. The Fire Alarm contractor shall coordinate the following with the electrical contractor:

1. As required by the Ralph H. Johnson Safety Office, the fire alarm contractor shall provide Honeywell ATD-L3-IV heat detectors at the deck of every room/area during construction immediately after demolition of the ceiling.
2. Each temporary detector shall be connected to the existing fire alarm system and provided a temporary addressable device address.
3. For each temporary heat detector, the contractor shall provide conduit, wiring, and connections to the existing FACP located in room A398.
4. At the end of construction, the contractor shall coordinate the removal of the temporary detectors with the COR, and the Ralph H. Johnson VAMC Safety Office.

3.3 TYPICAL OPERATION

A. Activation of any manual pull station, water flow or pressure switch, heat detector, kitchen hood suppression system, gaseous suppression system, or smoke detector shall cause the following operations to occur:

1. Operate the emergency voice communication system in the Building. For sprinkler protected buildings, flash strobes continuously only in the zone of alarm. For buildings without sprinkler protection throughout, flash strobes continuously only on the floor of alarm.
2. Continuously sound a temporal pattern general alarm and flash all strobes in the building in alarm until reset at the local fire alarm control unit in the Building.
3. Release only the magnetic door holders in the smoke zone on the floor from which alarm was initiated after the alert signal.

4. Transmit a separate alarm signal, via the main fire alarm control unit to the fire department.
5. Unlock the electrically locked exit doors within the zone of alarm.

B. Operation of a smoke detector at a corridor door used for automatic closing shall also release only the magnetic door holders on that floor in that smoke zone. Operation of a smoke detector at a shutter used for automatic closing shall also release only the shutters on that floor in that smoke zone.

C. Operation of duct smoke detectors shall cause a system supervisory condition and shut down the ventilation system and close the associated smoke dampers as appropriate.

D. Alarm verification shall not be used for smoke detectors installed for the purpose of early warning.

3.4 TESTS

A. Provide the service of a NICET level III, competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment to technically supervise and participate during all of the adjustments and tests for the system. Make all adjustments and tests in the presence of the COR.

B. When the systems have been completed and prior to the scheduling of the final inspection, furnish testing equipment and perform the following tests in the presence of the COR. When any defects are detected, make repairs or install replacement components, and repeat the tests until such time that the complete fire alarm systems meets all contract requirements. After the system has passed the initial test and been approved by the COR, the contractor may request a final inspection.

1. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
2. Test the insulation on all installed cable and wiring by standard methods as recommended by the equipment manufacturer.
3. Run water through all flow switches. Check time delay on water flow switches. Submit a report listing all water flow switch operations and their retard time in seconds.
4. Open each alarm initiating and notification circuit to see if trouble signal actuates.

5. Ground each alarm initiation and notification circuit and verify response of trouble signals.

3.5 FINAL INSPECTION AND ACCEPTANCE

A. Prior to final acceptance a minimum 30 day "burn-in" period shall be provided. The purpose shall be to allow equipment to stabilize and potential installation and software problems and equipment malfunctions to be identified and corrected. During this diagnostic period, all system operations and malfunctions shall be recorded. Final acceptance will be made upon successful completion of the "burn-in" period and where the last 14 days is without a system or equipment malfunction.

B. At the final inspection a factory trained representative of the manufacturer of the major equipment shall repeat the tests in Article 3.3 TESTS and those required by NFPA 72. In addition the representative shall demonstrate that the systems function properly in every respect. The demonstration shall be made in the presence of a VA representative.

3.6 INSTRUCTION

A. The manufacturer's authorized representative shall provide instruction and training to the VA as follows:

1. Two 1-hour sessions to engineering staff, security police and central attendant personnel for simple operation of the system. One session at the start of installation and 1 sessions at the completion of installation.
2. Two 2-hours sessions to engineering staff for detailed operation of the system. One session at the completion of installation and one session 3 months after the completion of installation.
3. One 8-hour sessions to electrical technicians for maintaining, programming, modifying, and repairing the system at the completion of installation.

B. The Contractor and/or the Systems Manufacturer's representative shall provide a typewritten "Sequence of Operation" including a trouble shooting guide of the entire system for submittal to the VA. The sequence of operation will be shown for each input in the system in a matrix format and provided in a loose leaf binder. When reading the sequence of operation, the reader will be able to quickly and easily determine what output will occur upon activation of any input in the system. The INPUT/OUTPUT matrix format shall be as shown in Appendix A to NFPA 72.

C. Furnish the services of a competent instructor for instructing personnel in the programming requirements necessary for system expansion. Such programming shall include addition or deletion of devices, zones, indicating circuits and printer/display text.

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