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DEPARTMENT OF VETERANS AFFAIRS
VHA MASTER SPECIFICATIONS

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LIST OF DRAWING SHEETS

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

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VOLUME 01	
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VF - 021	EXISTING CONDITIONS
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GC-051	EROSION CONTROL PLAN
CS-101	SITE PLAN
CG-151	GRADING AND DRAINAGE PLAN
CS-171	UTILITY PLAN
CK-601	SITE DETAILS
AD101	DEMOLITION PLAN
A001	WALL TYPES
A101	FLOOR PLANS
A102	ROOF PLAN
A201	EXTERIOR ELEVATIONS
A301	BUILDING SECTIONS
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A312	WALL SECTIONS
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S501	FOUNDATION DETAILS
S502	MASONRY DETAILS
S510	FRAMING DETAILS
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S602	WALL SECTIONS
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VOLUME 02

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VOLUME 03

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T1.B.A	BLDG 01 - LV B - ZONE A - NEW WORK
T1.B.B	BLDG 01 - LV B - ZONE B - NEW WORK
T1.B.C	BLDG 01 - LV B - ZONE C - NEW WORK
T1.B.D	BLDG 01 - LV B - ZONE D - NEW WORK
T1.B.E1	BLDG 01 - LV B - ZONE E1 - NEW WORK
T1.B.E2	BLDG 01 - LV B - ZONE E2 - NEW WORK
T1.B.F	BLDG 01 - LV B - ZONE F - NEW WORK
T1.B.G	BLDG 01 - LV B - ZONE G - NEW WORK
T1.B.JM	BLDG 01 - LV B - ZONE J & M - NEW WORK
T1.1	B01 - FIRST FLOOR ZONES - NEW WORK
T1.1.A	BLDG 01 - LV 1 - ZONE A - NEW WORK
T1.1.B	BLDG 01 - LV 1 - ZONE B - NEW WORK
T1.1.C	BLDG 01 - LV 1 - ZONE C - NEW WORK
T1.1.D	BLDG 01 - LV 1 - ZONE D - NEW WORK
T1.1.E1	BLDG 01 - LV 1 - ZONE E1 - NEW WORK
T1.1.E2	BLDG 01 - LV 1 - ZONE E2 - NEW WORK
T1.1.F	BLDG 01 - LV 1 - ZONE F - NEW WORK
T1.1.G	BLDG 01 - LV 1 - ZONE G - NEW WORK
T1.1.H	BLDG 01 - LV 1 - ZONE H - NEW WORK
T1.1.JLM	BLDG 01 - LV 1 - ZONE J,L,M - NEW WORK
T1.1.K	BLDG 01 - LV 1 - ZONE K - NEW WORK
T1.1.T	BLDG 11 - LV 1 - ZONE T - NEW WORK
T1.1.U	BLDG 12 - LV 1 - ZONE U - NEW WORK
T1.1.V	BLDG 14 - LV 1 - ZONE V - NEW WORK
T1.1.W	BLDG 28 - LV 1,2 - ZONE W - NEW WORK
T1.1.X	BLDG 30 - LV 1,2 - ZONE X - NEW WORK
T1.1.Y	T01-T05 - LV 1 - ZONE Y - NEW WORK
T1.1.Z	T06-T10 - LV 1 - ZONE Z - NEW WORK
T1.2	B01 - SECOND FLOOR ZONES - NEW WORK

T1.2.A	BLDG 01 - LV 2 - ZONE A - NEW WORK
T1.2.B	BLDG 01 - LV 2 - ZONE B - NEW WORK
T1.2.C	BLDG 01 - LV 2 - ZONE C - NEW WORK
T1.2.D	BLDG 01 - LV 2 - ZONE D - NEW WORK
T1.2.E	BLDG 01 - LV 2 - ZONE E - NEW WORK
T1.2.H	BLDG 01 - LV 2 - ZONE H - NEW WORK
T1.2.J	BLDG 01 - LV 2 - ZONE J - NEW WORK
T1.2.K	BLDG 01 - LV 2 - ZONE K - NEW WORK
T1.2.U	BLDG 12 - LV 2 - ZONE A,B - NEW WORK
T1.3	B01 - THIRD FLOOR ZONES - NEW WORK
T1.3.A	BLDG 01 - LV 3 - ZONE A - NEW WORK
T1.3.B	BLDG 01 - LV 3 - ZONE B - NEW WORK
T1.3.C	BLDG 01 - LV 3 - ZONE C - NEW WORK
T1.3.D	BLDG 01 - LV 3 - ZONE D - NEW WORK
T1.3.E	BLDG 01 - LV 3 - ZONE E - NEW WORK
T1.3.H	BLDG 01 - LV 3 - ZONE H - NEW WORK
T1.3.J	BLDG 01 - LV 3 - ZONE J - NEW WORK
T1.3.K	BLDG 01 - LV 3 - ZONE K - NEW WORK
T1.3.U	BLDG 12 - LV 3 - ZONE A,B - NEW WORK
T1.4	B01 - FOURTH FLOOR ZONES - NEW WORK
T1.4.A	BLDG 01 - LV 4 - ZONE A - NEW WORK
T1.4.B	BLDG 01 - LV 4 - ZONE B - NEW WORK
T1.4.C	BLDG 01 - LV 4 - ZONE C - NEW WORK
T1.4.D	BLDG 01 - LV 4 - ZONE D - NEW WORK
T1.4.E	BLDG 01 - LV 4 - ZONE E - NEW WORK
T1.4.H	BLDG 01 - LV 4 - ZONE H - NEW WORK
T1.4.J	BLDG 01 - LV 4 - ZONE J - NEW WORK
T1.4.K	BLDG 01 - LV 4 - ZONE K - NEW WORK
T1.5	B01 - FIFTH FLOOR ZONES - NEW WORK
T1.5.A	BLDG 01 - LV 5 - ZONE A - NEW WORK
T1.5.B	BLDG 01 - LV 5 - ZONE B - NEW WORK
T1.5.C	BLDG 01 - LV 5 - ZONE C - NEW WORK
T1.5.D	BLDG 01 - LV 5 - ZONE D - NEW WORK
T1.5.E	BLDG 01 - LV 5 - ZONE E - NEW WORK
T1.5.H	BLDG 01 - LV 5 - ZONE H - NEW WORK
T1.5.J	BLDG 01 - LV 5 - ZONE J - NEW WORK
T1.5.K	BLDG 01 - LV 5 - ZONE K - NEW WORK

T2.BD	BLDG 01 - BASEMENT DIAMOND PLAN
T2.1D	BLDG 1 - LV 1 - DIAMOND PLAN
T2.1TD	BLDG 11 - LV 1 - DIAMOND PLAN
T2.1UD	BLDG 12 - LV 1 - DIAMOND PLAN
T2.1VD	BLDG 14 - LV 1 - DIAMOND PLAN
T2.1WD	BLDG 28 - LV 1,2 - DIAMOND PLAN
T2.1XD	BLDG 30 - LV 1,2 - DIAMOND PLAN
T2.1YD	T01-T05 - LV 1 - DIAMOND PLAN
T2.1ZD	T06-T10 - LV 1 - DIAMOND PLAN
T2.2D	BLDG 1 - LV 2 - DIAMOND PLAN
T2.2UD	BLDG 12 - LV 2 - DIAMOND PLAN
T2.3D	BLDG 1 - LV 3 - DIAMOND PLAN
T2.3UD	BLDG 12 - LV 3 - DIAMOND PLAN
T2.4D	BLDG 1 - LV 4 - DIAMOND PLAN
T2.5D	BLDG 1 - LV 5 - DIAMOND PLAN
TD401	BLDG 01 - BASEMENT - ENLARGED DEMO PLANS
TD401A	ENLARGED DEMO PLAN PHOTOS
TD402	BLDG 01 - FIRST FLOOR - ENLARGED DEMO PLANS
TD402A	ENLARGED DEMO PLAN PHOTOS
TD402B	ENLARGED DEMO PLAN PHOTOS
TD403	BLDG 01 - SECOND FLOOR - ENLARGED DEMO PLANS
TD403A	ENLARGED DEMO PLAN PHOTOS
TD404	BLDG 01 - THIRD FLOOR - ENLARGED DEMO PLANS
TD404A	ENLARGED DEMO PLAN PHOTOS
TD405	BLDG 01 - FOURTH FLOOR - ENLARGED DEMO PLANS
TD405A	ENLARGED DEMO PLAN PHOTOS
TD406	BLDG 01 - FIFTH FLOOR - ENLARGED DEMO PLANS
TD406A	ENLARGED DEMO PLAN PHOTOS
TD407	BLDG 11/12/14/TRAILERS - ENLARGED DEMO PLANS
TD407A	ENLARGED DEMO PLAN PHOTOS
T-401	ENLARGED DATA ROOMS
T-402	ENLARGED DATA ROOMS
T-403	ENLARGED DATA ROOMS
T-404	ENLARGED DATA ROOMS
T-405	ENLARGED DATA ROOMS
T-406	ENLARGED DATA ROOMS
T-407	ENLARGED DATA ROOMS

T-500	TELECOM SCHEDULES
T-501	TELECOM - TYPICAL RACK ELEVATIONS
T-502	TELECOM DETAILS
T-503	TELECOM DETAILS
T-601	TELECOM DIAGRAMS

- - E N D - - -

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 Gainesville VAMC-EHRM Upgrade as required by drawings and specifications.

B. Visits to the site by Bidders may be made in accordance with what is listed in the solicitation and at the discretion of the Contracting Officer.

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

D. Before placement and installation of work subject to tests by testing laboratory retained by the General Contractor, the Contractor shall notify the 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.

F. Contractor Work Hours

a. Normal working hours for this contract will be from 7:00AM to 5:00PM (local time) Monday through Friday except for weekends and established Federal Holidays.

b. Performing on-site work outside normal working hours will require approval from the Contracting Officer and the COR. Requests shall be submitted via email at least 72 hours prior to the requested date and at no additional cost to the Government. Approvals are subject to the availability of on-site staff.

1.3 STATEMENT OF BID ITEM(S)

A. ITEM I, GENERAL CONSTRUCTION: BASE BID: Work includes general construction, alterations required to implement the EHRM system upgrade for Gainesville facility.
Base Bid: _____

1.4 SPECIFICATIONS AND DRAWINGS FOR CONTRACTOR

A. Digital drawings and contract documents may be obtained from the website where the solicitation is posted. 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 toolboxes 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. A limited number of permits shall be issued for General Contractor and its employees for parking in designated areas only. Contractor to coordinate with VA COR.

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 determined by the COR.

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

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

H. Utilities Services: Where necessary to cut existing pipes, electrical wires, conduits, cables, etc., of utility services, or of fire protection systems or communications systems (except telephone), they shall be cut and capped at suitable places where shown; or, in absence of such indication, where directed by COR. All such actions shall be coordinated with the COR or Utility Company involved:

1. Whenever it is required that a connection fee be paid to a public utility provider for new permanent service to the construction project, for such items as water, sewer, electricity, gas or steam, payment of such fee shall be the responsibility of the Government and not the Contractor.

I. 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 COR and Contractor.
3. See phasing notes on drawing sheet T-002 and phasing plans on sheet T-300.

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

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 Medical Center at all times. Provide temporary facilities, labor, materials, equipment, connections, and utilities to assure uninterrupted services. Where necessary to cut existing water, steam, gases, sewer or air pipes, or conduits, wires, cables, etc. of utility services or of fire protection systems and communications systems (including telephone), they shall be cut and capped at suitable places where shown; or, in absence of such indication, where directed by COR.
1. No utility service such as water, gas, steam, sewers or electricity, or fire protection systems and communications systems may be interrupted without prior approval of COR . Electrical

work shall be accomplished with all affected circuits or equipment de-energized. When an electrical outage cannot be accomplished, work on any energized circuits or equipment shall not commence without a detailed work plan, the Medical Center Director’s prior knowledge and written approval. 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 COR, in writing, 7 days in advance of proposed interruption. Request shall state reason, date, exact time of, and approximate duration of such interruption.
3. Contractor will be advised (in writing) of approval of request, or of which other date and/or time such interruption will cause least inconvenience to operations of Medical Center . Interruption time approved by Medical Center may occur at other than Contractor's normal working hours.
4. Major interruptions of any system must be requested, in writing, at least 15 calendar days prior to the desired time and shall be performed as directed by the COR.
5. In case of a contract construction emergency, service will be interrupted on approval of COR. Such approval will be confirmed in writing as soon as practical.
6. 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. Wherever excavation for new utility lines cross existing roads, at least one lane must be open to traffic at all times with approval.
2. Method and scheduling of required cutting, altering and removal of existing roads, walks and entrances must be approved by the COR.

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

1.7 ALTERATIONS

A. Survey: Before any work is started, the Contractor shall make a thorough survey with the COR and 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 buildings.
   2. Existence and conditions of items such as plumbing fixtures and accessories, electrical fixtures, equipment, venetian blinds, shades, etc., required by drawings to be either reused or relocated, or both.
   3. Shall note any discrepancies between drawings and existing conditions at site.
   4. Shall designate areas for working space, materials storage and routes of access to areas within buildings where alterations occur and which have been agreed upon by Contractor and COR.

B. Any items required by drawings to be either reused or relocated or both, found during this survey to be nonexistent, or in opinion of COR , to be in such condition that their use is impossible or impractical, shall be furnished and/or replaced by Contractor with new items in accordance with specifications which will be furnished by Government. Provided the contract work is changed by reason of this subparagraph B, the contract 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 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 Medical Center .
3. Items of portable equipment and furnishings located in rooms and spaces in which work is to be done under this contract shall remain the property of the Government. When rooms and spaces are vacated by the Department of Veterans Affairs during the alteration period, such items which are NOT required by drawings and specifications to be either relocated or reused will be removed by the Government in advance of work to avoid interfering with Contractor's operation.
4. PCB Transformers and Capacitors : The Contractor shall be responsible for disposal of the Polychlorinated Biphenyl (PCB) transformers and capacitors . The transformers and capacitors shall be taken out of service and handled in accordance with the procedures of the Environmental Protection Agency (EPA) and the Department of Transportation (DOT) as outlined in Code of Federal Regulation (CFR), Titled 40 and 49 respectively. The EPA's Toxic Substance Control Act (TSCA) Compliance Program Policy Nos. 6-PCB-6 and 6-PCB-7 also apply. Upon removal of PCB transformers and capacitors for disposal, the "originator" copy of the Uniform Hazardous Waste Manifest (EPA Form 8700-22), along with the Uniform Hazardous Waste Manifest Continuation Sheet (EPA Form 8700-22A) shall be returned to the Contracting Officer who will annotate the contract file and transmit the Manifest to the Medical Center's Chief.
   a) Copies of the following listed CFR titles may be obtained from the Government Printing Office:
      40 CFR 261 ..... Identification and Listing of Hazardous Waste
      40 CFR 262 ..... Standards Applicable to Generators of Hazardous Waste
      40 CFR 263 ..... Standards Applicable to Transporters of Hazardous Waste
      40 CFR 761 ..... PCB Manufacturing, Processing, Distribution in Commerce, and use Prohibitions

49 CFR 172.....Hazardous Material tables and Hazardous Material Communications Regulations
49 CFR 173.....Shippers - General Requirements for Shipments and Packaging
49 CRR 173 .....Subpart A General
49 CFR 173.....Subpart B Preparation of Hazardous Material for Transportation
49 CFR 173.....Subpart J Other Regulated Material; Definitions and Preparation
TSCA.....Compliance Program Policy Nos. 6-PCB-6 and 6-PCB-7

1.9 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.

D. Refer to FAR clause 52.236-7, "Permits and Responsibilities," which is included in General Conditions. A National Pollutant Discharge Elimination System (NPDES) permit is required for this project. The Contractor is considered an "operator" under the permit and has extensive responsibility for compliance with permit requirements. VA will make the permit application available at the (appropriate medical center) office. The apparent low bidder, contractor and affected subcontractors shall furnish all information and certifications that are required to comply with the permit process and permit requirements. Many of the permit requirements will be satisfied by completing construction as shown and specified. Some requirements involve the Contractor's method of operations and operations planning and the Contractor is responsible for

employing best management practices. The affected activities often include, but are not limited to the following:

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

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 PROFESSIONAL SURVEYING SERVICES

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

1.12 LAYOUT OF WORK

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

(FAR 52.236-17)

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

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

D. Upon completion of the work, the Contractor shall furnish the COR one electronic copy and reproducible drawings at the scale of the contract drawings, showing the finished grade on the grid developed for constructing the work, including burial monuments and fifty foot stationing along new road centerlines. These drawings shall bear the seal of the registered land surveyor or registered civil engineer.

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

1.13 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.

1.14 WARRANTY MANAGEMENT

A. Warranty Management Plan: Develop a warranty management plan which contains information relevant to FAR 52.246-21 Warranty of Construction in 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.
      2) 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.
1) 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 a digital 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
Telephone number
Warranty Contact
Address
Telephone number
Warranty response time priority code

1.15 USE OF ROADWAYS

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

1.16 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. Boilers, pumps, feedwater heaters and auxiliary equipment must be operated as a complete system and be fully maintained by operating personnel. Boiler water must be given complete and continuous chemical treatment.

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

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

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.

1.17 TEMPORARY USE OF EXISTING ELEVATORS

A. Limited 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.
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.

1.18 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 reasonably 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.

1.19 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.

1.20 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.

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

1.21 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.

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.

- - - E N D - - -

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

1.1 DESCRIPTION

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

1.2 PROJECT SCHEDULER

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

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

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

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

1.3 SUBMITTALS

A. Initial Schedule:

1. Submit an initial schedule within 7 calendar days after Notice to Proceed (NTP).
    a. Include full schedule details for the first 60 calendar days of work starting on the NTP date and show the schedule ending on or before the Contract Completion Date (CCD).
    b. Provide a summary bar chart schedule (acceptable formats include, but are not limited to, Microsoft Excel, Microsoft Project, Oracle Primavera P6, and Gantt Chart).
    c. Show the proposed sequence, durations, early and late start dates for major work activities.
    d. Show the proposed calendar dates for starting and finishing initial contract activities including, but not limited to, set up of construction site, site layouts, travel routes, waste, and staffing areas.
2. Conduct a schedule review meeting with the Government within 14 calendar days after NTP. At this meeting, plan to discuss the proposed schedule for the entire project, including both

the detailed first 60-day period covered by the initial schedule as well as the following summary schedule. If deviations to the staging, phasing, or sequencing required by the contract documents are proposed, be prepared to discuss these deviations.

3. The Government will respond by approving the initial schedule, rejecting the schedule and identifying the reason for rejection, or by asking the contractor for additional information clarifying the proposed schedule activities and timelines.
4. The Government will use the approved initial schedule to monitor progress until the baseline schedule is approved.
5. The Government may withhold progress payments until the initial schedule is approved.

B. Schedule of Costs.

1. No more than 30 calendar days after receipt of the Notice to Proceed, prepare and submit a schedule of costs to the Government for review, in accordance with the technical and schedule submittal requirements listed in this specification.
2. The approved Schedule of Costs will serve as a tool in addition to the required monthly schedule update to determine progress payments to the Contractor for work completed.
3. The costs shown on the Schedule of Costs must represent true costs and the work activities/events match the project schedule work activities/events. The VA Contracting Officers Representative (VA COR) may require the Contractor to submit its original estimate sheets or other supporting documentation to substantiate the detailed makeup of the cost schedule.
4. The total costs of all work activities/events listed on the Schedule of Costs must equal the total contract price. The breakdown must include all line items specified in the contract and work activities shown on the schedule.
5. The Contractor is responsible for regularly updating the Schedule of Costs to reflect any approved changes to the contract scope or cost structure. Updates must be submitted for approval to the Contracting Officer to ensure continued accuracy and compliance with contract requirements.
6. Failure to submit or maintain an accurate and approved Schedule of Costs may result in delayed progress payments and potential penalties as outlined in the contract agreement.
7. All documentation related to the Schedule of Costs, including original estimate sheets and cost substantiation documents, must be maintained and made available for review upon request by the Contracting Officer or VA COR.

C. Baseline Schedule.

1. No more than 30 calendar days after approval of the initial schedule, prepare and submit a baseline schedule to the Government for review, in accordance with the technical and schedule submittal requirements listed in this specification.

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

D. Monthly Schedule Update.

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

E. Revised Schedule.

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

5. The Government may withhold progress payments until the revised schedule is approved.

F. Final Schedule.

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

G. The Government’s approval of any schedule, whether initial, baseline, update, or revised, does not modify the contract or constitute endorsement or validation by the Government of the Contractor's logic, activity durations, or assumptions in creating the schedule. By approving the schedule, the Government does not guarantee that the project can be performed or completed as scheduled. If the Contractor or the Government discover errors after the schedule has been approved, correct the error(s) in the next schedule submission.

1.4 WORK ACTIVITY/EVENT COST DATA

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

B. The Contractor shall cost load work activities/events for guarantee period services, test, balance and adjust various systems in accordance with the provisions in Article, FAR 52.232 – 5 (PAYMENT UNDER FIXED PRICE CONSTRUCTION CONTRACTS) and VAAR 852.232 – Article 70 Without NAS-CPM, 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. The sum of each Bid Item work shall equal the value of the bid item in the Contractors' bid.

E. With prior written approval from the Contracting Officer, the Contractor may request payment for suitably stored and maintained materials/equipment that conform to specifications and are ready

for installation, in accordance with the provisions in VAAR 852.232 – Article 70 Without NAS-CPM, Article 71 Including NAS-CPM, for (PAYMENTS UNDER FIXED PRICE CONSTRUCTION). Requests must include comprehensive documentation, such as invoices, proof of payment, and evidence of secure storage with appropriate insurance. Upon approval, payment for materials will be made in accordance with contract provisions, and title to the materials shall vest in the Owner. The contractor is responsible for replacement of non-confirming or damaged materials at no additional cost to the owner. Payment for stored materials will be reflected on the schedule by cost-loading the delivery activity to represent payment upon material receipt at the site, while the installation activity will be separately cost-loaded to represent payment under completion of installation. This schedule will clearly delineate submittal, procurement, delivery (cost-loaded for stored material payment), and installation (cost-loaded for installed material payment) as distinct activities.

1.5 PROJECT SCHEDULE REQUIREMENTS

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

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

requirements as specified in Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

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

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

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

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

E. Separate Cost-Loaded Activities for Adjusting and Testing Systems:
1. The CPM shall include separate cost-loaded activities for the adjustment and testing of systems in accordance with the provisions in VAAR 852.232 – Article 70 Without NAS-CPM, Article 71 Including NAS-CPM for (PAYMENTS UNDER FIXED PRICE CONSTRUCTION). The percentages provided shall be used to determine the cost of adjust and test work activities/ events, identifying the value of the work for payment purposes.

1.6 TECHNICAL REQUIREMENTS

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

B. Schedule Requirements.
1. Calculate the schedule using the Retained Logic scheduling option unless written authorization is obtained from the Government to use the Progress Override scheduling option.
2. At least 90% of all schedule activities shall be assigned to Finish-to-Start (FS) relationships.
3. Do not use the following types of logic relationships:

a. Negative lags

b. Lead and lag time activities

c. Start-to-finish or finish-to-finish relationships

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

d. Constraints (a limited number of constraints may be used only with the Government's written authorization).

e. Manually modified dates (manually modify dates may be used only with the Government's written authorization).

4. For any logic relationships that do not meet the criteria above in 1.6.B.2, the contractor must provide justification for the noncompliance to obtain the Government's authorization to proceed. If the Government does not provide written authorization, the contractor must resubmit the schedule submission.

5. Include the following work activities, as applicable:

a. Work to be performed by the contractor, subcontractors, and suppliers.

b. Work to be performed by the Government, other contractors, and third parties such as permitting authorities or other entities required for completion of the project.

c. The project start date, scheduled completion date, and other contractually mandated milestones, start and finish dates for phases, and site access or availability dates.

d. Submittals and Government review and approval of submittals (Reference specification section 01 33 23 for submission requirements).

e. Fabrication, delivery, installation, testing, and similar activities for materials, equipment, and related items.

f. Sampling and testing periods.

g. Settlement or surcharge periods.

h. Cure periods.

i. Utility notifications, shutdowns, relocations, and similar activities.

j. Installation, erection and removal, and similar activities related to temporary systems or structures such as temporary electrical systems or shoring.

k. Punch list, substantial completion, final cleanup, and similar activities.

l. Required acceptance testing, inspections, or similar activities.

m. Durations for receipt of permits or acquisition of rights of way.

6. Define the following attributes for each activity in the schedule:

a. A unique alphanumeric Activity ID.

b. A unique descriptive name, using such clear, concise attributes as work type, location so each activity is easily understood. Avoid name abbreviations or overly long activity names

to ensure each activity can be objectively measured and clearly understood by all stakeholders.

c. A duration stated in workdays of no more than 20 workdays unless a longer duration is requested by the contractor and approved by the Government.

d. Uses codes for responsibility, phasing, and staging.

1.7 SCHEDULE SUBMISSION REQUIREMENTS

A. Preparing Schedule on Owner's Database. If the schedule is prepared using My Primavera in the owner's database, then for each schedule submission, submit the following items:

1. A transmittal letter to the owner identifying which schedule in the database is being submitted for review.
2. A narrative report.

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

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

Activity ID and description

a.Original duration

b.Remaining duration

c.Calendar ID

d.Predecessors and Successors

e.Early start date

f.Early finish date

g.Late start date

h. Late finish date
i. Total float
j. Relationship type
k. Lags
l. Constraints

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

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

D. Narrative Reports for the Initial and Baseline Schedule. For each submission of the initial and baseline schedule provide a narrative report that includes the following information:

1. Explanation of the overall plan to complete the project, including where the work will begin and how the work and crews will flow through the project

2. Use and application of the workdays per week, number of shifts per day, number of hours per shift, holidays observed, and how the schedule accommodates adverse weather days for each month of activity
3. If the project is a multi-year project, then identify the work to be completed in each construction season
4. A statement explaining why the scheduled completion date is forecast to occur before or after the contract completion date.
5. An explanation stating why any of the contract milestone dates are forecast to occur late.
6. A description of problems or issues anticipated
7. A description of anticipated delays, including:
    a. Identification of the delayed activity by activity ID and description
    b. Type of delay
    c. Cause of the delay
    d. Effect of the delay on other activities, milestones, and completion dates
    e. Identification of the actions needed to avoid or mitigate the delay
    f. A description of the critical path
    g. A description of work paths with total float values within 20 workdays of the critical path's total float value. For example, if the critical path has a total float value of zero, then describe all the work paths with total float values of 20 or less.
    h. A statement identifying constraints and an explanation of the reason for and purpose of each constraint.
    i. A statement describing the status of required permits.
    j. The statement describing the reason for the use of each lag.

E. Narrative Reports for the Monthly Schedule Update and Revised Schedule. For each submission of the monthly schedule update and revised schedule provide a narrative report that includes the following information:

1. A description of the status of the scheduled completion date (and any contract milestone date(s)) since the last schedule submitted
2. A statement explaining why the scheduled completion date is forecast to occur before or after the contract completion date. An explanation stating why any of the contract milestone dates are forecasted to occur late
3. A description of the work performed since the last schedule update
4. A description of unusual labor, shift, equipment, or material conditions or restrictions encountered or anticipated
5. A description of the problems encountered or anticipated since the last schedule submission

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

1) Permits
2) Change orders
3) Time extension requests
4) Noncompliance or similar notices indicating deficiencies in the contractor's performance.

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

1.8 QUALITY ASSURANCE

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

1.9 PAYMENT TO THE CONTRACTOR

A. Monthly, the contractor shall submit an application and certificate for payment using VA Form 10-6001a or the AIA application and certificate for payment documents G702 & G703 reflecting updated schedule activities and cost data in accordance with the provisions of the following Article, PAYMENT AND PROGRESS REPORTING, as the basis upon which progress payments will be made pursuant to Article, FAR 52.232 – 5 (PAYMENT UNDER FIXED-PRICE CONSTRUCTION CONTRACTS) and VAAR 852.232 – Article 70 Without NAS-CPM 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 electronic files of

the resulting monthly updated schedule, provided in both PDF and native scheduling software formats.

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

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

1.10 PAYMENT AND PROGRESS REPORTING

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

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

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

C. After completing the monthly schedule update, the contractor's representative or scheduling consultant shall rerun all current period contract change(s) against the prior approved monthly project schedule. The analysis shall only include original workday durations and schedule logic agreed upon by the contractor and COR for the contract change(s). When there is a disagreement on logic and/or durations, the Contractor shall use the schedule logic and/or durations provided and approved by the COR. After each rerun update, the resulting electronic project schedule data file shall be appropriately identified and submitted to the VA in accordance to the requirements listed in articles 1.3 and 1.7. This electronic submission is separate from the regular monthly project schedule update requirements and shall be submitted to the COR within fourteen (14) calendar days of completing the regular schedule update. Before inserting the contract changes durations, care must be taken to ensure that only the original durations will be

used for the analysis, not the reported durations after progress. In addition, once the final network diagram is approved, the contractor must recreate all manual progress payment updates on this approved network diagram and associated reruns for contract changes in each of these update periods as outlined above for regular update periods. This will require detailed record keeping for each of the manual progress payment updates.

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

1.11 RESPONSIBILITY FOR COMPLETION

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

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

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

1.12 ADJUSTMENT OF CONTRACT COMPLETION

A. The contract completion time will be adjusted only for causes specified in this contract. Request for an extension of the contract completion date by the Contractor shall be supported with a clearly explained narrative justification, CPM data and supporting evidence as the VA COR may deem necessary for determination as to whether or not the Contractor is entitled to an extension of time

under the provisions of the contract. Submission of proof based on revised activity/event logic, durations (in work days) and costs is obligatory to any approvals. The schedule must clearly display that the Contractor has used, in full, all the float time available for the work involved in this request. The Contracting Officer's determination as to the total number of days of contract extension will be based upon the current computer produced calendar dated schedule for the time period in question and all other relevant information.

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

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

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

- - - END - - -

SECTION 01 33 23

SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

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.

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:

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

1.6 SUBMITTAL FORMAT AND TRANSMISSION

A. Provide submittals in electronic format, with the exception of material samples. Use PDF as the electronic format, unless otherwise specified or directed by the Contracting Officer.

B. Compile the electronic submittal file as a single, complete document. Name the electronic submittal file specifically according to its contents.

C. Electronic files must be of sufficient quality that all information is legible. Generate PDF files from original documents so that the text included in the PDF file is both searchable and can be copied. If documents are scanned, Optical Character Resolution (OCR) routines are required.

D. All documents (submittals) should be sent through FTP File Sharing system.

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 may be 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

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 21 calendar days for submittals.
E. VA review period is 21 calendar days for RFIs.
F. The VA will return submittals to the Contractor with the following notations:
    1. "Approved": authorizes the Contractor to proceed with the work covered.
    2. "Approved as noted": authorizes the Contractor to proceed with the work covered provided the Contractor incorporates the noted comments and makes the noted corrections.
    3. "Disapproved, revise and resubmit": indicates noncompliance with the contract requirements or that submittal is incomplete. Resubmit with appropriate changes and corrections. No work shall proceed for this item until resubmittal is approved.
    4. "Not reviewed": indicates submittal does not have evidence of being reviewed and approved by Contractor or is not complete. A submittal marked "not reviewed" will be returned with an

explanation of the reason it is not reviewed. Resubmit submittals after taking appropriate action.

1.11 APPROVED SUBMITTALS

A. The VA approval of submittals is not to be construed as a complete check, and indicates only that the general method of construction, materials, detailing, and other information are satisfactory.

B. VA approval of a submittal does not relieve the Contractor of the responsibility for any error which may exist. The Contractor is responsible for fully complying with all contract requirements and the satisfactory construction of all work, including the need to check, confirm, and coordinate the work of all subcontractors for the project. Non-compliant material incorporated in the work will be removed and replaced at the Contractor's expense.

C. After submittals have been approved, no resubmittal for the purpose of substituting materials or equipment will be considered unless accompanied by an explanation of why a substitution is necessary.

D. Retain a copy of all approved submittals at project site, including approved samples.

1.12 WITHHOLDING OF PAYMENT

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

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SECTION 01 35 26

SAFETY REQUIREMENTS

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SECTION 01 35 26

SAFETY REQUIREMENTS

1.1 APPLICABLE PUBLICATIONS:

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

B. American Society of Safety 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-2010	Guidelines 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 Health Requirements Publication No. EM 385-1-1, 2014 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:

   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). These incidents must be investigated and are required to be reported to the VA within 2 hours.

   h. 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 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;
2. Notifications and Reports;
3. Mishap Reports; G
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)
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.

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 COR:

a) Monthly HS&E Performance Report (Exposure Hours Data);

b) Mishap investigation reports;

c) Project site injury and illness logs;

d) 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 associates with the following:

1) Emergency response;

2) Contingency for severe weather;

3) Fire Prevention;

4) Medical Support;

5) Posting of emergency telephone numbers;

6) Prevention of alcohol and drug abuse;

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

8) Night operations and lighting;

9) Hazard communication program;

10) Welding/Cutting “Hot” work;

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

12) General Electrical Safety;

13) Hazardous energy control (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 COR for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES 15 calendar days prior to the date of the preconstruction conference for acceptance. Work cannot proceed without an accepted APP.

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

E. Once work begins, changes to the accepted APP shall be made with the knowledge and concurrence of the COR. Should any severe hazard exposure, i.e. imminent danger, become evident, stop work in the area, secure the area, and develop a plan to remove the exposure and control the hazard. Notify the 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 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 COR for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES for review at least 15 calendar days prior to the start of each phase. Subsequent AHAs as shall be formatted as amendments to the APP. The analysis should be used during daily inspections to ensure the implementation and effectiveness of the activity's safety and health controls.

4. The AHA list will be reviewed periodically (at least 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 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:

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), and an Alternate Safety Officer. The Prime Contractor shall provide a minimum of one “Full-Time” SSHO at each project site, for each shift (with no other duties) 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 qualified 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 Primary 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 COR for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES 15 calendar days prior to the date of the preconstruction conference for acceptance.

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 COR.

B. A Certified Safety Professional (CSP) with specialized knowledge in construction safety or a certified Construction Safety and Health Technician (CSHT) shall randomly conduct a monthly site safety inspection. The CSP or CSHT 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 COR will be notified immediately prior to start of the inspection and invited to accompany the inspection.

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

4. A report of the inspection findings with status of abatement will be provided to the COR 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, accidental property damage (both government and contractor) and Near-Misses that occur on site. Notify and provide an initial report to the COR 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 COR 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 COR within 7 calendar days of the accident. The COR will provide copies of any required or special forms.

C. A summation of all man-hours worked by the contractor and associated sub-contractors for each month will be reported to COR 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 COR monthly. COR 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 COR in circumstances of work operations that have limited potential for falling object hazards such as during finishing work or minor remodeling. With authorization to relax the requirement of hard hats, if a worker becomes exposed to an overhead falling object hazard, then hard hats would be required in accordance with the OSHA and/or EM 385-1-1 regulations.

2. Safety glasses - unless written authorization is given by the COR in circumstances of no eye hazards, appropriate safety glasses meeting the ANSI Z.87.1 standard must be worn by each person on site.

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

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

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.

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 fire-rated solid core wood in steel frame, painted

3. Dust proof 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 COR for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES. This plan may be an element of the Accident Prevention Plan.

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 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 exits for occupied buildings, including paths from exits to roads. Minimize disruptions and coordinate with COR.

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

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

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

K. Standpipes: Install and extend standpipes up with each floor in accordance with 29 CFR 1926 and NFPA 241. Do not charge wet standpipes subject to freezing until weather protected.

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

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

N. Smoke Detectors: Prevent accidental operation. Remove temporary covers at end of work operations each day. Coordinate with COR.

O. Hot Work: Perform and safeguard hot work operations in accordance with NFPA 241 and NFPA 51B. Coordinate with COR at least 2 weeks in advance. Designate contractor's responsible project-site fire prevention program manager to permit hot work.

P. Fire Hazard Prevention and Safety Inspections: Inspect entire construction areas weekly. Coordinate with, and report findings and corrective actions weekly to COR.

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

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

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

1.18 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 COR 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 COR.

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 COR and discussed with all engaged in the activity, including the Contractor, subcontractor(s), and Government on-site representatives at preparatory and initial control phase meetings.

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 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 COR 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 COR. 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.

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.

C. 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

D. 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.

E. 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 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 COR.

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 COR.

1.25 WELDING AND CUTTING

As specified in section 1.14, Hot Work: Perform and safeguard hot work operations in accordance with NFPA 241 and NFPA 51B. Coordinate with COR at least 2 weeks hours in advance. Designate contractor's responsible project-site fire prevention program manager to permit hot work.

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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SECTION 01 42 19
REFERENCE STANDARDS

PART 1 – GENERAL

1.1 DESCRIPTION

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

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

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

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

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

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

DEPARMENT OF VETERANS AFFAIRS
Office of Construction & Facilities Management
Facilities Quality Service (00CFM1A)
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

- - - E N D - - -

SECTION 01 45 00
QUALITY CONTROL

PART 1 – GENERAL

1.1 DESCRIPTION

This section specifies requirements for Contractor Quality Control (CQC) for Design-Bid-Build (DBB).

1.2 APPLICABLE PUBLICATIONS

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

B. ASTM International (ASTM)

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

1.3 SUBMITTALS

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

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

PART 2 PRODUCTS – NOT USED

PART 3 – EXECUTION

3.1 GENERAL REQUIREMENTS

Establish and maintain an effective quality control (QC) system. that complies with the FAR Clause 52.246.12 titled “Inspection of Construction”. QC consists of plans, procedures, and organization necessary to produce an end product which complies with the Contract

requirements. The QC system covers all design and construction operations, both onsite and offsite, and be keyed to the proposed design and construction sequence. The project superintendent will be held responsible for the quality of work and is subject to removal by the Contracting Office or Authorized designee for non-compliance with the quality requirements specified in the Contract. In this context the highest level manager responsible for the overall construction activities at the site, including quality and production is the project superintendent. The project superintendent maintains a physical presence at the site at all times and is responsible for all construction and related activities at the site, except as otherwise acceptable to the Contracting Officer.

3.2 CQC PLAN:

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

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

1. A description of the QC organization, including a chart showing lines of authority and acknowledgement that the CQC staff will implement the three phase control system for all aspects of the work specified. Include a CQC System Manager that reports to the project superintendent.
2. The name, qualifications (in resume format) duties, responsibilities, and authorities of each person assigned a CQC function.
3. A copy of the letter to the CQC System Manager signed by an authorized official of the firm which describes the responsibilities and delegates sufficient authorities to adequately perform the functions of the CQC System Manager, including authority to stop work which is not in compliance with the Contract. Letters of direction to all other various quality control representatives outlining duties, authorities, and responsibilities will be issued by the CQC System Manager. Furnish copies of these letters to the Contracting Officer or Authorized designee.
4. Procedures for scheduling, reviewing, certifying, and managing submittals including those of subcontractors, designers of record, consultants, A/E’s offsite fabricators, suppliers and

purchasing agents. These procedures must be in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples.

5. Control, verification, and acceptance of testing procedures for each specific test to include the test name, specification paragraph requiring test, feature of work to be tested, test frequency, and person responsible for each test. (Laboratory facilities approved by the Contracting Officer or Authorized designee are required to be used)
6. Procedures for tracking Preparatory, Initial, and Follow-Up control phases and control, verification, and acceptance tests including documentation.
7. Procedures for tracking design and construction deficiencies from identification through acceptable corrective action. Establish verification procedures that identified deficiencies have been corrected.
8. Reporting procedures, including proposed reporting formats.
9. A list of the definable features of work. A definable feature of work is a task which is separate and distinct from other tasks has separate control requirements, and is identified by different trades or disciplines, or it is work by the same trade in a different environment. Although each section of specifications can generally be considered as a definable feature of work, there are frequently more than one definable feature under a particular section. This list will be agreed upon during the Coordination meeting.
10. Coordinate schedule work with Special Inspections required by Section 01 45 35 Special Inspections, the Statement of Special Inspections and Schedule of Special Inspections. Where the applicable Code issue by the International Code Council (ICC) calls for inspections by the Building Official, the Contractor must include the inspections in the CQC Plan and must perform the inspections required by the applicable ICC. The Contractor must perform these inspections using independent qualified inspectors. Include the Special Inspection Plan requirements in the CQC Plan.

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

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

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

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

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

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

3.3 COORDINATION MEETING:

After the Preconstruction Conference Post-award Conference before start of design or construction, and prior to acceptance by the Government of the CQC Plan, meet with the Contracting Officer or Authorized designee to discuss the Contractor's quality control system. Submit the CQC Plan a minimum of 5 business days prior to the Coordination Meeting. During the meeting, a mutual understanding of the system details must be developed, including the forms for recording the CC operations, design activities (if applicable), control activities, testing, administration of the system for both onsite and offsite work, and the interrelationship of Contractor's Management and control with the Government's Quality Assurance. Minutes of the meeting will be prepared by the Government, signed by both the Contractor and Contracting Officer or Authorized designee and will become a part of the contract file. There can be occasions when subsequent conferences will be called by either party to reconfirm mutual understandings or address deficiencies in the CQC system or procedures which can require corrective action by the Contractor.

3.4 QUALITY CONTROL ORGANIZATION:

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

B. CQC System Manager: Identify as CQC System Manager an individual within the onsite work organization that is responsible for overall management of CQC and has the authority to act in all CQC matters for the Contractor. The CQC system Manager is required to be a graduate engineer, graduate architect, or a graduate of construction management, with a minimum of PM or SRE to determine qualifications based on project 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 directly employed by the General Contractor and cannot be employed by a supplier or subcontractor on this project ; 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.

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

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

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

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

3.6 CONTROL:

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

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

k. Discussion of the initial control phase.

l. 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 is required to meet criteria detailed in ASTM D3740 and ASTM E329.

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

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

3.8 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

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 ---

SECTION 01 45 29
TESTING LABORATORY SERVICES

PART 1 - GENERAL

1.1 DESCRIPTION:

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

1.2 APPLICABLE PUBLICATIONS:

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

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

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

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

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

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

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

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

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

C. American Concrete Institute (ACI):

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

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

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

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

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 EARTHWORK:

A. General: The Testing Laboratory shall provide qualified personnel, materials, equipment, and transportation as required to perform the services identified/required herein, within the agreed to schedule and/or time frame. The work to be performed shall be as identified herein and shall include but not be limited to the following:

1. Observe fill and subgrades during proof-rolling to evaluate suitability of surface material to receive fill or base course. Provide recommendations to the COR regarding suitability or unsuitability of areas where proof-rolling was observed. Where unsuitable results are observed, witness excavation of unsuitable material and recommend to COR extent of removal and replacement of unsuitable materials and observe proof-rolling of replaced areas until satisfactory results are obtained.
2. Provide full time observation of fill placement and compaction and field density testing in building areas and provide full time observation of fill placement and compaction and field density testing in pavement areas to verify that earthwork compaction obtained is in accordance with contract documents.
3. Provide supervised geotechnical technician to inspect excavation, subsurface preparation, and backfill for structural fill.

B. Testing Compaction:

1. Determine maximum density and optimum moisture content for each type of fill, backfill and subgrade material used, in compliance with AASHTO, T99/T180, Method A , ASTM, D698, D1557, Method A, ASTM D698 and/or ASTM D1557.
2. Make field density tests in accordance with the primary testing method following ASTM D6938, AASHTO T310 wherever possible. Field density tests utilizing ASTM D1556, AASHTO T191 , or ASTM D2167 shall be utilized on a case-by-case basis only if there are problems with the validity of the results from the primary method due to specific site field conditions. Should the testing laboratory propose these alternative methods, they should provide satisfactory explanation to the COR before the tests are conducted.
    a. Trenches: One test at maximum 30 m (100 foot) intervals per 1200 mm (4 foot) of vertical lift and at changes in required density, but in no case fewer than two tests.

C. Testing Materials: Test suitability of on-site and off-site borrow as directed by COR.

3.2 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 the 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 five cylinders for each 40 m^3 (50 cubic yards) or less of each concrete type, and at least five cylinders for any one day's pour for each concrete type. After good concrete quality control has been established and maintained as determined by the COR, make five cylinders for each 80 m^3 (100 cubic yards) or less of each concrete type, and at least five cylinders from any one day's pour for each concrete type. Label each cylinder with an identification number. The 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. 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 the 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 three cylinders 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 three cylinders, 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 placement.
    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.

3.3 REINFORCEMENT:

A. Review mill test reports furnished by the Contractor.
B. Make one tensile and one bend test in accordance with ASTM A370 from each pair of samples obtained.
C. Written report shall include, in addition to test results, heat number, manufacturer, type and grade of steel, and bar size.
D. Perform tension tests of mechanical and welded splices in accordance with ASTM A370.

3.4 MASONRY:

A. Mortar Tests:
    1. Laboratory compressive strength test:
        a. Comply with ASTM C780.
        b. Obtain samples during or immediately after discharge from batch mixer.
        c. Furnish molds with 50 mm (2 inch), 3 compartment gang cube.
        d. Test one sample at 7 days and 2 samples at 28 days.
    2. Two tests during first week of operation; one test per week after initial test until masonry completion.
B. Grout Tests:
    1. Laboratory compressive strength test:
        a. Comply with ASTM C1019.
        b. Test one sample at 7 days and 2 samples at 28 days.
        c. Perform test for each 230 m^2 (2500 square feet) of masonry.
C. Masonry Unit Tests:
    1. Laboratory Compressive Strength Test:
        a. Comply with ASTM C140.

b. Test 3 samples for each 460 m^2 (5000 square feet) of wall area.

D. Prism Tests: For each type of wall construction indicated, test masonry prisms per ASTM C1314 for each 460 m^2 (5000 square feet) of wall area. Prepare one set of prisms for testing at 7 days and one set for testing at 28 days.

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

3.6 STEEL DECKING:

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

3.7 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.

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

j. 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.

k. 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, landforms, and other landscape features shown on the drawings to be preserved by marking, fencing, or using any other approved techniques.
    a. Box and protect from damage existing trees and shrubs to remain on the construction site.
    b. Immediately repair all damage to existing trees and shrubs by trimming, cleaning, and painting with antiseptic tree paint.
    c. Do not store building materials or perform construction activities closer to existing trees or shrubs than the farthest extension of their limbs.
3. Reduction of Exposure of Unprotected Erodible Soils: Plan and conduct earthwork to minimize the duration of exposure of unprotected soils. Clear areas in reasonably sized increments only as needed to use. Form earthwork to final grade as shown. Immediately protect side slopes and back slopes upon completion of rough grading.

4. Temporary Protection of Disturbed Areas: Construct diversion ditches, benches, and berms to retard and divert runoff from the construction site to protected drainage areas approved under paragraph 208 of the Clean Water Act.
    a. Reuse or conserve the collected topsoil sediment as directed by the COR. Topsoil use and requirements are specified in Section 31 20 00, EARTH MOVING.
    b. Institute effluent quality monitoring programs as required by Federal, State, and local environmental agencies.
5. Protect adjacent areas from despoilment by temporary excavations and embankments.
6. 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.
7. Store chemical waste away from the work areas in corrosion resistant containers and dispose of waste in accordance with Federal, State, and local regulations.
8. 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.
    2. Control movement of materials and equipment at stream crossings during construction to prevent violation of water pollution control standards of the Federal, State, or local government.
    3. Monitor water areas affected by construction.

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

E. Protection of Air Resources: Keep construction activities under surveillance, management, and control to minimize pollution of air resources. Burning is not permitted on the job site. Keep activities, equipment, processes, and work operated or performed, in strict accordance with the State of Florida. 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.

E. 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 8:00 a.m. and 6:00 p.m unless otherwise permitted by local ordinance or 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. 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		
GENERATORS	75	SAWS	75
COMPRESSORS	75	VIBRATORS	75

b. Use shields or other physical barriers to restrict noise transmission.
c. Provide soundproof housings or enclosures for noise-producing machinery.
d. Use efficient silencers on equipment air intakes.
e. Use efficient intake and exhaust mufflers on internal combustion engines that are maintained so equipment performs below noise levels specified.
f. Line hoppers and storage bins with sound deadening material.
g. Conduct truck loading, unloading, and hauling operations so that noise is kept to a minimum.

3. Measure sound level for noise exposure due to the construction at least once every five successive working days while work is being performed above 55 ____ dB(A) noise level. Measure noise exposure at the property line or 15 m (50 feet) from the noise source, whichever is greater. Measure the sound levels on the A weighing network of a General Purpose sound level meter at slow response. To minimize the effect of reflective sound waves at buildings, take measurements at 900 to 1800 mm (three to six feet) in front of any building face. Submit the recorded information to the 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 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 00, DEMOLITION.

B. Section 01 00 00, GENERAL REQUIREMENTS.

1.3 QUALITY ASSURANCE

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

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

C. Contractor shall develop and implement procedures to 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 of by landfill or incineration.

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.

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

I. 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) Cleaners.
3) Composite Panels.
4) Corrosion Preventatives.
5) Erosion Control Materials.
6) Dust Suppressants.
7) Floor Cleaners and Protectors.
8) Floor Coverings (Non-Carpet).
9) Glass Cleaners.
10) Hydraulic Fluids.
11) Industrial Cleaners.
12) Interior Paints and Coatings.
13) Multipurpose Cleaners.
14) Multipurpose Lubricants.
15) Packaging Films.

16) Paint Removers.
17) Pneumatic Equipment Lubricants.
18) Wood and Concrete Sealers.
19) 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. Spray Sprinkler Bodies

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. Electronics and Information Technology:
1) Data Center Storage.
2) Digital Media Player.
3) Enterprise Servers.
4) Set-Top and Cable Boxes.
5) Uninterruptible Power Supplies.
b. Heating and Cooling Equipment:
1) Air-Source Heat Pumps (Residential).
2) Boilers.
3) Water Heaters.
4) Light Commercial Heating and Cooling Equipment.
c. Other:
1) Light Bulbs.
2) Light Fixtures.
3) Water Coolers.
4) 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. Electric Chillers, Air-Cooled (Commercial).
3. Electric Chillers, Water-Cooled (Commercial).
4. Fluorescent Lamps, General Service.
5. Industrial Lighting (High/Low Bay).
6. Light Emitting Diode (LED) Luminaires.

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.
    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 (*CONTRACTOR PROVIDED*)

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 21, Division 22, Division 23, Division 26, Division 27, and Division 28 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, and Division 28 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.

G. The General Contractor must contract directly and provide a commissioning agent approved by the VA.

1.2 CONTRACTURAL 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 23 08 00 COMMISSIONING OF HVAC SYSTEMS.

E. Section 26 08 00 COMMISSIONING OF ELECTRICAL SYSTEMS.

F. Section 27 08 00 COMMISSIONING OF COMMUNICATIONS SYSTEMS.

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.

1.5 ACRONYMS

List of Acronyms	

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

VAMC	VA Medical Center
VA CFM	VA Office of Construction and Facilities Management
VACO	VA Central Office
VA PM	VA Project Manager
VA-RE	VA COR
USGBC	United States Green Building Council

1.6 DEFINITIONS

A. 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.

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

C. 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

D. 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.

E. 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.

F. 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.

G. 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.

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

I. 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)

J. 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

K. 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.

L. 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.

M. 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.

N. 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).

O. Commissioning Manager (CxM): A qualified individual appointed by the Contractor to manage the commissioning process on behalf of the Contractor.

P. 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)

Q. Commissioning Plan: A document that outlines the commissioning process, commissioning scope and defines responsibilities, processes, schedules, and the documentation requirements of the Commissioning Process.

R. 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.

S. 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.

T. Commissioning Representative (CxR): An individual appointed by a sub-contractor to manage the commissioning process on behalf of the sub-contractor.

U. Commissioning Specifications: The contract documents that detail the objective, scope and implementation of the commissioning process as developed in the Commissioning Plan.

V. Commissioning Team: Individual team members whose coordinated actions are responsible for implementing the Commissioning Process.

W. Construction Phase Commissioning: All commissioning efforts executed during the construction process after the design phase and prior to the Acceptance Phase Commissioning.

X. 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.

Y. Construction Phase Commissioning (CPC): All commissioning efforts executed during the construction process after the design phase and prior to the Acceptance Phase Commissioning.

Z. 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.

AA. Data Logging: The monitoring and recording of temperature, flow, current, status, pressure, etc. of equipment using stand-alone data recorders.

BB. 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.

CC. Deficiency: See “Commissioning Issue”.

DD. 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.

EE. 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.

FF. Design Narrative: A written description of the proposed design solutions that satisfy the requirements of the OPR.

GG. Design Phase Commissioning (DPC): All commissioning tasks executed during the design phase of the project.

HH. 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.

II. 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.

JJ. 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.

KK. 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.

LL. 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.

MM. 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.

NN. 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.

OO. Lessons Learned Workshop: A workshop conducted to discuss and document project successes and identify opportunities for improvements for future projects.

PP. 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.

QQ. 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').

RR. 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.

SS. 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.

TT. 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.

UU. 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

VV. 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.

WW. 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.

XX. 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.

YY. Range: The upper and lower limits of an instrument's ability to measure the value of a quantity for which the instrument is calibrated.

ZZ. 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.

AAA. 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.

BBB. 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.

CCC. Special System Inspections: Inspections required by a local code authority prior to occupancy and are not normally a part of the commissioning process.

DDD. Static Tests: Tests or inspections that validate a specified static condition such as pressure testing. Static tests may be specification or code initiated.

EEE. Start Up Tests: Tests that validate the component or system is ready for automatic operation in accordance with the manufactures requirements.

FFF. Systems Manual: A system-focused composite document that includes all information required for the owners operators to operate the systems.

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

HHH. 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.

III. 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.

JJJ. 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.

KKK. 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.

LLL. Trending: Monitoring over a period of time with the building automation system.

MMM. 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.

NNN. 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.

OOO. 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.

PPP. Warranty Visit: A commissioning meeting and site review where all outstanding warranty issues and deferred testing is reviewed and discussed.

QQQ. 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	
Basements	Basement walls, crawl spaces, waterproofing, drainage
Exterior Closure	Exterior walls, exterior windows, exterior doors, louvers, grilles and sunscreens,
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.
Fire Suppression	
Fire Sprinkler Systems	Wet pipe system, dry pipe system, pre-action system, special agent systems
HVAC	
Noise and Vibration Control	Noise and vibration levels for critical equipment such as Air Handlers, etc. 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.
Heating Hot Water System	Heating hot water system.
HVAC Air Handling Systems	Outdoor Air conditioning units, CRAC units
HVAC Ventilation/Exhaust Systems	UPS room exhaust
HVAC Terminal Unit Systems	VAV Terminal Units
Decentralized Unitary HVAC Systems	Split-system HVAC systems, controls, interface with facility DDC
Humidity Control Systems	Humidifiers, de-humidifiers, controls, interface with facility DDC

Electrical	
Grounding & Bonding Systems	Witness 3rd party testing, review reports
Electrical System Protective Device Study	Review reports, verify field settings consistent with Study
Low-Voltage Distribution System	Normal power distribution system, Life-safety power distribution system, critical power distribution system, equipment power distribution system, distribution panels, panelboards, verify breaker testing results (injection current, etc)
Emergency Power Systems	Uninterruptable Power Supplies (UPS), etc
Lighting & Lighting Control Systems	Lighting control systems
Communications	
Grounding & Bonding System	Witness 3rd party testing, review reports
Structured Cabling System	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
Intrusion Detection Systems	Witness 3rd party testing, review reports
Video Surveillance 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.

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.

3. Commissioning Agent: The designated person, company, or entity that plans, schedules, and coordinates the commissioning team to implement the commissioning process. The general contractor will engage the CxA under a separate contract.

C. Members Appointed by VA:
1. User: Representatives of the facility user and operation and maintenance personnel.
2. 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.

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

1.15 QUALITY ASSURANCE

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

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

1.16 COORDINATION

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

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

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

D. Commissioning Coordinating Meetings: The Commissioning Agent will conduct periodic Commissioning Coordination Meetings of the commissioning team to review status of commissioning activities, to discuss scheduling conflicts, and to discuss upcoming commissioning process activities.

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

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

PART 2 – PRODUCTS

2.1 TEST EQUIPMENT

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

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

C. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the Specifications. If not otherwise noted, the

following minimum requirements apply: Temperature sensors and digital thermometers shall have a certified calibration within the past year to an accuracy of 0.5 oC (1.0 oF) and a resolution of + or - 0.1 oC (0.2 oF). 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 **Commissioning Roles & Responsibilities**		CxA = Commissioning Agent RE = COR A/E = Design Arch/Engineer PC = Prime Contractor O&M = Gov't Facility O&M				L = Lead P = Participate A = Approve R = Review O = Optional	
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	L	A	P	P	N/A	

	support the OPR and BOD.						
Cx Plan & Spec	Final Commissioning Plan	L	A	R	R	O	
Schedules	Duration Schedule for Commissioning Activities	L	A	R	R	N/A	
OPR and BOD	Maintain OPR on behalf of Owner	L	A	R	R	O	
	Maintain BOD/DID on behalf of Owner	L	A	R	R	O	
Document Reviews	TAB Plan Review	L	A	R	R	O	
	Submittal and Shop Drawing Review	R	A	R	L	O	
	Review Contractor Equipment Startup Checklists	L	A	R	R	N/A	
	Review Change Orders, ASI, and RFI	L	A	R	R	N/A	
Site Observations	Witness Factory Testing	P	A	P	L	O	
	Construction Observation Site Visits	L	A	R	R	O	
Functional Test Protocols	Final Pre-Functional Checklists	L	A	R	R	O	
	Final Functional Performance Test Protocols	L	A	R	R	O	

Technical Activities	Issues Resolution Meetings	P	A	P	L	O	
Reports and Logs	Status Reports	L	A	R	R	O	
	Maintain Commissioning Issues Log	L	A	R	R	O	

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

Acceptance Phase		CxA = Commissioning Agent					L = Lead
		RE = COR					P=Participate
Commissioning Roles & Responsibilities		A/E = Design Arch/Engineer					A = Approve
		PC = Prime Contractor					R = Review
		O&M = Gov't Facility O&M					O = Optional
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	
Coordination	Coordinate with [OGC's, AHJ, Vendors, etc.] to ensure that Cx interacts properly with other systems as needed to support OPR and BOD	L	P	P	P	O	
Cx Plan & Spec	Maintain/Update Commissioning Plan	L	A	R	R	O	

Schedules	Prepare Functional Test Schedule	L	A	R	R	O	
OPR and BOD	Maintain OPR on behalf of Owner	L	A	R	R	O	
	Maintain BOD/DID on behalf of Owner	L	A	R	R	O	
Document Reviews	Review Completed Pre-Functional Checklists	L	A	R	R	O	
	Pre-Functional Checklist Verification	L	A	R	R	O	
	Review Operations & Maintenance Manuals	L	A	R	R	R	
	Training Plan Review	L	A	R	R	R	
	Warranty Review	L	A	R	R	O	
	Review TAB Report	L	A	R	R	O	
Site Observations	Construction Observation Site Visits	L	A	R	R	O	
	Witness Selected Equipment Startup	L	A	R	R	O	
Functional Test Protocols	TAB Verification	L	A	R	R	O	
	Systems Functional Performance Testing	L	A	P	P	P	
	Retesting	L	A	P	P	P	
Technical Activities	Issues Resolution Meetings	P	A	P	L	O	
	Systems Training	L	S	R	P	P	
Reports and Logs	Status Reports	L	A	R	R	O	
	Maintain Commissioning Issues Log	L	A	R	R	O	
	Final Commissioning Report	L	A	R	R	R	
	Prepare Systems Manuals	L	A	R	R	R	

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

Warranty Phase		CxA = Commissioning Agent RE = COR A/E = Design Arch/Engineer PC = Prime Contractor O&M = Gov't Facility O&M					L = Lead P =Participate A = Approve R = Review O = Optional
Commissioning Roles & Responsibilities							
Category	**Task Description**	CxA	RE	A/E	PC	O&M	Notes
Meetings	Post-Occupancy User Review Meeting	L	A	O	P	P	
Site Observations	Periodic Site Visits	L	A	O	O	P	
Functional Test Protocols	Deferred and/or seasonal Testing	L	A	O	P	P	
Technical Activities	Issues Resolution Meetings	L	S	O	O	P	
	Post-Occupancy Warranty Checkup and review of Significant Outstanding Issues	L	A		R	P	
Reports and Logs	Final Commissioning Report Amendment	L	A		R	R	
	Status Reports	L	A		R	R	

3.2 STARTUP, INITIAL CHECKOUT, AND PRE-FUNCTIONAL CHECKLISTS

A. The following procedures shall apply to all equipment and systems to be commissioned, according to Part 1, Systems to Be Commissioned.

1. Pre-Functional Checklists are important to ensure that the equipment and systems are hooked up and operational. These ensure that Systems Functional Performance Testing

may proceed without unnecessary delays. Each system to be commissioned shall have a full Pre-Functional Checklist completed by the Contractor prior to Systems Functional Performance Testing. No sampling strategies are used.

a. The Pre-Functional Checklist will identify the trades responsible for completing the checklist. The Contractor shall ensure the appropriate trades complete the checklists.

b. The Commissioning Agent will review completed Pre-Functional Checklists and field-verify the accuracy of the completed checklist using sampling techniques.

2. Startup and Initial Checkout Plan: The Contractor shall develop detailed startup plans for all equipment. The primary role of the Contractor in this process is to ensure that there is written documentation that each of the manufacturer recommended procedures have been completed. Parties responsible for startup shall be identified in the Startup Plan and in the checklist forms.

   a. The Contractor shall develop the full startup plan by combining (or adding to) the checklists with the manufacturer's detailed startup and checkout procedures from the O&M manual data and the field checkout sheets normally used by the Contractor. The plan shall include checklists and procedures with specific boxes or lines for recording and documenting the checking and inspections of each procedure and a summary statement with a signature block at the end of the plan.

   b. The full startup plan shall at a minimum consist of the following items:

      1) The Pre-Functional Checklists.

      2) The manufacturer's standard written startup procedures copied from the installation manuals with check boxes by each procedure and a signature block added by hand at the end.

      3) The manufacturer's normally used field checkout sheets.

   c. The Commissioning Agent will submit the full startup plan to the VA and Contractor for review. Final approval will be by the VA.

   d. The Contractor shall review and evaluate the procedures and the format for documenting them, noting any procedures that need to be revised or added.

3. Sensor and Actuator Calibration

   a. All field installed temperature, relative humidity, CO2 and pressure sensors and gages, and all actuators (dampers and valves) on all equipment shall be calibrated using the methods described in Division 21, Division 22, Division 23, Division 26, Division 27, and Division 28 specifications.

   b. All procedures used shall be fully documented on the Pre-Functional Checklists or other suitable forms, clearly referencing the procedures followed and written documentation of initial, intermediate and final results.

4. Execution of Equipment Startup
    a. Four weeks prior to equipment startup, the Contractor shall schedule startup and checkout with the VA and Commissioning Agent. The performance of the startup and checkout shall be directed and executed by the Contractor.
    b. The Commissioning Agent will observe the startup procedures for selected pieces of primary equipment.
    c. The Contractor shall execute startup and provide the VA and Commissioning Agent with a signed and dated copy of the completed startup checklists, and contractor tests.
    d. Only individuals that have direct knowledge and witnessed that a line item task on the Startup Checklist was actually performed shall initial or check that item off. It is not acceptable for witnessing supervisors to fill out these forms.

3.3 DEFICIENCIES, NONCONFORMANCE, AND APPROVAL IN CHECKLISTS AND STARTUP

A. The Contractor shall clearly list any outstanding items of the initial startup and Pre-Functional Checklist procedures that were not completed successfully, at the bottom of the procedures form or on an attached sheet. The procedures form and any outstanding deficiencies shall be provided to the VA and the Commissioning Agent within two days of completion.

B. The Commissioning Agent will review the report and submit comments to the VA. The Commissioning Agent will work with the Contractor to correct and verify deficiencies or uncompleted items. The Commissioning Agent will involve the VA and others as necessary. The Contractor shall correct all areas that are noncompliant or incomplete in the checklists in a timely manner, and shall notify the VA and Commissioning Agent as soon as outstanding items have been corrected. The Contractor shall submit an updated startup report and a Statement of Correction on the original noncompliance report. When satisfactorily completed, the Commissioning Agent will recommend approval of the checklists and startup of each system to the VA.

C. The Contractor shall be responsible for resolution of deficiencies as directed the VA.

3.4 PHASED COMMISSIONING

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

3.5 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. 10. Required pretest field measurements
11. 11. Instructions for setting up the test.
12. 12. Special cautions, alarm limits, etc.
13. 13. Specific step-by-step procedures to execute the test, in a clear, sequential and repeatable format
14. 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. 15. A section for comments.
16. 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.

3.6 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.

3.7 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.

3.8 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, and Division 28 sections. The Training and Demonstration shall include, but is not limited to, the following:

1. Review the Contract Documents.
2. Review installed systems, subsystems, and equipment.
3. Review instructor qualifications.
4. Review instructional methods and procedures.
5. Review training module outlines and contents.
6. Review course materials (including operation and maintenance manuals).
7. Review and discuss locations and other facilities required for instruction.
8. Review and finalize training schedule and verify availability of educational materials, instructors, audiovisual equipment, and facilities needed to avoid delays.
9. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

C. Training Module Submittals: The Contractor shall submit the following information to the VA and the Commissioning Agent:

1. Instruction Program: Submit two copies of outline of instructional program for demonstration and training, including a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module. At completion of training, submit two complete training manuals for VA's use.
2. Qualification Data: Submit qualifications for facilitator and/or instructor.
3. Attendance Record: For each training module, submit list of participants and length of instruction time.
4. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

5. Demonstration and Training Recording:
    a. General: Engage a qualified commercial photographer to record demonstration and training. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice. At beginning of each training module, record each chart containing learning objective and lesson outline.
    b. Video Format: Provide high quality color DVD color on standard size DVD disks.
    c. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to show area of demonstration and training. Display continuous running time.
    d. Narration: Describe scenes on video recording by audio narration by microphone while demonstration and training is recorded. Include description of items being viewed. Describe vantage point, indicating location, direction (by compass point), and elevation or story of construction.
    e. Submit two copies within seven days of end of each training module.
6. Transcript: Prepared on 8-1/2-by-11-inch paper, punched and bound in heavy-duty, 3-ring, vinyl-covered binders. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding videotape. Include name of Project and date of videotape on each page.

D. Quality Assurance:
1. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
2. Instructor Qualifications: A factory authorized service representative, complying with requirements in Division 01 Section "Quality Requirements," experienced in operation and maintenance procedures and training.
3. Photographer Qualifications: A professional photographer who is experienced photographing construction projects.

E. Training Coordination:
1. Coordinate instruction schedule with VA's operations. Adjust schedule as required to minimize disrupting VA's operations.
2. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

3. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by the VA.

F. Instruction Program:

1. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections, and as follows:
   a. Fire protection systems, including fire alarm, fire pumps, and fire suppression systems.
   b. Intrusion detection systems.
   c. Conveying systems, including elevators, wheelchair lifts, escalators, and automated materials handling systems.
   d. Medical equipment, including medical gas equipment and piping.
   e. Laboratory equipment, including laboratory air and vacuum equipment and piping.
   f. Heat generation, including boilers, feedwater equipment, pumps, steam distribution piping, condensate return systems, heating hot water heat exchangers, and heating hot water distribution piping.
   g. Refrigeration systems, including chillers, cooling towers, condensers, pumps, and distribution piping.
   h. HVAC systems, including air handling equipment, air distribution systems, and terminal equipment and devices.
   i. HVAC instrumentation and controls.
   j. Electrical service and distribution, including switchgear, transformers, switchboards, panelboards, uninterruptible power supplies, and motor controls.
   k. Packaged engine generators, including synchronizing switchgear/switchboards, and transfer switches.
   l. Lighting equipment and controls.
   m. Communication systems, including intercommunication, surveillance, nurse call systems, public address, mass evacuation, voice and data, and entertainment television equipment.
   n. Site utilities including lift stations, condensate pumping and return systems, and storm water pumping systems.

G. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participants are expected to master. For each module, include instruction for the following:

1. Basis of System Design, Operational Requirements, and Criteria: Include the following:

a. System, subsystem, and equipment descriptions.
b. Performance and design criteria if Contractor is delegated design responsibility.
c. Operating standards.
d. Regulatory requirements.
e. Equipment function.
f. Operating characteristics.
g. Limiting conditions.
h. Performance curves.

2. Documentation: Review the following items in detail:
   a. Emergency manuals.
   b. Operations manuals.
   c. Maintenance manuals.
   d. Project Record Documents.
   e. Identification systems.
   f. Warranties and bonds.
   g. Maintenance service agreements and similar continuing commitments.
3. Emergencies: Include the following, as applicable:
   a. Instructions on meaning of warnings, trouble indications, and error messages.
   b. Instructions on stopping.
   c. Shutdown instructions for each type of emergency.
   d. Operating instructions for conditions outside of normal operating limits.
   e. Sequences for electric or electronic systems.
   f. Special operating instructions and procedures.
4. Operations: Include the following, as applicable:
   a. Startup procedures.
   b. Equipment or system break-in procedures.
   c. Routine and normal operating instructions.
   d. Regulation and control procedures.
   e. Control sequences.
   f. Safety procedures.
   g. Instructions on stopping.
   h. Normal shutdown instructions.
   i. Operating procedures for emergencies.
   j. Operating procedures for system, subsystem, or equipment failure.
   k. Seasonal and weekend operating instructions.
   l. Required sequences for electric or electronic systems.

m. Special operating instructions and procedures.

5. Adjustments: Include the following:
   a. Alignments.
   b. Checking adjustments.
   c. Noise and vibration adjustments.
   d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
   a. Diagnostic instructions.
   b. Test and inspection procedures.
7. Maintenance: Include the following:
   a. Inspection procedures.
   b. Types of cleaning agents to be used and methods of cleaning.
   c. List of cleaning agents and methods of cleaning detrimental to product.
   d. Procedures for routine cleaning
   e. Procedures for preventive maintenance.
   f. Procedures for routine maintenance.
   g. Instruction on use of special tools.
8. Repairs: Include the following:
   a. Diagnosis instructions.
   b. Repair instructions.
   c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
   d. Instructions for identifying parts and components.
   e. Review of spare parts needed for operation and maintenance.

H. Training Execution:
1. Preparation: Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a combined training manual. Set up instructional equipment at instruction location.
2. Instruction:
   a. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Department of Veterans Affairs for number of participants, instruction times, and location.
   b. Instructor: Engage qualified instructors to instruct VA's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

1) The Commissioning Agent will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
2) The VA will furnish an instructor to describe VA's operational philosophy.
3) The VA will furnish the Contractor with names and positions of participants.

3. Scheduling: Provide instruction at mutually agreed times. For equipment that requires seasonal operation, provide similar instruction at start of each season. Schedule training with the VA and the Commissioning Agent with at least seven days' advance notice.
4. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of an oral, or a written, performance-based test.
5. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

I. Demonstration and Training Recording:
1. General: Engage a qualified commercial photographer to record demonstration and training. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice. At beginning of each training module, record each chart containing learning objective and lesson outline.
2. Video Format: Provide high quality color DVD color on standard size DVD disks.
3. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to show area of demonstration and training. Display continuous running time.
4. Narration: Describe scenes on videotape by audio narration by microphone while demonstration and training is recorded. Include description of items being viewed. Describe vantage point, indicating location, direction (by compass point), and elevation or story of construction.

END OF SECTION

SECTION 02 41 00
DEMOLITION

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies demolition and removal of buildings, portions of buildings, utilities, other structures and debris.

1.2 RELATED WORK:

A. Demolition and removal of roads, walks, curbs, and on-grade slabs outside buildings to be demolished: Section 31 20 00, EARTH MOVING .Safety Requirements: Section 01 35 26 Safety Requirements Article, ACCIDENT PREVENTION PLAN (APP).

B. Disconnecting utility services prior to demolition: Section 01 00 00, GENERAL REQUIREMENTS.

C. Reserved items that are to remain the property of the Government: Section 01 00 00, GENERAL REQUIREMENTS.

D. Asbestos Removal: Section 02 82 11, TRADITIONAL ASBESTOS ABATEMENT.

E. Environmental Protection: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

F. Construction Waste Management: Section 01 74 19 CONSTRUCTION WASTE MANAGEMENT.

G. Infectious Control: Section 01 35 26, SAFETY REQUIREMENTS.

1.3 PROTECTION:

A. Perform demolition in such manner as to eliminate hazards to persons and property; to minimize interference with use of adjacent areas, utilities and structures or interruption of use of such utilities; and to provide free passage to and from such adjacent areas of structures. Comply with requirements of GENERAL CONDITIONS Article, ACCIDENT PREVENTION.

B. Provide safeguards, including warning signs, barricades, temporary fences, warning lights, and other similar items that are required for protection of all personnel during demolition and removal operations. Comply with requirements of Section 01 00 00, GENERAL REQUIREMENTS, Article PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES AND IMPROVEMENTS.

C. Maintain fences, barricades, lights, and other similar items around exposed excavations until such excavations have been completely filled.

D. Provide enclosed dust chutes with control gates from each floor to carry debris to truck beds and govern flow of material into truck. Provide overhead bridges of tight board or prefabricated metal construction at dust chutes to protect persons and property from falling debris.

E. Prevent spread of flying particles and dust. Sprinkle rubbish and debris with water to keep dust to a minimum. Do not use water if it results in hazardous or objectionable condition such as, but not limited to ice, flooding, or pollution. Vacuum and dust the work area daily.

F. In addition to previously listed fire and safety rules to be observed in performance of work, include following:

1. No wall or part of wall shall be permitted to fall outwardly from structures.
3. Wherever a cutting torch or other equipment that might cause a fire is used, provide and maintain fire extinguishers nearby ready for immediate use. Instruct all possible users in use of fire extinguishers.
4. Keep hydrants clear and accessible at all times. Prohibit debris from accumulating within a radius of 15 feet of fire hydrants.

G. Before beginning any demolition work, the Contractor shall survey the site and examine the drawings and specifications to determine the extent of the work. The contractor shall take necessary precautions to avoid damages to existing items to remain in place, to be reused, or to remain the property of the Medical Center; any damaged items shall be repaired or replaced as approved by the COR. The Contractor shall coordinate the work of this section with all other work and shall construct and maintain shoring, bracing, and supports as required. The Contractor shall ensure that structural elements are not overloaded and shall be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract. Do not overload structural elements. Provide new supports and reinforcement for existing construction weakened by demolition or removal works. Repairs, reinforcement, or structural replacement must have COR's approval.

H. The work shall comply with the requirements of Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

I. The work shall comply with the requirements of Section 01 00 00, GENERAL REQUIREMENTS and Section 01 35 26, SAFETY REQUIREMENTS.

1.4 UTILITY SERVICES:

A. Demolish and remove outside utility service lines shown to be removed.

B. Remove abandoned outside utility lines that would interfere with installation of new utility lines and new construction.

PART 2 - PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 DEMOLITION:

A. Demolish and remove sections of building interiors, including all appurtenances related or connected thereto, as noted below and temporary trailer 11 in its entirety:

1. As required for installation of new utility service lines.
2. Trailer 11 - To full depth within an area defined by hypothetical lines located 1500 mm (5 feet) outside building lines of new data center.

B. Debris, including brick, concrete, stone, metals and similar materials shall become property of Contractor and shall be disposed of by him daily, off the Medical Center to avoid accumulation at the demolition site. Materials that cannot be removed daily shall be stored in areas specified by the COR. Break up concrete slabs below grade that do not require removal from present location

into pieces not exceeding 600 mm (24 inches) square to permit drainage. The contractor shall dispose debris in compliance with applicable federal, state or local permits, rules and/or regulations.

C. Remove and legally dispose of all materials, other than earth to remain as part of project work, from any trash dumps shown. Materials removed shall become property of contractor and shall be disposed of in compliance with applicable federal, state or local permits, rules and/or regulations. All materials in the indicated trash dump areas, including above surrounding grade and extending to a depth of 1500mm (5 feet) below surrounding grade, shall be included as part of the lump sum compensation for the work of this section. Materials that are located beneath the surface of the surrounding ground more than 5 feet, or materials that are discovered to be hazardous, shall be handled as unforeseen. The removal of hazardous material shall be referred to Hazardous Materials specifications.

D. Remove existing utilities as indicated or uncovered by work and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by the COR. When Utility lines are encountered that are not indicated on the drawings, the COR shall be notified prior to further work in that area.

3.2 CLEAN-UP:

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

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SECTION 02 82 11
TRADITIONAL ASBESTOS ABATEMENT

PART 1 - GENERAL

1.1 SUMMARY OF THE WORK

A. Contract Documents and Related Requirements: Drawings, general provisions of the contract, including general and supplementary conditions and other Division 01 specifications, shall apply to the work of this section. The contract documents show or describe the work to be done under the contract and related requirements and conditions impacting the project. Related requirements and conditions include applicable codes and regulations, notices and permits, existing site conditions and restrictions on use of the site, requirements for partial owner occupancy during the work, coordination with other work and the phasing of the work. In the event the Asbestos Abatement Contractor discovers a conflict in the contract documents and/or requirements or codes, the conflict must be brought to the immediate attention of the Contracting Officer for resolution. Whenever there is a conflict or overlap in the requirements, the most stringent shall apply. Any actions taken by the Contractor without obtaining guidance from the Contracting Officer shall become the sole risk and responsibility of the Asbestos Abatement Contractor. All costs incurred due to such action are also the responsibility of the Asbestos Abatement Contractor.

B. Extent of Work:
   1. Below is a brief description of the estimated quantities of asbestos containing materials to be abated. These quantities are for informational purposes only and are based on the best information available at the time of the specification preparation. The Contractor shall satisfy themselves of the actual quantities to be abated. Nothing in this section may be interpreted as limiting the extent of work otherwise required by this contract and related documents.
   2. Removal, clean-up and disposal of asbestos containing materials (ACM) and asbestos waste contaminated elements or debris in an appropriate regulated area for the following approximate quantities: Refer to two separate asbestos and lead survey reports by Terracon Consultants, Inc. dated February 16, 2024 and June 10, 2024.

C. Related Work:
   1. Section 07 84 00, FIRESTOPPING
   2. Section 02 41 00, DEMOLITION
   3. Division 09, FINISHES
   4. Division 22, PLUMBING
   5. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING
   6. Section 22 05 19, METERS AND GAUGES FOR PLUMBING PIPING
   7. Section 22 05 19, METERS AND GAGES FOR PLUMBING PIPING
   8. Section 22 05 23, GENERAL-DUTY VALVES FOR PLUMBING PIPING

9. Section 22 05 33, HEAT TRACING FOR PLUMBING PIPING
10. Section 22 11 00, FACILITY WATER DISTRIBUTION
11. Section 22 13 00, FACILITY SANITARY AND VENT PIPING SEWERAGE
12. Section 23 05 11, COMMON WORK RESULTS FOR HVAC
13. Section 22 13 23, SANITARY WASTE INTERCEPTORS
14. Section 22 14 00, FACILITY STORM DRAINAGE
15. Section 22 66 00, CHEMICAL-WASTE SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES
16. Section 23 07 11, HVAC AND BOILER PLANT INSULATION
17. Section 23 11 23, FACILITY NATURAL-GAS PIPING
18. Section 23 21 13, HYDRONIC PIPING
19. Section 23 22 13, STEAM AND CONDENSATE HEATING PIPING
20. Section 23 31 00, HVAC DUCTS AND CASINGS
21. Section 23 37 00, AIR OUTLETS AND INLETS

D. Tasks:
   1. The work tasks are summarized briefly as follows:
      a. Pre-abatement activities including pre-abatement meeting(s), inspection(s), notifications, permits, submittal approvals, regulated area preparations, emergency procedures arrangements, and standard operating procedures for asbestos abatement work.
      b. Abatement activities including removal of asbestos containing material clean-up and disposal of ACM waste during and after the abatement, recordkeeping, security, monitoring, and inspections.
      c. Cleaning and decontamination activities including final visual inspection, air monitoring and certification of decontamination.

E. Contractors Use of Premises:
   1. The Contractor and Contractor's personnel shall cooperate fully with the VA representative/consultant to facilitate efficient use of buildings and areas within buildings. The Contractor shall perform the work in accordance with the VA specifications, drawings, phasing plan and in compliance with any/all applicable Federal, State and Local regulations and requirements.
   2. The Contractor shall use the existing facilities in the building strictly within the limits indicated in contract documents as well as the approved VA Design and Construction Procedures. VA Design and Construction Procedures drawings of partially occupied buildings will show the limits of regulated areas; the placement of decontamination facilities; the temporary location of bagged waste ACM; the path of transport to outside the building; and the temporary waste storage area for each building/regulated area. Any variation from the arrangements shown on

drawings shall be secured in writing from the VA representative through the pre-abatement plan of action.

1.2 VARIATIONS IN QUANTITY

A. The quantities and locations of ACM as indicated on the drawings and the extent of work included in this section are estimated which are limited by the physical constraints imposed by occupancy of the buildings and accessibility to ACM. Accordingly, minor variations (+/- 10 percent) in quantities of ACM within the regulated area are considered as having no impact on contract price and time requirements of this contract. Where additional work is required beyond the above variation, the contractor shall provide unit prices for newly discovered ACM and those prices shall be used for additional work required under the contractor.

1.3 STOP ASBESTOS REMOVAL

A. If the Contracting Officer; the COR; the facility Safety Officer/Manager or their designee, or the VA Professional Industrial Hygienist/Certified Industrial Hygienist (VPIH/CIH) presents a verbal **Stop Asbestos Removal Order**, the Contractor/Personnel shall immediately stop all asbestos removal and maintain HEPA filtered negative pressure air flow in the containment and adequately wet any exposed ACM. If a verbal Stop Asbestos Removal Order is issued, the VA shall follow-up with a written order to the Contractor as soon as it is practicable. The Contractor shall not resume any asbestos removal activity until authorized to do so in writing by the VA Contracting Officer. A stop asbestos removal order may be issued at any time the VA Contracting Officer determines abatement conditions/activities are not within VA specification, regulatory requirements or that an imminent hazard exists to human health or the environment. Work stoppage will continue until conditions have been corrected to the satisfaction of the VA. Standby time and costs for corrective actions will be borne by the Contractor, including the VPIH/CIH time. The occurrence of any of the following events shall be reported immediately by the Contractor's competent person to the VA Contracting Office or field representative using the most expeditious means (e.g., verbal or telephonic), followed up with written notification to the Contracting Officer as soon as practical. The Contractor shall immediately stop asbestos removal/disturbance activities and initiate fiber reduction activities if:
   1. Airborne PCM analysis results equal to or greater than 0.01 f/cc above background levels inside the building but outside the regulated area;
   2. breach or break in regulated area containment barrier(s);
   3. less than –0.02 inch WCG pressure in the regulated area;
   4. serious injury/death at the site;
   5. fire/safety emergency at the site;
   6. respiratory protection system failure;
   7. power failure or loss or inadequate use of wetting agent;

8. any visible emissions observed outside the regulated area; or
9. failure to follow project specification requirements.

1.4 DEFINITIONS

A. General: Definitions and explanations here are neither complete nor exclusive of all terms used in the contract documents but are general for the work to the extent they are not stated more explicitly in another element of the contract documents. Drawings must be recognized as diagrammatic in nature and not completely descriptive of the requirements indicated therein.

B. Glossary:

Abatement - Procedures to control fiber release from asbestos-containing materials. Includes removal, encapsulation, enclosure, demolition, and renovation activities related to asbestos containing materials (ACM).

Adequately wet - Sufficiently mixed or penetrated with liquid to prevent the release of particulates. If visible emissions are observed coming from the ACM, then that material has not been adequately wetted.

Aerosol - Solid or liquid particulate suspended in air.

Aggressive method - Removal or disturbance of building material by sanding, abrading, grinding, or other method that breaks, crumbles, or disintegrates intact ACM.

Aggressive air sampling - EPA AHERA defined clearance sampling method using air moving equipment such as fans and leaf blowers to aggressively disturb and maintain in the air residual fibers after abatement.

AHERA - Asbestos Hazard Emergency Response Act. Asbestos regulations for schools issued in 1987.

Aircell - Pipe or duct insulation made of corrugated cardboard which contains asbestos.

Air monitoring - The process of measuring the fiber content of a known volume of air collected over a specified period of time. The NIOSH 7400 Method, Issue 3, Fifth Edition is used to determine the fiber levels in air. For personal samples, area air samples and clearance air testing using Phase Contrast Microscopy (PCM) analysis, the NIOSH Method 7402 (Issue 2, Fourth Edition) can be used when it is necessary to confirm fibers counted by PCM as being asbestos. The AHERA TEM analysis may be used for background, area samples and clearance samples when required by this specification, or at the discretion of the VPIH/CIH as appropriate.

Air sample filter - The filter used to collect fibers which are then counted. The filter is made of mixed cellulose ester (MCE) membrane for PCM (Phase Contrast Microscopy, 25 mm, 3-piece with 2 inches Static Extension Cowl, 0.8 micron pore size) and MCE for TEM (Transmission Electron Microscopy, 25 mm, 3-piece with 2 inches Static Extension Cowl, 0.45 micron pore size).

Amended water - Water to which a surfactant (wetting agent) has been added to increase the penetrating ability of the liquid.

Asbestos - Includes chrysotile, amosite, crocidolite, tremolite asbestos, anthophyllite asbestos, actinolite asbestos, and any of these minerals that have been chemically treated or altered. Asbestos also includes PACM, as defined below.

Asbestos Hazard Abatement Plan (AHAP) - Asbestos work procedures required to be submitted by the contractor before work begins.

Asbestos-containing material (ACM) - Any material containing more than one percent of asbestos.

Asbestos contaminated elements (ACE) - Building elements such as ceilings, walls, lights, or ductwork that are contaminated with asbestos.

Asbestos-contaminated soil (ACS) – Soil found in the work area or in adjacent areas such as crawlspaces or pipe tunnels which is contaminated with asbestos-containing material debris and cannot be easily separated from the material.

Asbestos-containing waste (ACW) material - Asbestos-containing material or asbestos contaminated objects requiring disposal.

Asbestos Project Monitor – Some states require that any person conducting asbestos abatement air sampling, clearance inspections and clearance air sampling be licensed as an asbestos project monitor.

Asbestos waste decontamination facility - A system consisting of drum/bag washing facilities and a temporary storage area for cleaned containers of asbestos waste. Used as the exit for waste and equipment leaving the regulated area. In an emergency, it may be used to evacuate personnel.

Authorized person - Any person authorized by the VA, the Contractor, or government agency and required by work duties to be present in regulated areas.

Authorized visitor - Any person approved by the VA; the contractor; or any government agency representative having jurisdiction over the regulated area (e.g., OSHA, Federal and State EPA).

Barrier - Any surface that isolates the regulated area and inhibits fiber migration from the regulated area.

Containment Barrier - An airtight barrier consisting of walls, floors, and/or ceilings of sealed plastic sheeting which surrounds and seals the outer perimeter of the regulated area.

Critical Barrier - The barrier responsible for isolating the regulated area from adjacent spaces, typically constructed of 2-layers of 6-mil independently installed plastic sheeting (Polyethylene) secured in place at openings such as doors, windows, penetrations or any other opening into the regulated area.

Primary Barrier – Plastic barriers placed over critical barriers and exposed directly to abatement work or to secondary barrier.

Secondary Barrier - Any additional plastic barriers used to isolate and provide protection from debris during abatement work.

Breathing zone - The hemisphere forward of the shoulders with a radius of about 150 - 225 mm (6 - 9 inches) from the worker's nose.

Bridging encapsulant - An encapsulant that forms a layer on the surface of the ACM.

Building/facility owner - The legal entity, including a lessee, which exercises control over management and recordkeeping functions relating to a building and/or facility in which asbestos activities take place.

Bulk testing - The collection and analysis of suspect asbestos containing materials.

Certified Industrial Hygienist (CIH) - A person certified in the comprehensive practice of industrial hygiene by the American Board of Industrial Hygiene.

Class I asbestos work - Activities involving the removal of Thermal System Insulation (TSI) and surfacing ACM and Presumed Asbestos Containing Material (PACM).

Class II asbestos work - Activities involving the removal of ACM which is not thermal system insulation or surfacing material. This includes, but is not limited to, the removal of asbestos-containing wallboard, floor tile and sheeting, roofing and siding shingles, and construction mastic.

Clean room/Changing room - An uncontaminated room having facilities for the storage of employee's street clothing and uncontaminated materials and equipment.

Clearance sample - The final air sample taken after all asbestos work has been done and visually inspected. Performed by the VA's professional industrial hygiene consultant/Certified Industrial Hygienist (VPIH/CIH).

Closely resemble - The major workplace conditions which have contributed to the levels of historic asbestos exposure, are no more protective than conditions of the current workplace.

Competent person - In addition to the definition in 29 CFR 1926.32(f), one who is capable of identifying existing asbestos hazards in the workplace and selecting the appropriate control strategy for asbestos exposure, who has the authority to take prompt corrective measures to eliminate them, as specified in 29 CFR 1926.32(f); in addition, for Class I and II work who is specially trained in a training course which meets the criteria of EPA's Model Accreditation Plan (40 CFR 763) for supervisor.

Contractor's Professional Industrial Hygienist (CPIH/CIH) - The asbestos abatement contractor's industrial hygienist. The industrial hygienist must meet the qualification requirements of a PIH and may report to a certified industrial hygienist (CIH).

Count - Refers to the fiber count or the average number of fibers greater than five microns in length with a length-to-width (aspect) ratio of at least 3 to 1, per cubic centimeter of air.

Crawlspace – An area which can be found either in or adjacent to the work area. This area has limited access and egress and may contain asbestos materials and/or asbestos contaminated soil.

Decontamination area/unit - An enclosed area adjacent to and connected to the regulated area and consisting of an equipment room, shower room, and clean room, which is used for the decontamination of workers, materials, and equipment that are contaminated with asbestos.

Demolition - The wrecking or taking out of any load-supporting structural member and any related razing, removing, or stripping of asbestos products.

Disposal bag - Typically 6-mil thick sift-proof, dustproof, leak-tight container used to package and transport asbestos waste from regulated areas to the approved landfill. Each bag/container must be labeled/marked in accordance with EPA, OSHA and DOT requirements.

Disturbance – Asbestos Operations and Maintenance Activities (OSHA Class III) that disrupt the matrix of ACM or PACM, crumble or pulverize ACM or PACM, or generate visible debris from ACM or PACM. Disturbance includes cutting away small amounts of ACM or PACM, no greater than the amount that can be contained in one standard sized glove bag or waste bag in order to access a building component. In no event shall the amount of ACM or PACM so disturbed exceed that which can be contained in one glove bag or disposal bag, which shall not exceed 60 inches in length or width.

Drum - A rigid, impermeable container made of cardboard fiber, plastic, or metal which can be sealed in order to be sift-proof, dustproof, and leak-tight.

Employee exposure - The exposure to airborne asbestos that would occur if the employee were not wearing respiratory protection equipment.

Encapsulant - A material that surrounds or embeds asbestos fibers in an adhesive matrix and prevents the release of fibers.

Encapsulation - Treating ACM with an encapsulant.

Enclosure - The construction of an airtight, impermeable, permanent barrier around ACM to control the release of asbestos fibers from the material and also eliminate access to the material.

Equipment room - A contaminated room located within the decontamination area that is supplied with impermeable bags or containers for the disposal of contaminated protective clothing and equipment.

Fiber - A particulate form of asbestos, 5 microns or longer, with a length to width (aspect) ratio of at least 3 to 1.

Fibers per cubic centimeter (f/cc) - Abbreviation for fibers per cubic centimeter, used to describe the level of asbestos fibers in air.

Filter - Media used in respirators, vacuums, or other machines to remove particulate from air.

Firestopping - Material used to close the open parts of a structure in order to prevent a fire from spreading.

Friable asbestos containing material - Any material containing more than one (1) percent asbestos as determined using the method specified in 40 CFR 763, Polarized Light Microscopy, that, when dry, can be crumbled, pulverized, or reduced to powder by hand pressure.

Glovebag - Not more than a 60 x 60 inch impervious plastic bag-like enclosure affixed around an asbestos-containing material, with glove-like appendages through which materials and tools may be handled.

High efficiency particulate air (HEPA) filter – An ASHRAE MERV 17 filter capable of trapping and retaining at least 99.97 percent of all mono-dispersed particles of 0.3 micrometers in diameter.

HEPA vacuum - Vacuum collection equipment equipped with a HEPA filter system capable of collecting and retaining asbestos fibers.

Homogeneous area - An area of surfacing, thermal system insulation or miscellaneous ACM that is uniform in color, texture and date of application.

HVAC - Heating, Ventilation and Air Conditioning

Industrial hygienist (IH) - A professional qualified by education, training, and experience to anticipate, recognize, evaluate and develop controls for occupational health hazards. Meets definition requirements of the American Industrial Hygiene Association (AIHA).

Industrial hygienist technician (IH Technician) - A person working under the direction of an IH or CIH who has special training, experience, certifications and licenses required for the industrial hygiene work assigned. Some states require that an industrial hygienist technician conducting asbestos abatement air sampling, clearance inspection and clearance air sampling be licensed as an asbestos project monitor.

Intact - The ACM has not crumbled, been pulverized, or otherwise deteriorated so that the asbestos is no longer likely to be bound with its matrix.

Lockdown - Applying encapsulant, after a final visual inspection, on all abated surfaces at the conclusion of ACM removal prior to removal of critical barriers.

National Emission Standards for Hazardous Air Pollutants (NESHAP) - EPA's rule to control emissions of asbestos to the environment (40 CFR part 61, Subpart M).

Negative initial exposure assessment - A demonstration by the employer which complies with the criteria in 29 CFR 1926.1101 (f)(2)(iii), that employee exposure during an operation is expected to be consistently below the PEL or Excursion Limit (EL).

Negative pressure - Air pressure which is lower than the surrounding area, created by exhausting air from a sealed regulated area through HEPA equipped filtration units. OSHA requires maintaining -0.02 inch water column gauge inside the negative pressure enclosure.

Negative pressure respirator - A respirator in which the air pressure inside the facepiece is negative during inhalation relative to the air pressure outside the respirator facepiece.

Non-friable ACM - Material that contains more than 1 percent asbestos but cannot be crumbled, pulverized, or reduced to powder by hand pressure.

Organic vapor cartridge - The type of cartridge used on air purifying respirators to remove organic vapor hazardous air contaminants.

Outside air - The air outside buildings and structures, including, but not limited to, the air under a bridge or in an open ferry dock.

Owner/operator - Any person who owns, leases, operates, controls, or supervises the facility being demolished or renovated or any person who owns, leases, operates, controls, or supervises the demolition or renovation operation, or both.

Penetrating encapsulant - Encapsulant that is absorbed into the ACM matrix without leaving a surface layer.

Permissible exposure limit (PEL) - The level of exposure OSHA allows for as an eight (8) hour time-weighted average (TWA). For asbestos fibers, the eight (8) hour time-weighted average PEL is 0.1 fibers per cubic centimeter (0.1 f/cc) of air and the 30-minute Excursion Limit (EL) is 1.0 fibers per cubic centimeter (1 f/cc).

Personal protective equipment (PPE) – equipment designed to protect user from injury and/or specific job hazard. Such equipment may include protective clothing, hard hats, safety glasses, fall protection, and respirators.

Personal sampling/monitoring - Representative air samples obtained in the breathing zone for one or more workers within the regulated area using a filter cassette and a calibrated air sampling pump to determine asbestos exposure.

Pipe tunnel – An area, typically located adjacent to mechanical spaces or boiler rooms in which the pipes servicing the heating system in the building are routed to allow the pipes to access heating elements. These areas may contain asbestos pipe insulation, asbestos fittings, debris or asbestos-contaminated soil.

Polarized light microscopy (PLM) - Light microscopy using dispersion staining techniques and refractive indices to identify and quantify the type of asbestos present in a bulk sample.

Polyethylene sheeting - Strong plastic barrier material 4 to 6-mils thick, semi-transparent, flame retardant per NFPA 241.

Positive/negative fit check - A method of verifying the seal of a facepiece respirator by temporarily occluding the filters and breathing in (inhaling) and then temporarily occluding the exhalation valve and breathing out (exhaling) while checking for inward or outward leakage of the respirator, respectively.

Presumed ACM (PACM) - Thermal system insulation, surfacing, and flooring material installed in buildings prior to 1981. If the building owner has actual knowledge or should have known through the exercise of due diligence that other materials are ACM, they too must be treated as PACM. The designation of PACM may be rebutted pursuant to 29 CFR 1926.1101 (k)(5).

Professional IH - An IH who meets the definition requirements of AIHA; meets the definition requirements of OSHA as a "Competent Person" at 29 CFR 1926.1101 (b); has completed two specialized EPA approved courses on management and supervision of asbestos abatement projects; has formal training in respiratory protection and waste disposal; and has a minimum of

four projects of similar complexity with this project of which at least three projects serving as the supervisory IH. The PIH may be either the VA's PIH (VPIH/CIH) or Contractor's PIH (CPIH/CIH).

Project designer - A person who has successfully completed the training requirements for an asbestos abatement project designer as required by 40 CFR 763 Subpart E, Appendix C, Part I; (B)(5).

Assigned protection factor - A value assigned by OSHA/NIOSH to indicate the expected protection provided by each respirator class, when the respirator is properly selected and worn correctly. The number indicates the reduction of exposure level from outside to inside the respirator facepiece.

Qualitative fit test (QLFT) - A fit test using a challenge material that can be sensed by the wearer if leakage in the respirator occurs.

Quantitative fit test (QNFT) - A fit test using a challenge material which is quantified outside and inside the respirator thus allowing the determination of the actual fit factor.

Regulated area - An area established by the employer to demarcate where Class I, II, III asbestos work is conducted, and any adjoining area where debris and waste from such asbestos work may accumulate; and a work area within which airborne concentrations of asbestos exceed, or there is a reasonable possibility they may exceed the PEL.

Regulated ACM (RACM) - Friable ACM; Category I non-friable ACM that has become friable; Category I non-friable ACM that will be or has been subjected to sanding, grinding, cutting, or abrading or; Category II non-friable ACM that has a high probability of becoming or has become crumbled, pulverized, or reduced to powder by the forces expected to act on the material in the course of the demolition or renovation operation.

Removal - All operations where ACM, PACM and/or RACM is taken out or stripped from structures or substrates, including demolition operations.

Renovation - Altering a facility or one or more facility components in any way, including the stripping or removal of asbestos from a facility component which does not involve demolition activity.

Repair - Overhauling, rebuilding, reconstructing, or reconditioning of structures or substrates, including encapsulation or other repair of ACM or PACM attached to structures or substrates.

Shower room - The portion of the PDF where personnel shower before leaving the regulated area.

Supplied air respirator (SAR) - A respiratory protection system that supplies minimum Grade D respirable air per ANSI/Compressed Gas Association Commodity Specification for Air, G-7.1-2018.

Surfacing ACM - A material containing more than 1 percent asbestos that is sprayed, troweled on or otherwise applied to surfaces for acoustical, decorative, fireproofing and other purposes.

Surfactant - A chemical added to water to decrease water's surface tension thus making it more penetrating into ACM.

Thermal system ACM - A material containing more than 1 percent asbestos applied to pipes, fittings, boilers, breeching, tanks, ducts, or other structural components to prevent heat loss or gain.

Transmission electron microscopy (TEM) - A microscopy method that can identify and count asbestos fibers.

VA Professional Industrial Hygienist (VPIH/CIH) – The Department of Veterans Affairs Professional Industrial Hygienist must meet the qualifications of a PIH and may report to a Certified Industrial Hygienist (CIH).

VA Representative - The VA official responsible for on-going project work.

VA Total – means a building or substantial part of the building is completely removed, torn or knocked down, bulldozed, flattened, or razed, including removal of building debris.

Visible emissions - Any emissions, which are visually detectable without the aid of instruments, coming from ACM/PACM/RACM/ACS or ACM waste material.

Waste/Equipment decontamination facility (W/EDF) – The area in which equipment is decontaminated before removal from the regulated area.

Waste generator - Any owner or operator whose act or process produces asbestos-containing waste material.

Waste shipment record - The shipping document, required to be originated and signed by the waste generator, used to track and substantiate the disposition of asbestos-containing waste material.

Wet cleaning - The process of thoroughly eliminating, by wet methods, any asbestos contamination from surfaces or objects.

C. Referenced Standards Organizations: See Section 01 42 19 REFERENCED STANDARDS.

1.5 APPLICABLE CODES AND REGULATIONS

A. General Applicability of Codes, Regulations, and Standards:

1. All work under this contract shall be done in strict accordance with all applicable Federal, State, and Local regulations, standards and codes governing asbestos abatement, and any other trade work done in conjunction with the abatement. All applicable codes, regulations and standards are adopted into this specification and will have the same force and effect as this specification.
2. The most recent edition of any relevant regulation, standard, document or code shall be in effect. Where conflict among the requirements or with these specifications exists, the most stringent requirement(s) shall be utilized.

3. Copies of all standards, regulations, codes and other applicable documents, including this specification and those listed in Section 1.5 shall be available at the worksite in the clean change area of the worker decontamination system and/or the Contractor's on-site Field Office. These standards, regulations, codes and other applicable documents, including this specification and those listed in Section 1.5 may be made available electronically.

B. Asbestos Abatement Contractor Responsibility: The Asbestos Abatement Contractor (Contractor) shall assume full responsibility and liability for compliance with all applicable Federal, State and Local regulations related to any and all aspects of the asbestos abatement project. The Contractor is responsible for providing and maintaining training, accreditations, medical exams, medical records, personal protective equipment (PPE), respiratory protection, respirator fit testing and personnel air monitoring, as required by applicable Federal, State and Local regulations. The Contractor shall hold the VA and VPIH/CIH consultants harmless for any Contractor's failure to comply with any applicable work, packaging, transporting, disposal, safety, health, or environmental requirement on the part of himself, his employees, or his subcontractors. The Contractor will incur all costs of the CPIH/CIH, including all sampling/analytical costs to assure compliance with OSHA/EPA/State/Local requirements related to failure to comply with the regulations applicable to the work.

C. Federal Requirements:

1. Federal requirements which govern asbestos abatement include, but are not limited to, the following regulations:
    a. Occupational Safety and Health Administration **(OSHA)**
        1)Title 29 CFR 1926.1101 - Construction Standard for Asbestos
        2)Title 29 CFR 1926 Subpart E - Personal Protective Equipment and Life Saving Equipment
        3)Title 29 CFR 1910.134 - Respiratory Protection
        4)Title 29 CFR 1926 - Construction Industry Standards
        5)Title 29 CFR 1926.33 - Access to Employee Exposure and Medical Records
        6)Title 29 CFR 1926.59 same as 1910.1200 - Hazard Communication
        7)Title 29 CFR 1926 Subpart C – General Safety and Health Provisions and Subpart D – Occupational Health and Environmental Controls
    b. Environmental Protection Agency **(EPA)**:
        1)40 CFR 61 Subpart M - National Emission Standard for Hazardous Air Pollutants - Asbestos.
        2)40 CFR 763 - Asbestos Hazard Emergency Response Act (AHERA) and Asbestos Hazard Abatement Reauthorization Act (ASHARA)
    c. Department of Transportation **(DOT)**
        1)Title 49 CFR 171 - 180 – Transportation

D. State Requirements:
   1. State requirements that apply to the asbestos abatement work, disposal, clearance, etc., include, but are not limited to, the following:
   2. Florida Statutes (F.S.) 469.001 – 469.014.

E. Local Requirements:
   1. If local requirements are more stringent than federal or state standards, the local standards are to be followed.

F. Standards:
   1. Standards which govern asbestos abatement activities include, but are not limited to, the following:
      a. American National Standards Institute (ANSI)/ASSP Z9.2-2018 - Fundamentals Governing the Design and Operation of Local Exhaust Systems and ANSI/ASSE Z88.2-2015 - Practices for Respiratory Protection.
      b. Underwriters Laboratories (UL) 586-2009 - UL Standard for Safety of HEPA Filter Units, 9th Edition; ANSI Approval 2017-12-19.
   2. Standards which govern encapsulation work include, but are not limited to the following:
      a. American Society for Testing and Materials International (ASTM)
   3. Standards which govern the fire and safety concerns in abatement work include, but are not limited to, the following:
      a. National Fire Protection Association (NFPA) 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations.
      b. NFPA 701 - Standard Methods for Fire Tests for Flame Resistant Textiles and Film.
      c. NFPA 101 - Life Safety Code

G. EPA Guidance Documents:
   1. EPA guidance documents which discuss asbestos abatement work activities are listed below. These documents are made part of this section by reference.
   2. Guidance for Controlling ACM in Buildings (Purple Book) EPA 560/5-85-024
   3. Asbestos Waste Management Guidance EPA 530-SW-85-007
   4. A Guide to Respiratory Protection for the Asbestos Abatement Industry EPA-560-OPTS-86-001
   5. Guide to Managing Asbestos in Place (Green Book) TS 799 20T July 1990

H. Notices:
   1. State and Local agencies: Send written notification as required by State and Local regulations prior to beginning any work on ACM as follows:
   2. Florida Department of Environmental Protection, Air Resource
   3. Management: Jacksonville, FL (904) 256-1700

4. Copies of notifications shall be submitted to the VA for the facility's records in the same time frame notification are given to EPA, State, and Local authorities.

I. Permits/Licenses: The contractor shall apply for and have all required permits and licenses to perform asbestos abatement work as required by Federal, State, and Local regulations.

J. Posting and Filing of Regulations: Maintain two (2) copies of applicable Federal, State, and Local regulations. Post one copy of each in the clean room at the regulated area where workers will have daily access to the regulations and keep another hard copy or electronic copy in the Contractor's office.

K. VA Responsibilities prior to commencement of work:

1. Notify occupants adjacent to regulated areas of project dates and requirements for relocation, if needed. Arrangements must be made prior to starting work for relocation of desks, files, equipment, and personal possessions to avoid unauthorized access into the regulated area. **Note: Notification of adjacent personnel is required by OSHA in 29 CFR 1926.1101 (k) to prevent unnecessary or unauthorized access to the regulated area**.
2. Submit to the Contractor results of background air sampling; including location of samples, person who collected the samples, equipment utilized, calibration data and method of analysis. During abatement, submit to the Contractor, results of bulk material analysis and air sampling data collected during the course of the abatement. This information shall not release the Contractor from any responsibility for OSHA compliance.

L. Emergency Action Plan and Arrangements:

1. An Emergency Action Plan shall be developed prior to commencing abatement activities and shall be agreed to by the Contractor and the VA. The Plan shall meet the requirements of 29 CFR 1926, Subpart C, Standard 1926.35 Employee Emergency Action Plans.
2. Emergency procedures shall be in written form and prominently posted in the clean room and equipment room of the decontamination unit. Everyone, prior to entering the regulated area, must read and sign these procedures to acknowledge understanding of the regulated area layout, location of emergency exits and emergency procedures.
3. Emergency planning shall include written notification of police, fire, and emergency medical personnel of planned abatement activities; work schedule; layout of regulated area; and access to the regulated area, particularly barriers that may affect response capabilities.
4. Emergency planning shall include consideration of fire, explosion, hazardous atmospheres, electrical hazards, slips/trips and falls, confined spaces, and heat stress illness. Written procedures for response to emergency situations shall be developed and employee training in procedures shall be provided.
5. Employees shall be trained in regulated area/site evacuation procedures in the event of workplace emergencies.

a. For non-life-threatening situations - employees injured or otherwise incapacitated shall be decontaminated following normal procedures with assistance from fellow workers, if necessary, before exiting the regulated area to obtain proper medical treatment.
b. For life-threatening injury or illness, worker decontamination shall take least priority after measures to stabilize the injured worker, medical personnel shall remove them from the regulated area if back or neck injury is present, and secure proper medical treatment.

6. Telephone numbers of any/all emergency response personnel shall be prominently posted in the clean room, along with the location of the nearest telephone.
7. The Contractor shall provide verification of first aid/CPR training for personnel responsible for providing first aid/CPR. OSHA requires medical assistance within 3-4 minutes of a life-threatening injury/illness. Bloodborne Pathogen training shall also be verified for those personnel required to provide first aid/CPR.
8. The Emergency Action Plan shall provide for a Contingency Plan in the event that an incident occurs that may require the modification of the standard operating procedures during abatement. Such incidents include, but are not limited to, fire; accident; power failure; negative pressure failure; and supplied air system failure. The Contractor shall detail procedures to be followed in the event of an incident assuring that asbestos abatement work is stopped and wetting is continued until correction of the problem.

M. Pre-Construction Meeting:

1. Prior to commencing the work, the Contractor shall meet with the VA Certified Industrial Hygienist (VPIH/CIH) to present and review, as appropriate, the items following this paragraph. The Contractor's Competent Person(s) who will be on-site shall participate in the pre-start meeting. The pre-start meeting is to discuss and determine procedures to be used during the project. At this meeting, the Contractor shall provide:
   a. Proof of Contractor and Consultant licensing.
   b. Proof the Competent Person(s) is trained and accredited and approved for working in this State. Verification of the experience of the Competent Person(s) shall also be presented.
   c. A list of all workers who will participate in the project, including experience and verification of training and accreditation.
   d. A list of and verification of training for all personnel who have current first-aid/CPR training. A minimum of one person per shift must have adequate training.
   e. Current medical written opinions for all personnel working on-site meeting the requirements of 29 CFR 1926.1101 (m).
   f. Current fit-tests for all personnel wearing respirators on-site meeting the requirements of 29 CFR 1926.1101 (h) and Appendix C.
   g. A copy of the Contractor's Asbestos Hazard Abatement Plan. In these procedures, the following information must be detailed, specific for this project.

1)Regulated area preparation procedures;

2)Notification requirements procedure of Contractor as required in 29 CFR 1926.1101 (d) Multi-Employer Worksites;

3)Decontamination area set-up/layout and decontamination procedures for employees;

4)Abatement methods/procedures and equipment to be used;

5)Personal protective equipment to be used.

h. At this meeting the Contractor shall provide all submittals as required.

i. Procedures for handling, packaging and disposal of asbestos waste.

j. Emergency Action Plan and Contingency Plan Procedures.

1.6 PROJECT COORDINATION

A. The following are the minimum administrative and supervisory personnel necessary for coordination of the work.

1. Personnel:

a. Administrative and supervisory personnel shall consist of a qualified Competent Person(s) as defined by OSHA in the Construction Standards and the Asbestos Construction Standard; Contractor Professional Industrial Hygienist and Industrial Hygiene Technicians. These employees are the Contractor's representatives responsible for compliance with these specifications and all other applicable requirements.

b. Non-supervisory personnel shall consist of an adequate number of qualified personnel to meet the schedule requirements of the project. Personnel shall meet required qualifications. Personnel utilized on-site shall be pre-approved by the VA representative. A request for approval shall be submitted for any person to be employed during the project giving the person's name; last four digits of social security number; qualifications; accreditation card with color picture, if required by state; Certificate of Worker's Acknowledgment; and Affidavit of Medical Surveillance and Respiratory Protection and current Respirator Fit Test.

c. Minimum qualifications for Contractor and assigned personnel are:

1)The Contractor has conducted within the last five (5) years, five (5) projects of similar complexity and dollar value as this project; has not been cited and penalized for serious violations of Federal (and State or Local as applicable) EPA and OSHA asbestos regulations in the past three (3) years; has adequate liability/occurrence insurance for asbestos work as required by the state; is licensed in applicable state; has adequate and qualified personnel available to complete the work; has comprehensive standard operating procedures for asbestos work; has adequate materials, equipment and supplies to perform the work.

2)The Competent Person has four (4) years of abatement experience of which two (2) years were as the Competent Person on the project; meets the OSHA definition of a Competent Person; has been the Competent Person on two (2) projects of similar size and complexity as this project within the past three (3) years; has completed EPA AHERA/OSHA/State/Local training requirements/accreditation(s) and refreshers; and has all required OSHA documentation related to medical and respiratory protection.

3)The Contractor Professional Industrial Hygienist/CIH (CPIH/CIH) works under the supervision of a Florida Licensed Asbestos Consultant and shall have five (5) years of monitoring experience and supervision of asbestos abatement projects; has participated as senior IH on five (5) abatement projects, three (3) of which are similar in size and complexity as this project; has specialized EPA AHERA/OSHA training in asbestos abatement management, respiratory protection, waste disposal and asbestos inspection; has completed the NIOSH 582 Course or equivalent, Contractor/Supervisor course; and has appropriate medical/respiratory protection records/documentation.

4)The Abatement Personnel shall have completed the EPA AHERA/OSHA abatement worker course; have training on the standard operating procedures of the Contractor; has one year of asbestos abatement experience within the past three (3) years of similar size and complexity; has applicable medical and respiratory protection documentation; has certificate of training/current refresher and State accreditation/license.

d. All personnel shall be in compliance with OSHA construction safety training as applicable and submit certification.

e. All personnel shall be in compliance with F.S. 469

1.7 RESPIRATORY PROTECTION

A. General - Respiratory Protection Program: The Contractor shall develop and implement a written Respiratory Protection Program (RPP) which is in compliance with OSHA requirements found at 29 CFR 1926.1101 and 29 CFR 1910.134. ANSI Standard Z88.2-2015 provides excellent guidance for developing a respiratory protection program. All respirators used must be NIOSH approved for asbestos abatement activities. The written RPP shall, at a minimum, contain the basic requirements found at 29 CFR 1910.134 (c) - Respiratory Protection Program.

B. Respiratory Protection Program Coordinator: The Respiratory Protection Program Coordinator (RPPC) must be identified and shall have two (2) years of experience coordinating RPP of similar size and complexity. The RPPC must submit a signed statement attesting to the fact that the program meets the above requirements.

C. Selection and Use of Respirators: The procedure for the selection and use of respirators must be submitted to the VA as part of the Contractor's qualifications. The procedure must be written clearly enough for workers to understand. A copy of the Respiratory Protection Program must be available in the clean room of the decontamination unit or in the onsite Contractor’s office, for reference by employees or authorized visitors.

D. Minimum Respiratory Protection: Shall be a ½-mask negative pressure air purifying respirator equipped with P100 filters, provided personal air samples in the workplace remain at or below 0.1 f/cc, determined as an 8-hour TWA. Full face powered air purifying respirator equipped with P100 filters shall be required until Contractor demonstrates that personal air samples are at or below 0.1 f/cc, determined as an 8-hour TWA. A higher level of respiratory protection shall be required, if fiber levels exceed 1 f/cc as an 8-hour TWA, inside the regulated work area. Respirator selection shall meet the requirements of 29 CFR 1926.1101 (h) and 29 CFR 1910.134 (d)(3)(i)(A) Table 1, except as indicated in this paragraph. Abatement personnel must have a respirator for their exclusive use.

E. Medical Written Opinion: No employee shall be allowed to wear a respirator unless a physician or other licensed health care professional has provided a written determination they are medically qualified to wear the class of respirator to be used on the project while wearing whole body impermeable garments and subjected to heat or cold stress.

F. Respirator Fit Test: All personnel wearing respirators shall have a current qualitative/quantitative fit test which was conducted in accordance with 29 CFR 1910.134 (f) and Appendix A. Quantitative fit tests shall be done for PAPRs which have been put into a motor/blower failure mode.

G. Respirator Fit Check: The Competent Person shall assure that the positive/negative pressure user seal check is done each time the respirator is donned by an employee. Head coverings must cover respirator head straps. Any situation that prevents an effective facepiece to face seal as evidenced by failure of a user seal check shall preclude that person from entering the regulated area until resolution of the problem.

H. Maintenance and Care of Respirators: The Respiratory Protection Program Coordinator shall submit evidence and documentation showing compliance with 29 CFR 1910.134 (h) Maintenance and Care of Respirators.

I. Supplied Air Systems: If a supplied air system is used, the system shall meet all requirements of 29 CFR 1910.134 and the ANSI/Compressed Gas Association (CGA) Commodity Specification for Air current requirements for Type 1 - Grade D breathing air. Low pressure systems are not allowed to be used on asbestos abatement projects. Supplied Air respirator use shall be in accordance with EPA/NIOSH publication EPA-560-OPTS-86-001 "A Guide to Respiratory Protection for the Asbestos Abatement Industry". The competent person on site will be responsible for the supplied air system to ensure the safety of the worker.

1.8 WORKER PROTECTION

A. Training of Abatement Personnel: Prior to beginning any abatement activity, all personnel shall be trained in accordance with OSHA 29 CFR 1926.1101 (k)(9) and any additional State/Local requirements. Training must include, at a minimum, the elements listed at 29 CFR 1926.1101 (k)(9)(viii). Training shall have been conducted by a third party, EPA/State approved trainer meeting the requirements of EPA 40 CFR 763 Appendix C (AHERA MAP). Initial training certificates and current refresher and accreditation proof must be submitted for each person working at the site.

B. Medical Examinations: Medical examinations meeting the requirements of 29 CFR 1926.1101 (m) shall be provided for all personnel working in the regulated area, regardless of exposure levels. A current physician's written opinion as required by 29 CFR 1926.1101 (m)(4) shall be provided for each person and shall include in the medical opinion that the person has been evaluated for working in a heat and cold stress environment while wearing personal protective equipment (PPE) and is able to perform the work without risk of material health impairment.

C. Regulated Area Entry Procedure: The Competent Person shall ensure that each time workers enter the regulated area; they remove ALL street clothes in the clean room of the decontamination unit and put on new disposable coveralls, head coverings, a clean respirator, and then proceed through the shower room to the equipment room where they put on non-disposable required personal protective equipment.

D. Decontamination Procedure: The Competent Person shall require all personnel to adhere to following decontamination procedures whenever they leave the regulated area.

1. When exiting the regulated area, remove disposable coveralls, and ALL other clothes, disposable head coverings, and foot coverings or boots in the equipment room.
2. Still wearing the respirator and completely naked, proceed to the shower. Showering is MANDATORY. Care must be taken to follow reasonable procedures in removing the respirator to avoid inhaling asbestos fibers while showering. The following procedure is required as a minimum:
    a. Thoroughly wet body including hair and face. If using a PAPR hold blower above head to keep filters dry.
    b. With respirator still in place, thoroughly decontaminate body, hair, respirator face piece, and all other parts of the respirator except the blower and battery pack on a PAPR. Pay particular attention to cleaning the seal between the face and respirator facepiece and under the respirator straps.
    c. Take a deep breath, hold it and/or exhale slowly, completely wetting hair, face, and respirator. While still holding breath, remove the respirator and hold it away from the face before starting to breathe.

3. Carefully decontaminate the facepiece of the respirator inside and out. If using a PAPR, shut down using the following sequence: a) first cap inlets to filters; b) turn blower off to keep debris collected on the inlet side of the filter from dislodging and contaminating the outside of the unit; c) thoroughly decontaminate blower and hoses; d) carefully decontaminate battery pack with a wet rag being cautious of getting water in the battery pack thus preventing destruction. **(THIS PROCEDURE IS NOT A SUBSTITUTE FOR RESPIRATOR CLEANING!)**
4. Shower and wash body completely with soap and water. Rinse thoroughly.
5. Rinse shower room walls and floor to drain prior to exiting.
6. Proceed from shower to clean room; dry off and change into street clothes or into new disposable work clothing.

E. Regulated Area Requirements: The Competent Person shall meet all requirements of 29 CFR 1926.1101 (o) and assure that all requirements for regulated areas at 29 CFR 1926.1101 (e) are met. All personnel in the regulated area shall not be allowed to eat, drink, smoke, chew tobacco or gum, apply cosmetics, or in any way interfere with the fit of their respirator.

1.9 DECONTAMINATION FACILITIES

A. Description: Provide each regulated area with separate personnel decontamination facilities (PDF) and waste/equipment decontamination facilities (W/EDF). Ensure that the PDF are the only means of ingress and egress to the regulated area and that all equipment, bagged waste, and other material exit the regulated area only through the W/EDF.

B. General Requirements: All personnel entering or exiting a regulated area must go through the PDF and shall follow the requirements at 29 CFR 1926.1101 (j)(1) and these specifications. All waste, equipment and contaminated materials must exit the regulated area through the W/EDF and be decontaminated in accordance with these specifications. Walls and ceilings of the PDF and W/EDF must be constructed of a minimum of 3 layers of 6-mil opaque fire retardant polyethylene sheeting and be securely attached to existing building components and/or an adequate temporary framework. A minimum of 3 layers of 6-mil poly shall also be used to cover the floor under the PDF and W/EDF units. Construct doors so that they overlap and secure to adjacent surfaces. Weight inner doorway sheets with layers of duct tape or approved equivalent so that they close quickly after release. Put arrows on sheets so they show direction of travel and overlap. If the building adjacent area is occupied, construct a solid barrier on the occupied side(s) to protect the sheeting and reduce potential for non-authorized personnel entering the regulated area.

C. Temporary Facilities to the PDF and W/EDF: The Competent Person shall provide temporary water service connections to the PDF and W/EDF. Backflow prevention must be provided at the point of connection to the VA system. Water supply must be of adequate pressure and meet requirements of 29 CFR 1910.141(d)(3). Provide adequate temporary overhead electric power

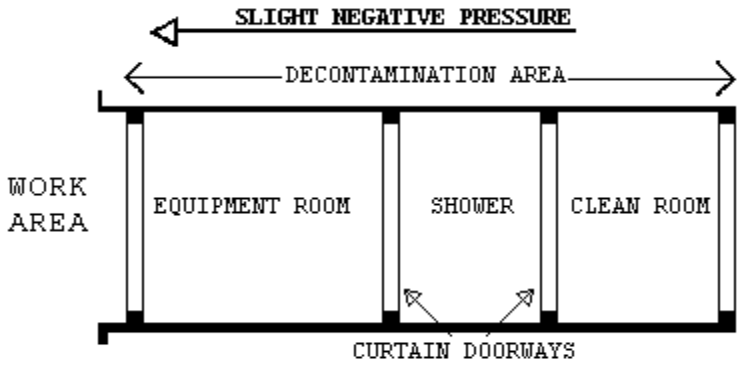
with ground fault circuit interruption (GFCI) protection. Provide a sub-panel equipped with GFCI protection for all temporary power in the clean room. Provide adequate lighting to provide a minimum of 50 foot candles in the PDF and W/EDF. Provide temporary heat, if needed, to maintain 70 degrees F throughout the PDF and W/EDF.

D. Personnel Decontamination Facility (PDF): The Competent Person shall provide a PDF consisting of shower room which is contiguous to a clean room and equipment room which is connected to the regulated area. The PDF must be sized to accommodate the number of personnel scheduled for the project. The shower room, located in the center of the PDF, shall be fitted with as many portable showers as necessary to insure all employees can complete the entire decontamination procedure within 15 minutes. The PDF shall be constructed of opaque poly for privacy. The PDF shall be constructed to eliminate any parallel routes of egress without showering.

1. Clean Room: The clean room must be physically and visually separated from the rest of the building to protect the privacy of personnel changing clothes. The clean room shall be constructed of at least 3 layers of 6-mil opaque fire retardant poly to provide an airtight room. Provide a minimum of 2 - 900 mm (3 foot) wide 6-mil poly opaque fire retardant doorways. One doorway shall be the entry from outside the PDF and the second doorway shall be to the shower room of the PDF. The floor of the clean room shall be maintained in a clean, dry and sanitary condition. Shower overflow shall not be allowed into the clean room. Provide 1 storage locker per person. A portable fire extinguisher, minimum 10 pounds capacity, Type ABC, shall be provided in accordance with OSHA and NFPA Standard 10. All persons entering the regulated area shall remove all street clothing in the clean room and dress in disposable protective clothing and respiratory protection. Any person entering the clean room does so either from the outside with street clothing on or is coming from the shower room completely naked and thoroughly washed. Male/Females required to enter the regulated area shall be ensured of their privacy throughout the entry/exit process by posting guards at both entry points to the PDF so no male/female can enter or exit the PDF during his/her stay in the PDF.
2. Shower Room: The Competent Person shall assure that the shower room is a completely water tight compartment to be used for the movement of all personnel from the clean room to the equipment room and for the showering of all personnel going from the equipment room to the clean room. Each shower shall be constructed so water runs down the walls of the shower and into a drip pan. Install a freely draining smooth floor on top of the shower pan. The shower room shall be separated from the rest of the building and from the clean room and equipment room using airtight walls made from at least 3 layers of 6-mil opaque fire retardant poly. The shower shall be equipped with a shower head and controls, hot and cold water, drainage, soap dish and continuous supply of soap, and shall be maintained in a

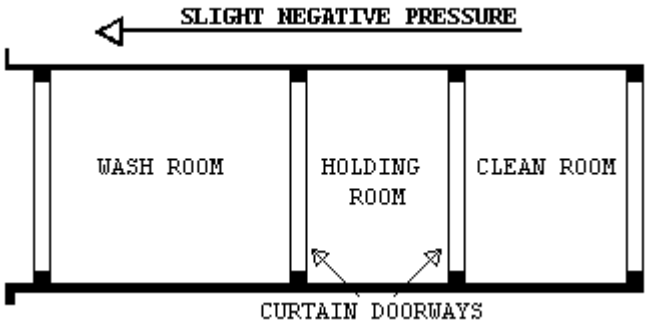
sanitary condition throughout its use. The controls shall be arranged so an individual can shower without assistance. Provide a flexible hose shower head, hose bibs and all other items shown on Shower Schematic. Wastewater will be pumped to a drain after being filtered through a minimum of a 100 micron sock in the shower drain; a 20 micron filter; and a final 5 micron filter. Filters will be changed a minimum of daily or more often as needed. Filter changes must be done in the shower to prevent loss of contaminated water. Hose down all shower surfaces after each shift and clean any debris from the shower pan. Residue is to be disposed of as asbestos waste.

3. Equipment Room: The Competent Person shall provide an equipment room which shall be an airtight compartment for the storage of work equipment/tools, reusable personal protective equipment, except for a respirator and for use as a gross decontamination area for personnel exiting the regulated area. The Competent Person shall ensure that most gross contamination is removed from the outside of PPE, suits and respirators in the regulated work area, prior to entering the Equipment Room. The equipment room shall be separated from the regulated area by a minimum 3 foot wide door made with 2 layers of 6-mil opaque fire retardant poly. The equipment room shall be separated from the regulated area, the shower room, and the rest of the building by airtight walls and ceiling constructed of a minimum of 3 layers of 6-mil opaque fire retardant poly. Damp wipe all surfaces of the equipment room after each shift change. Provide an additional loose layer of 6-mil fire retardant poly per shift change and remove this layer after each shift. If needed, provide a temporary electrical sub-panel equipped with GFCI in the equipment room to accommodate any equipment required in the regulated area.
4. The PDF shall be as follows: Clean room at the entrance followed by a shower room followed by an equipment room leading to the regulated area. Each doorway in the PDF shall be a minimum of 2 layers of 6-mil opaque fire retardant poly.



E. Waste/Equipment Decontamination Facility (W/EDF):

1. The Competent Person shall provide a W/EDF consisting of a washroom, holding room, and clean room for removal of waste, equipment, and contaminated material from the regulated area. Personnel shall not enter or exit the W/EDF except in the event of an emergency. Clean debris and residue in the W/EDF daily. All surfaces in the W/EDF shall be wiped/hosed down after each shift and all debris shall be cleaned from the shower pan. The W/EDF shall consist of the following:
   a. Wash Down Station: Provide an enclosed shower unit in the regulated area just outside the washroom as an equipment bag and container cleaning station.
   b. Washroom: Provide a wash room for cleaning of bagged or containerized asbestos containing waste materials passed from the regulated area. Construct the washroom using 50 x 100 mm (2 inches x 4 inches) wood framing or approved equivalent and 3 layers of 6-mil fire retardant poly. Locate the washroom so that packaged materials, after being wiped clean, can be passed to the Holding Room. Doorways in the washroom shall be constructed of 2 layers of 6-mil fire retardant poly.
   c. Holding Room: Provide a holding room as a drop location for bagged materials passed from the washroom. Construct the holding room using 50 x 100 mm (2 inches x 4 inches) wood framing or approved equivalent and 3 layers of 6-mil fire retardant poly. The holding room shall be located so that bagged material cannot be passed from the washroom to the clean room unless it goes through the holding room. Doorways in the holding room shall be constructed of 2 layers of 6-mil fire retardant poly.
   d. Clean Room: Provide a clean room to isolate the holding room from the exterior of the regulated area. Construct the clean room using 2 inches x 4 inches wood framing or approved equivalent and 2 layers of 6-mil fire retardant poly. The clean room shall be located so as to provide access to the holding room from the building exterior. Doorways to the clean room shall be constructed of 2 layers of 6-mil fire retardant poly. When a negative pressure differential system is used, a rigid enclosure separation between the W/EDF clean room and the adjacent areas shall be provided.
   e. The W/EDF shall be as follows: Washroom leading to a Holding Room followed by a Clean Room leading to outside the regulated area. See diagram.



F. Waste/Equipment Decontamination Procedures: At the washdown station in the regulated area, thoroughly wet clean contaminated equipment and/or sealed polyethylene bags and pass into washroom after visual inspection. When passing anything into the washroom, close all doorways of the W/EDF, other than the doorway between the washdown station and the washroom. Keep all outside personnel clear of the W/EDF. Once inside the washroom, wet clean the equipment and/or bags. After cleaning and inspection, pass items into the Holding Room. Close all doorways except the doorway between the Holding Room and the Clean Room. Workers from the Clean Room/Exterior shall enter the Holding Room and remove the decontaminated/cleaned equipment/bags for removal and disposal. At no time shall personnel from the clean side be allowed to enter the washroom.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. General Requirements: Prior to the start of work, the contractor shall provide and maintain a sufficient quantity of materials and equipment to assure continuous and efficient work throughout the duration of the project. Work shall not start unless the following items have been delivered to the site and the CPIH/CIH has submitted verification to the VA's representative.

1. All materials shall be delivered in their original package, container or bundle bearing the name of the manufacturer and the brand name (where applicable).
2. Store all materials subject to damage off the ground, away from wet or damp surfaces and under cover sufficient enough to prevent damage or contamination. Flammable and combustible materials cannot be stored inside buildings. Replacement materials shall be stored outside of the regulated area until abatement is completed.
3. The Contractor shall not block or hinder use of buildings by patients, staff, and visitors to the VA in partially occupied buildings by placing materials/equipment in any unauthorized location.
4. The Competent Person shall inspect for damaged, deteriorating or previously used materials. Such materials shall not be used and shall be removed from the worksite and disposed of properly.
5. Polyethylene sheeting for walls in the regulated area shall be a minimum of 4-mils. For floors and all other uses, sheeting of at least 6-mil shall be used in widths selected to minimize the frequency of joints. Fire retardant poly shall be used throughout.
6. The method of attaching polyethylene sheeting shall be agreed upon in advance by the Contractor and the VA and selected to minimize damage to equipment and surfaces. Method of attachment may include any combination of moisture resistant duct tape, poly tape, furring

strips, spray glue, staples, nails, screws, lumber and plywood for enclosures or approved equivalent procedures capable of sealing polyethylene to dissimilar finished or unfinished surfaces under both wet and dry conditions.

7. Polyethylene sheeting utilized for the PDF shall be opaque white or black in color, 6-mil fire retardant poly.
8. Installation and plumbing hardware, showers, hoses, drain pans, sump pumps and wastewater filtration system shall be provided by the Contractor.
9. An adequate number of HEPA vacuums, scrapers, sprayers, nylon brushes, brooms, disposable mops, rags, sponges, staple guns, shovels, ladders and scaffolding of suitable height and length as well as meeting OSHA requirements, fall protection devices, water hose to reach all areas in the regulated area, airless spray equipment, and any other tools, materials or equipment required to conduct the abatement project. All electrically operated hand tools, equipment, electric cords shall be connected to GFCI protection.
10. Special protection for objects in the regulated area shall be detailed (e.g., plywood over carpeting or hardwood floors to prevent damage from scaffolds, water and falling material).
11. Disposal bags – 2 layers of 6-mil poly for asbestos waste shall be pre-printed with labels, markings and address as required by OSHA, EPA and DOT regulations.
12. The VA shall be provided an advance copy of the Safety Data Sheets (SDS) as required for all hazardous chemicals under OSHA 29 CFR 1910.1200 - Hazard Communication in the pre-start meeting submittal. Chlorinated compounds shall not be used with any spray adhesive, mastic remover or other product. Appropriate encapsulant(s) shall be provided.
13. OSHA DANGER demarcation signs, as many and as required by OSHA 29 CFR 1926.1101(k)(7) shall be provided and placed by the Competent Person. All other posters and notices required by Federal and State regulations shall be posted in the Clean Room.
14. Adequate and appropriate PPE for the project and number of personnel/shifts shall be provided. All personal protective equipment issued must be based on a written hazard assessment conducted under 29 CFR 1910.132(d).

2.2 MONITORING, INSPECTION AND TESTING

A. General:

1. Perform throughout abatement work monitoring, inspection and testing inside and around the regulated area in accordance with the OSHA requirements and these specifications. OSHA requires that the employee exposure to asbestos must not exceed 0.1 fiber per cubic centimeter (f/cc) of air, averaged over an 8-hour work shift or 1.0 fibers per cubic centimeter (F/cm^2) of air for a 30 minute excursion. The CPIH/CIH is responsible for and shall inspect and oversee the performance of the Contractor IH Technician. The IH Technician shall continuously inspect and monitor conditions inside the regulated area to ensure compliance

with these specifications. In addition, the CPIH/CIH shall personally manage air sample collection, analysis, and evaluation for personnel, regulated area, and adjacent area samples inside the building, but outside the regulated area. Inside the building, but outside the regulated area air samples shall be collected in the Clean Room of the PDF, at the approximate location of HEPA exhaust discharge, and at a minimum of three (3) locations in areas immediately outside the regulated work area to satisfy this specification. Additional inspection and testing requirements are also indicated in other parts of this specification.

2. The VA will employ an independent industrial hygienist (VPIH/CIH) consultant and/or use its own IH to perform various services on behalf of the VA. The VPIH/CIH will perform the necessary monitoring, inspection, testing, and other support services to ensure that VA patients, employees, and visitors will not be adversely affected by the abatement work, and that the abatement work proceeds in accordance with these specifications, that the abated areas or abated buildings have been successfully decontaminated. The work of the VPIH/CIH consultant in no way relieves the Contractor from their responsibility to perform the work in accordance with contract/specification requirements, to perform continuous inspection, monitoring and testing for the safety of their employees, and to perform other such services as specified. The cost of the VPIH/CIH and their services will be borne by the VA except for any repeat of final inspection and testing that may be required due to unsatisfactory initial results. Any repeated final inspections and/or testing, if required, will be paid for by the Contractor.
3. If fibers counted by the VPIH/CIH during abatement work, either inside or outside the regulated area, utilizing the NIOSH 7400 air monitoring method, exceed the specified respective limits, the Contractor shall stop work. The Contractor may request confirmation of the results by analysis of the samples by TEM. Request must be in writing and submitted to the VA's representative. Cost for the confirmation of results will be borne by the Contractor for both the collection and analysis of samples and for the time delay that may/does result for this confirmation. Confirmation sampling and analysis will be the responsibility of the CPIH/CIH with review and approval of the VPIH/CIH. An agreement between the CPIH/CIH and the VPIH/CIH shall be reached on the exact details of the confirmation effort, in writing, including such things as the number of samples, location, collection, quality control on-site, analytical laboratory, interpretation of results and any follow-up actions. This written agreement shall be co-signed by the IH's and delivered to the VA's representative.

B. Scope of Services of the VPIH/CIH Consultant:

1. The purpose of the work of the VPIH/CIH is to: assure quality; adherence to the specification; resolve problems; prevent the spread of contamination beyond the regulated area; and assure clearance at the end of the project. In addition, their work includes performing the final inspection and testing to determine whether the regulated area or building has been

adequately decontaminated. All air monitoring is to be done utilizing PCM/TEM. The VPIH/CIH will perform the following tasks:

a. Task 1: Establish background levels before abatement begins by collecting background samples. Retain samples for possible TEM analysis.
b. Task 2: Perform representative air monitoring, inspection, and testing outside the regulated area during actual abatement work to detect any faults in the regulated area isolation and any adverse impact on the surroundings from regulated area activities.
c. Task 3: Perform unannounced visits to spot check overall compliance of work with contract/specifications. These visits may include any inspection, monitoring, and testing inside and outside the regulated area and all aspects of the operation except personnel monitoring.
d. Task 4: Provide support to the VA representative such as evaluation of submittals from the Contractor, resolution of conflicts, interpret data, etc.
e. Task 5: Perform, in the presence of the VA representative, final inspection and testing of a decontaminated regulated area at the conclusion of the abatement to certify compliance with all regulations and VA requirements/specifications.
f. Task 6: Advise contractor of the result of the final inspection and testing.

2. All documentation, inspection results and testing results generated by the VPIH/CIH will be available to the Contractor for information and consideration. The Contractor shall cooperate with and support the VPIH/CIH for efficient and smooth performance of their work.
3. The monitoring and inspection results of the VPIH/CIH will be used by the VA to issue any Stop Removal orders to the Contractor during abatement work and to accept or reject a regulated area or building as decontaminated.

C. Monitoring, Inspection and Testing by Contractor CPIH/CIH: The Contractor's CPIH/CIH is responsible for managing all personal monitoring, inspections, and testing required by these specifications, as well as any and all regulatory requirements adopted by these specifications. The CPIH/CIH is responsible for the continuous monitoring of all subsystems and procedures which could affect the health and safety of the Contractor's personnel. Safety and health conditions and the provision of those conditions inside the regulated area for all persons entering the regulated area is the exclusive responsibility of the Contractor/Competent Person. The person performing the personal air monitoring inside the regulated area shall be an IH Technician, who shall be trained and shall have specialized field experience in sampling and analysis. The IH Technician shall have successfully completed a NIOSH 582 Course or equivalent and provide documentation. The IH Technician shall participate in the AIHA Asbestos Analysis Registry or participate in the Proficiency Analytical Testing program of AIHA for fiber counting quality control assurance. The IH Technician shall also be an accredited EPA AHERA/State Contractor/Supervisor and Building Inspector. The IH Technician shall also work under the

supervision of a Florida Licensed Asbestos Consultant. The IH Technician shall have participated in five abatement projects collecting personal and area samples and have experience in substantially similar projects in size and scope. The analytical laboratory used by the Contractor to analyze the samples shall be AIHA accredited for asbestos PAT and approved by the VA prior to start of the project. A daily log shall be maintained by the CPIH/CIH or IH Technician, documenting all OSHA requirements for personal and area air monitoring for asbestos in 29 CFR 1926.1101(f), (g) and Appendix A. This log shall be made available to the VA representative and the VPIH/CIH upon request. The log will contain, at a minimum, information on personnel or area samples, other persons represented by the sample, the date of sample collection, start and stop times for sampling, sample volume, flow rate, and fibers/cc. The CPIH/CIH shall collect and analyze samples for each representative job being done in the regulated area, i.e., removal, wetting, clean-up, and load-out. No fewer than two (2) personal air samples or 25 percent of representative workforce per shift shall be collected, whichever is greater, in the regulated area; a minimum of three (3) area air samples at locations inside the building but immediately outside the regulated work area; one (1) area air sample shall be collected daily in the Clean Room of the PDF; and one (1) area air sample shall be collected daily at the approximate location of HEPA exhaust discharge. In addition to the continuous monitoring required, the CPIH/CIH will perform inspection and testing at the final stages of abatement for each regulated area as specified in the CPIH/CIH responsibilities. Additionally, the CPIH/CIH will monitor and record pressure readings within the containment daily with a minimum of two readings at the beginning and at the end of a shift, and submit the data in the daily report.

2.3 ASBESTOS HAZARD ABATEMENT PLAN

A. The Contractor shall have an established an Asbestos Hazard Abatement Plan (AHAP) in printed form and loose leaf folder consisting of simplified text, diagrams, sketches, and pictures that establish and explain clearly the procedures to be followed during all phases of the work by the Contractor's personnel. The AHAP must be modified as needed to address specific requirements of this project and the specifications. The AHAP shall be submitted for review and approval to the VA prior to the start of any abatement work. The minimum topics and areas to be covered by the AHAPs are:

1. Minimum Personnel Qualifications
2. Emergency Action Plan/Contingency Plans and Arrangements
3. Security and Safety Procedures
4. Respiratory Protection/Personal Protective Equipment Program and Training
5. Medical Surveillance Program and Recordkeeping
6. Regulated Area Requirements - Containment Barriers/Isolation of Regulated Area
7. Decontamination Facilities and Entry/Exit Procedures (PDF and W/EDF)

8. Negative Pressure Systems Requirements
9. Monitoring, Inspections, and Testing
10. Removal Procedures for ACM
11. Removal of Contaminated Soil (if applicable)
12. Encapsulation Procedures for ACM
13. Disposal of ACM waste/equipment
14. Regulated Area Decontamination/Clean-up
15. Regulated Area Visual and Air Clearance
16. Project Completion/Closeout

2.4 SUBMITTALS

A. Pre-Start Meeting Submittals:

1. Submit to the VA a minimum of 14 days prior to the pre-start meeting the following for review and approval. Meeting this requirement is a prerequisite for the pre-start meeting for this project:
   a. Submit a detailed work schedule for the entire project reflecting contract documents and the phasing/schedule requirements from the CPM chart.
   b. Submit a staff organization chart showing all personnel who will be working on the project and their capacity/function. Provide their qualifications, training, accreditations, and licenses, as appropriate. Provide a copy of the "Certificate of Worker's Acknowledgment" and the "Affidavit of Medical Surveillance and Respiratory Protection" for each person.
   c. Submit Asbestos Hazard Abatement Plan developed specifically for this project, incorporating the requirements of the specifications, prepared, signed and dated by the CPIH/CIH.
   d. Submit the specifics of the materials and equipment to be used for this project with manufacturer names, model numbers, performance characteristics, pictures/diagrams, and number available for the following:
      1)Supplied air system, negative air machines, HEPA vacuums, air monitoring pumps, calibration devices, pressure differential monitoring device and emergency power generating system.
      2)Wastewater filtration system, shower system, containment barriers.
      3)Encapsulants, surfactants, handheld sprayers, airless sprayers, glove bags, and fire extinguishers.
      4)Respirators, protective clothing, fall protection and other required personal protective equipment.
      5)Fire safety equipment to be used in the regulated area.

e. Submit the name, location, and phone number of the approved landfill; proof/verification the landfill is approved for ACM disposal; the landfill's requirements for ACM waste; the type of vehicle to be used for transportation; and name, address, and phone number of subcontractor, if used. Proof of asbestos training for transportation personnel shall be provided.

f. Submit required notifications and arrangements made with regulatory agencies having regulatory jurisdiction and the specific contingency/emergency arrangements made with local health, fire, ambulance, hospital authorities and any other notifications/arrangements.

g. Submit the name, location and verification of the laboratory and/or personnel to be used for analysis of air and/or bulk samples. Personal air monitoring must be done in accordance with OSHA 29 CFR 1926.1101(f) and Appendix A. Area or clearance air monitoring shall be conducted in accordance with EPA AHERA protocols.

h. Submit qualifications verification: Submit the following evidence of qualifications. Make sure that all references are current and verifiable by providing current phone numbers and documentation.

1)Asbestos Abatement Company: Project experience within the past 3 years; listing projects first most similar to this project: Project Name; Type of Abatement; Duration; Cost; Reference Name/Phone Number; Final Clearance; Completion Date

2)List of project(s) halted by owner, A/E, IH, regulatory agency in the last 3 years: Project Name; Reason; Date; Reference Name/Number; Resolution

3)List asbestos regulatory citations (e.g., OSHA), notices of violations (e.g., Federal and state EPA), penalties, and legal actions taken against the company including the company’s officers (including damages paid) in the last 3 years. Provide copies and all information needed for verification.

i. Submit information on personnel: Provide a resume; address each item completely; copies of certificates, accreditations, and licenses. Submit an affidavit signed by the CPIH/CIH stating that all personnel submitted below have medical records in accordance with OSHA 29 CFR 1926.1101(m) and that the company has implemented a medical surveillance program and written respiratory protection program, and maintains recordkeeping in accordance with the above regulation. Submit the phone number and doctor/clinic/hospital used for medical evaluations.

1)CPIH/CIH and IH Technician: Name; years of abatement experience; list of projects similar to this one; certificates, licenses, accreditations for proof of AHERA/OSHA specialized asbestos training; professional affiliations; medical opinion; and current respirator fit test.

2)Competent Person(s)/Supervisor(s): Number; names; last four digits of social security numbers; years of abatement experience as Competent Person/Supervisor; list of similar projects in size/complexity as Competent Person/Supervisor; as a worker; certificates, licenses, accreditations; proof of AHERA/OSHA specialized asbestos training; maximum number of personnel supervised on a project; medical opinion (asbestos surveillance and respirator use); and current respirator fit test.

3)Workers: Numbers; names; last four digits of social security numbers; years of abatement experience; certificates, licenses, accreditations; training courses in asbestos abatement and respiratory protection; medical opinion (asbestos surveillance and respirator use); and current respirator fit test.

j. Submit copies of State license for asbestos abatement; copy of insurance policy, including exclusions with a letter from agent stating in plain language the coverage provided and the fact that asbestos abatement activities are covered by the policy; copy of AHAPs incorporating the requirements of this specification; information on who provides your training, how often; who provides medical surveillance, how often; who performs and how is personal air monitoring of abatement workers conducted; a list of references of independent laboratories/IH's familiar with your air monitoring and standard operating procedures; and copies of monitoring results of the five referenced projects listed and analytical methods used.

k. Rented equipment must be decontaminated prior to returning to the rental agency.

l. Submit, before the start of work, the manufacturer's technical data for all types of encapsulants, all SDS and application instructions.

B. Submittals During Abatement:

1. The Competent Person shall maintain and submit a daily log at the regulated area documenting the dates and times of the following: purpose, attendees and summary of meetings; all personnel entering/exiting the regulated area; document and discuss the resolution of unusual events such as barrier breeching, equipment failures, emergencies, and any cause for stopping work; and representative air monitoring and results/TWA's/EL's. Submit this information daily to the VA's representative.

2. The CPIH/CIH shall document and maintain the inspection and approval of the regulated area preparation prior to start of work and daily during work.

a. Removal of any poly barriers.

b. Visual inspection/testing by the CPIH/CIH or IH Technician prior to application of lockdown encapsulant.

c. Packaging and removal of ACM waste from regulated area.

d. Disposal of ACM waste materials; copies of Waste Shipment Records/landfill receipts to the VA's representative on a weekly basis.

C. Submittals at Completion of Abatement: The CPIH/CIH shall submit a project report consisting of the daily logbook requirements and documentation of events during the abatement project including Waste Shipment Records signed by the landfill's agent. It will also include information on the containment and transportation of waste from the containment with applicable Chain of Custody forms. The report shall include a certificate of completion, signed and dated by the CPIH/CIH, in accordance with Attachment #1. All clearance and perimeter area samples must be submitted. The VA representative will retain the abatement report after completion of the project and provide copies of the abatement report to VAMC Office of Engineer and the Safety Office.

2.5 ENCAPSULANTS

A. Types of Encapsulants:
   1. The following four types of encapsulants, if used, must comply with performance requirements as stated in paragraph 2.5.2:
      a. Removal encapsulant - used as a wetting agent to remove ACM.
      b. Bridging encapsulant - provides a tough, durable coating on ACM.
      c. Penetrating encapsulant - penetrates/encapsulates ACM at least 13 mm (1/2 inches).
      d. Lockdown encapsulant - seals microscopic fibers on surfaces after ACM removal.

B. Performance Requirements:
   1. Encapsulants shall meet the latest requirements of EPA; shall not contain toxic or hazardous substances; or solvents; and shall comply with the following performance requirements:
      a. General Requirements for all Encapsulants:
         1)ASTM E84: Flame spread of 25; smoke emission of 50.
         2)University of Pittsburgh Protocol: Combustion Toxicity; zero mortality.
         3)ASTM C732: Accelerated Aging Test; Life Expectancy - 20 years.
         4)ASTM E96: Permeability - minimum of 0.4 perms.
      b. Bridging/Penetrating Encapsulants:
         1)ASTM E736: Cohesion/Adhesion Test - 24 kPa (50 pounds/square foot).
         2)ASTM E119: Fire Resistance - 3 hours (Classified by UL for use on fibrous/cementitious fireproofing).
         3)ASTM D2794: Gardner Impact Test; Impact Resistance - minimum 11.5 kg-mm (43 in/lb).
         4)ASTM D522: Mandrel Bend Test; Flexibility - no rupture or cracking.
      c. Lockdown Encapsulants:
         1)ASTM E119: Fire resistance - 3 hours (tested with fireproofing over encapsulant applied directly to steel member).
         2)ASTM E736: Bond Strength - 48 kPa (100 pounds/square foot) (test compatibility with cementitious and fibrous fireproofing).

3)In certain situations, encapsulants may have to be applied to hot pipes/equipment. The encapsulant must be able to withstand high temperatures without cracking or creating any noxious gaseous or vapors during or after application.

C. Certificates of Compliance: The Contractor shall submit to the VA representative certification from the manufacturer indicating compliance with performance requirements for encapsulants when applied according to manufacturer recommendations.

PART 3 - EXECUTION

3.1 REGULATED AREA PREPARATIONS

A. Site Security:

1. Regulated area access is to be restricted only to authorized, trained/accredited and protected personnel. These may include the Contractor's employees, employees of Subcontractors, VA employees and representatives, State and Local inspectors, and any other designated individuals. A list of authorized personnel shall be established prior to commencing the project and be posted in the clean room of the decontamination unit.
2. Entry into the regulated area by unauthorized individuals shall be reported immediately to the Competent Person by anyone observing the entry. The Competent Person shall immediately require any unauthorized person to leave the regulated area and then notify the VA Contracting Officer or VA Representative using the most expeditious means.
3. A logbook shall be maintained in the clean room of the decontamination unit. Anyone who enters the regulated area must record their name, affiliation, time in, and time out for each entry.
4. Access to the regulated area shall be through a single three stage decontamination unit. All other access (doors, windows, hallways, etc.) shall be sealed and demarcated as an asbestos regulated work area to prevent entry to or exit from the regulated area unless in the event of an emergency. The only exceptions for this requirement are the waste/equipment load-out area which shall be sealed except during the removal of containerized asbestos waste from the regulated area, and emergency exits. Emergency exits shall not be locked from the inside; however, they shall be sealed with poly sheeting and taped until needed. In any situation where exposure to high temperatures which may result in a flame hazard, fire retardant poly sheeting must be used.
5. The Contractor's Competent Person shall control site security during abatement operations in order to isolate work in progress and protect adjacent personnel. A 24-hour security system shall be provided at the entrance to the regulated area to assure that all entrants are logged in/out and that only authorized personnel are allowed entrance.

6. The Contractor will have the VA's assistance in notifying adjacent personnel of the presence, location and quantity of ACM in the regulated area and enforcement of restricted access by the VA's employees.
7. The regulated area shall be locked during non-working hours and secured by VA Representative or Competent Person. The VA Police shall be informed of asbestos abatement regulated areas to provide security checks during facility rounds and emergency response.

B. Signage and Power Management:
1. Post OSHA DANGER signs meeting the specifications of OSHA 29 CFR 1926.1101 at any location and approaches to the regulated area. Signs shall be posted at a distance sufficiently far enough away from the regulated area to permit any personnel to read the sign and take the necessary measures to avoid exposure. Additional signs will be posted following construction of the regulated area enclosure.
2. Shut down and lock out/tag out electric power to the regulated area. Provide temporary power and lighting. Ensure safe installation including GFCI of temporary power sources and equipment by compliance with all applicable electrical code and OSHA requirements for temporary electrical systems. Electricity shall be provided by the VA.
3. Shut down and lock out/tag out heating, cooling, and air conditioning system (HVAC) components that are in, supply or pass through the regulated area. Investigate the regulated area and agree on pre-abatement condition with the VA's representative. Seal all intake and exhaust vents in the regulated area with duct tape and 2 layers of independently installed 6-mil poly. Also, seal any seams in system components that pass through the regulated area. Remove all contaminated HVAC system filters and place in labeled 6-mil polyethylene disposal bags for staging and eventual disposal as asbestos waste.

C. Negative Pressure Filtration System:
1. The Contractor shall provide enough HEPA negative air machines to effect - 0.02 inch WCG pressure differential inside the regulated work area. The Competent Person shall determine the number of units needed for the regulated area by dividing the cubic feet in the regulated area by 15 and then dividing that result by the cubic feet per minute (CFM) for each unit to determine the number of units needed to provide four air changes per hour and achieve a pressure differential equal to or exceeding -0.02 inch WCG pressure inside the regulated work area. Provide standby units in the event of machine failure and/or emergency in an adjacent area. HEPA equipped negative air machines shall be discharged outside of the building a minimum of 30 feet from building make-up air, doors, open windows, patients, visitors and staff.
2. NIOSH has done extensive studies and has determined that negative air machines typically operate at ~50 percent efficiency. The contractor shall consider this in their determination of

number of units needed to provide four air changes per hour and achieve a pressure differential equal to or exceeding - 0.02 inch WCG pressure inside the regulated work area. The contractor shall use double the number of machines, based on their calculations, or submit proof their machines operate at stated capacities, at a 2 inches pressure drop across the filters.

3. Design and Layout:
   a. Before start of work submit the design and layout of the regulated area and the negative air machines. The submittal shall indicate the number of, location of and size of negative air machines. The point(s) of exhaust, air flow within the regulated area, anticipated negative pressure differential, and supporting calculations for sizing shall be provided. In addition, submit the following:
      1)Method of supplying power to the units and designation/location of the panels.
      2)Description of testing method(s) for correct air volume and pressure differential.
      3)If auxiliary power supply is to be provided for the negative air machines, provide a schematic diagram of the power supply and manufacturer's data on the generator and switch.
4. Negative Air Machines (Hepa Units):
   a. Negative Air Machine Cabinet: The cabinet shall be constructed of steel or other durable material capable of withstanding potential damage from rough handling and transportation. The width of the cabinet shall be less than 30 inches in order to fit in standard doorways. The cabinet must be factory sealed to prevent asbestos fibers from being released during use, transport, or maintenance. Any access to and replacement of filters shall be from the inlet end. The unit must be on casters or wheels.
   b. Negative Air Machine Fan: The rating capacity of the fan must indicate the CFM under actual operating conditions. Manufacturer's typically use "free-air" (no resistance) conditions when rating fans. The fan must be a centrifugal type fan.
   c. Negative Air Machine Final Filter: The final filter shall be a HEPA filter. The filter media must be completely sealed on all edges within a structurally rigid frame. The filter shall align with a continuous flexible gasket material in the negative air machine housing to form an air tight seal. Each HEPA filter shall be certified by the manufacturer to have an efficiency of not less than 99.97 percent. Testing shall have been done in accordance with Military Standard MIL-STD-282 and Army Instruction Manual 136-300-175A. Each filter must bear a UL586 label to indicate ability to perform under specified conditions. Each filter shall be marked with the name of the manufacturer, serial number, air flow rating, efficiency and resistance, and the direction of test air flow.
   d. Negative Air Machine Pre-filters: The pre-filters, which protect the final HEPA filter by removing larger particles, are required to prolong the operating life of the HEPA filter.

Two stages of pre-filtration are required. A first stage pre-filter shall be a low efficiency type for particles 10 µm or larger. A second stage pre-filter shall have a medium efficiency effective for particles down to 5 µm or larger. Pre-filters shall be installed either on or in the intake opening of the NAM and the second stage filter must be held in place with a special housing or clamps.

e. Negative Air Machine Instrumentation: Each unit must be equipped with a gauge to measure the pressure drop across the filters and to indicate when filters have become loaded and need to be changed. A table indicating the cfm for various pressure readings on the gauge shall be affixed near the gauge for reference or the reading shall indicate at what point the filters shall be changed, noting cfm delivery. The unit must have an elapsed time meter to show total hours of operation.

f. Negative Air Machine Safety and Warning Devices: An electrical/ mechanical lockout must be provided to prevent the fan from being operated without a HEPA filter. Units must be equipped with an automatic shutdown device to stop the fan in the event of a rupture in the HEPA filter or blockage in the discharge of the fan. Warning lights are required to indicate normal operation; too high a pressure drop across filters; or too low of a pressure drop across filters.

g. Negative Air Machine Electrical: All electrical components shall be approved by the National Electrical Manufacturer's Association (NEMA) and Underwriters Laboratories (UL). Each unit must be provided with overload protection and the motor, fan, fan housing, and cabinet must be grounded.

h. It is essential that replacement HEPA filters be tested using an “in-line” testing method, to ensure the seal around the periphery was not damaged during replacement. Damage to the outer HEPA filter seal could allow contaminated air to bypass the HEPA filter and be discharged to an inappropriate location. Contractor will provide written documentation of test results for negative air machine units with HEPA filters.

5. Pressure Differential: The fully operational negative air system within the regulated area shall continuously maintain four air changes per hour and achieve a pressure differential equal to or exceeding -0.02 inch WCG pressure inside the regulated work area. Before any disturbance of any asbestos material, this shall be demonstrated to the VA by use of a pressure differential meter/manometer as required by OSHA 29 CFR 1926.1101(g)(5)(i). The Competent Person shall be responsible for providing, maintaining, and documenting the negative pressure and air changes as required by OSHA and this specification.

6. Monitoring: The pressure differential shall be continuously monitored and recorded by the Contractor between the regulated area and the area outside the regulated area with a monitoring device that incorporates a strip chart recorder. The strip chart recorder shall

become part of the project log and shall indicate at least ≥ - 0.02 inch WCG pressure differential inside the regulated work area for the duration of the project.

7. Auxiliary Generator: If the building is occupied during abatement, provide an auxiliary gasoline/diesel generator located outside the building in an area protected from the weather. In the event of a power failure of the general power grid and the VAMC emergency power grid, the generator must automatically start and supply power to a minimum of 50 percent of the negative air machines in operation.
8. Supplemental Make-Up Air Inlets: Provide, as needed for proper air flow in the regulated area, in a location approved by the VA, openings in the plastic sheeting to allow outside air to flow into the regulated area. Auxiliary makeup air inlets must be located as far from the negative air machines as possible, off the floor near the ceiling, and away from the barriers that separate the regulated area from the occupied clean areas. Cover the inlets with weighted flaps which will seal in the event of failure of the negative pressure system.
9. Testing The System: The negative pressure system must be tested before any ACM is disturbed in any way. After the regulated area has been completely prepared, the decontamination units set up, and the negative air machines installed, start the units up one at a time. Demonstrate and document the operation and testing of the negative pressure system to the VA using smoke tubes and a negative pressure gauge. Verification and documentation of adequate negative pressure differential across each barrier must be done at the start of each work shift.
10. Demonstration of the Negative Pressure Filtration System:
    a. The demonstration of the operation of the negative pressure system to the VA shall include, but not be limited to, the following:
        1)Plastic barriers and sheeting move lightly in toward the regulated area.
        2)Curtains of the decontamination units move in toward regulated area.
        3)There is a noticeable movement of air through the decontamination units. Use the smoke tube to demonstrate air movement from the clean room to the shower room to the equipment room to the regulated area.
        4)Use smoke tubes to demonstrate air is moving across all areas in which work is to be done. Use a differential pressure gauge to indicate a negative pressure of at > - 0.02 inch across every barrier separating the regulated area from the rest of the building. Modify the system as necessary to meet the above requirements.
11. Use of the Negative Pressure Filtration System During Abatement Operations:
    a. Start units before beginning any disturbance of ACM occurs. After work begins, the units shall run continuously, maintaining four air changes per hour and achieving a pressure differential equal to or exceeding -0.02 inch WCG pressure inside the regulated work

area for the duration of the work until a final visual clearance and final air clearance has been successfully completed.

b. No negative air units shall be shut down at any time unless authorized by the VA Contracting Officer, verbally and in writing.

c. Pre-cleaning of ACM contaminated items shall be performed after the enclosure has been erected and negative pressure has been established in the work area. After items have been pre-cleaned and decontaminated, they may be removed from the work area for storage until the completion of abatement in the work area.

d. Abatement work shall begin at a location farthest from the units and proceed towards them. If an electric failure occurs, the Competent Person shall stop all abatement work and immediately begin wetting all exposed asbestos materials for the duration of the power outage. Abatement work shall not resume until power is restored and all units are operating properly again.

e. The negative air machines shall continue to run after all work is completed and until a final visual clearance and a final air clearance has been successfully completed for that regulated area.

12. Dismantling The System: After completion of the final visual and final air clearance has been obtained by the VPIH/CIH, the units may be shut down. The unit exterior surfaces shall have been completely decontaminated; pre-filters are not to be removed and the units inlet/outlet sealed with 2 layers of 6-mil poly immediately after shut down. No filter removal shall occur at the VA site following successful completion of site clearance. OSHA/EPA/DOT asbestos labels shall be attached to the units.

D. Containment Barriers and Coverings in the Regulated Area:

1. General: Seal off the perimeter to the regulated area to completely isolate the regulated area from adjacent spaces. All surfaces in the regulated area must be covered to prevent contamination and to facilitate clean-up. Should adjacent areas become contaminated as a result of the work, Contractor shall immediately stop work and clean up the contamination at no additional cost to the VA. Provide firestopping and identify all fire barrier penetrations due to abatement work as specified in Section 3.1.4.8; FIRESTOPPING.

2. Preparation Prior To Sealing: The Regulated Area: Place all tools, scaffolding, materials and equipment needed for working in the regulated area prior to erecting any plastic sheeting. All uncontaminated removable furniture, equipment and/or supplies shall be removed by the VA from the regulated area before commencing work. Any objects not scheduled for removal remaining in the regulated area shall be completely covered with 2 layers of 6-mil fire retardant poly sheeting and secured with duct tape. Lock out and tag out any HVAC/electrical systems in the regulated area.

3. Controlling Access to The Regulated Area: Access to the regulated area is allowed only through the personnel decontamination facility (PDF). All other means of access shall be eliminated and OSHA DANGER demarcation signs posted as required by OSHA. If the regulated area is adjacent to, or within view of an occupied area, provide a visual barrier of 6-mil opaque fire retardant poly to prevent building occupant observation. If the adjacent area is accessible to the public, the barrier must be solid and capable of withstanding the negative pressure.

4. Critical Barriers: Completely separate any operations in the regulated area from adjacent areas using 2 layers of 6-mil fire retardant poly and duct tape. Individually seal with 2 layers of 6-mil poly and duct tape all HVAC openings into the regulated area. Individually seal all lighting fixtures, clocks, doors, windows, convectors, speakers, or any other objects/openings in the regulated area. Heat must be shut off any objects covered with poly.
5. Primary Barriers:
    a. Cover the regulated area with two layers of 6-mil fire retardant poly on the floors and two layers of 6 mil, fire retardant poly on the walls, unless otherwise directed in writing by the VA representative. Floor layers must form a right angle with the wall and turn up the wall at least 300 mm (12 inches). Seams must overlap at least 1800 mm (6 feet) and must be spray glued and taped. Install sheeting so that layers can be removed independently from each other. Carpeting shall be covered with three layers of 6-mil poly. Corrugated cardboard sheets must be placed between the bottom and middle layers of poly. Mechanically support and seal with duct tape and glue all wall layers.

    b. If stairs and ramps are covered with 6-mil plastic, two layers must be used. Provide 19 mm (3/4 inch) exterior grade plywood treads held in place with duct tape/glue on the plastic. Do not cover rungs or rails with any isolation materials.
6. Secondary Barriers: A loose layer of 6-mil shall be used as a drop cloth to protect the primary layers from debris generated during the abatement. This layer shall be replaced as needed during the work.
7. Extension of the Regulated Area: If the enclosure of the regulated area is breached in any way that could allow contamination to occur, the affected area shall be included in the regulated area and constructed as per this section. Decontamination measures must be started immediately and continue until air monitoring indicates background levels are met.
8. Firestopping:
    a. Through penetrations caused by cables, cable trays, pipes, sleeves, conduits, etc. must be firestopped with a fire-rated firestop system providing an airtight seal.
    b. Firestop materials that are not equal to the wall or ceiling penetrated shall be brought to the attention of the VA Representative. The contractor shall list all areas of penetration,

the type of sealant used, and whether or not the location is fire rated. Any discovery of penetrations during abatement shall be brought to the attention of the VA representative immediately. All walls, floors and ceilings are considered fire rated unless otherwise determined by the VA Representative or Fire Marshall.

c. Any visible openings whether or not caused by a penetration shall be reported by the Contractor to the VA Representative for a sealant system determination. Firestops shall meet ASTM E814 and UL 1479 requirements for the opening size, penetrant, and fire rating needed.

E. Sanitary Facilities: The Contractor shall provide sanitary facilities for abatement personnel and maintain them in a clean and sanitary condition throughout the abatement project.

F. Personal Protective Equipment: Provide whole body clothing, head coverings, gloves and foot coverings and any other personal protective equipment as determined by conducting the hazard assessment required by OSHA at 29 CFR 1910.132 (d). The Competent Person shall ensure the integrity of personal protective equipment worn for the duration of the project. Duct tape shall be used to secure all suit sleeves to wrists and to secure foot coverings at the ankle.

G. Pre-Cleaning:

1. The Contractor shall be responsible for all pre-cleaning activities and shall work in conjunction with the VA to ensure VA access to critical systems is maintained.
2. The VA will provide water for abatement purposes. The Contractor shall connect to the existing VA system. The service to the shower(s) shall be supplied with backflow prevention.
3. Pre-cleaning of ACM contaminated items shall be performed after the enclosure has been erected and negative pressure has been established in the work area. All workers performing pre-cleaning activities must don appropriate personal protective equipment (PPE), as specified throughout this document and as approved in the Contractor’s work plan. After items have been pre-cleaned and decontaminated, they may be removed from the work area for storage until the completion of abatement in the work area.
4. Pre-clean all movable objects within the regulated area using a HEPA filtered vacuum and/or wet cleaning methods as appropriate. After cleaning, these objects shall be removed from the regulated area and carefully stored in an uncontaminated location. Drapes, clothing, upholstered furniture and other fabric items shall be disposed of as asbestos contaminated waste. Cleaning these asbestos contaminated items utilizing HEPA vacuum techniques and off-premises steam cleaning is very difficult and cannot guarantee decontamination. Carpeting will be disposed of prior to abatement if in the regulated area. If ACM floor tile is attached to the carpet while the Contractor is removing the carpet that section of the carpet will be disposed of as asbestos waste.
5. Pre-clean all fixed objects in the regulated area using HEPA filtered vacuums and/or wet cleaning techniques as appropriate. Careful attention must be paid to machinery behind grills

or gratings where access may be difficult but contamination may be significant. Also, pay particular attention to wall, floor and ceiling penetration behind fixed items. After pre-cleaning, enclose fixed objects with 2 layers of 6-mil poly and seal securely in place with duct tape. Objects (e.g., permanent fixtures, shelves, electronic equipment, laboratory tables, sprinklers, alarm systems, closed circuit TV equipment and computer cables) which must remain in the regulated area and that require special ventilation or enclosure requirements should be designated here along with specified means of protection. Contact the manufacturer for special protection requirements.

6. Pre-clean all surfaces in the regulated area using HEPA filtered vacuums and/or wet cleaning methods as appropriate. Do not use any methods that would raise dust such as dry sweeping or vacuuming with equipment not equipped with HEPA filters. Do not disturb asbestos-containing materials during this pre-cleaning phase.

H. Pre-Abatement Activities:

1. Pre-Abatement Meeting: The VA representative, upon receipt, review, and substantial approval of all pre-abatement submittals and verification by the CPIH/CIH that all materials and equipment required for the project are on the site, will arrange for a pre-abatement meeting between the Contractor, the CPIH/CIH, Competent Person(s), the VA representative(s), and the VPIH/CIH. The purpose of the meeting is to discuss any aspect of the submittals needing clarification or amplification and to discuss any aspect of the project execution and the sequence of the operation. The Contractor shall be prepared to provide any supplemental information/documentation to the VA's representative regarding any submittals, documentation, materials or equipment. Upon satisfactory resolution of any outstanding issues, the VA's representative will issue a written order to proceed to the Contractor. No abatement work of any kind described in the following provisions shall be initiated prior to the VA written order to proceed.
2. Pre-Abatement Construction and Operations:
    a. Perform all preparatory work for the first regulated area in accordance with the approved work schedule and with this specification.
    b. Upon completion of all preparatory work, the CPIH/CIH will inspect the work and systems and will notify the VA's representative when the work is completed in accordance with this specification. The VA's representative may inspect the regulated area and the systems with the VPIH/CIH and may require that upon satisfactory inspection, the Contractor's employees perform all major aspects of the approved AHAP(s), especially worker protection, respiratory systems, contingency plans, decontamination procedures, and monitoring to demonstrate satisfactory operation. The operational systems for respiratory protection and the negative pressure system shall be demonstrated for proper performance.

c. The CPIH/CIH shall document the pre-abatement activities described above and deliver a copy to the VA's representative.

d. Upon satisfactory inspection of the installation of and operation of systems, the VA's representative will notify the Contractor in writing to proceed with the asbestos abatement work in accordance with this specification and all applicable regulations.

3. Pre-Abatement Inspections and Preparations:

a. Before any work begins on the construction of the regulated area, the Contractor will:

1)Conduct a space-by-space inspection with an authorized VA representative such as the VA CPIH/CIH and prepare a written inventory of all existing damage in those spaces where asbestos abatement will occur. Still or video photography may be used to supplement the written damage inventory. Document will be signed and certified as accurate by both parties.

2)Ensure that all furniture, machinery, equipment, curtains, drapes, blinds, and other movable objects required to be removed from the regulated area have been cleaned and removed or properly protected from contamination.

3)If present and required, remove and dispose of carpeting from floors in the regulated area.

4)Inspect existing firestopping in the regulated area. Correct as needed.

3.2 REMOVAL OF ACM

A. Wetting ACM:

1. Use amended water for the wetting of ACM prior to removal. The Competent Person shall assure the wetting of ACM meets the definition of "adequately wet" in the EPA NESHAP regulation and OSHA’s “wet methods” for the duration of the project. A removal encapsulant may be used instead of amended water with written approval of the VA's representative.
2. Amended Water: Provide water to which a surfactant has been added to wet the ACM and reduce the potential for fiber release during disturbance of ACM. The mixture must be equal to or greater than the wetting provided by water amended by a surfactant consisting of one ounce of 50 percent polyoxyethylene ester and 50 percent polyoxyethylene ether mixed with 5 gallons (19L) of water.
3. Removal Encapsulant: When authorized by VA, provide a removal encapsulant designed specifically for the removal of ACM. The material must, when used, result in adequate wetting of the ACM and retard fiber release during removal.

B. Secondary Barrier and Walkways:

1. Install as a drop cloth a 6-mil poly sheet at the beginning of each work shift where removal is to be done during that shift. Completely cover floors and any walls within 10 feet (3 meters) of the area where work is to be done. Secure the secondary barrier with duct tape to prevent it

from moving or debris from getting behind it. Remove the secondary barrier at the end of the shift or as work in the area is completed. Keep residue on the secondary barrier wetted. When removing, fold inward to prevent spillage and place in a disposal bag.

2. Install walkways using 6-mil black poly between the regulated area and the decontamination facilities (PDF and W/EDF) to protect the primary layers from contamination and damage. Install the walkways at the beginning of each shift and remove at the end of each shift.

C. Wet Removal of ACM:

1. Adequately and thoroughly wet the ACM to be removed prior to removal with amended water or when authorized by VA, removal encapsulant to reduce/prevent fiber release to the air. Adequate time must be allowed for the amended water or removal encapsulant to saturate the ACM. Abatement personnel must not disturb dry ACM. Use a fine spray of amended water or removal encapsulant. Saturate the material sufficiently to wet to the substrate without causing excessive dripping. The material must be sprayed repeatedly/continuously during the removal process in order to maintain adequately wet conditions. Removal encapsulants must be applied in accordance with the manufacturer's written instructions. Perforate or carefully separate, using wet methods, an outer covering that is painted or jacketed in order to allow penetration and wetting of the material. Where necessary, carefully remove covering while wetting to minimize fiber release. **In no event shall dry removal occur except when authorized in writing by the VPIH/CIH and VA when a greater safety hazard (e.g., electricity) is present**.

2. If ACM does not wet well with amended water due to composition, coating or jacketing, remove as follows:

   a. Mist work area continuously with amended water whenever necessary to reduce airborne fiber levels.

   b. Remove saturated ACM in small sections. Do not allow material to dry out. As material is removed, bag material, while still wet into disposal bags. Twist the bag neck tightly, bend over (gooseneck) and seal with a minimum of three tight wraps of duct tape. Clean /decontaminate the outside of the bag of any residue and move to washdown station adjacent to W/EDF.

   c. Pipe/Tank/Vessel/Boiler Insulation: Remove the outer layer of wrap while spraying with amended water in order to saturate the ACM. Spray ACM with a fine mist of amended water or removal encapsulant. Allow time to saturate the material to the substrate. Cut bands holding pre-formed pipe insulation sections. Slit jacketing at the seams, remove and hand place in a disposal bag. Do not allow dropping to the floor. Remove molded fitting insulation/mud in large pieces and hand place in a disposal bag. Remove any residue on pipe or fitting with a stiff bristle nylon brush. In locations where pipe fitting

insulation is removed from fibrous glass or other non-asbestos insulated straight runs of pipe, remove fibrous material at least 6 inches from the point it contacts the ACM.

3.3 LOCKDOWN ENCAPSULATION

A. General: Lockdown encapsulation is an integral part of the ACM removal. At the conclusion of ACM removal and before removal of the primary barriers, the contractor shall encapsulate all surfaces with a bridging encapsulant.

B. Delivery and Storage: Deliver materials to the job site in original, new and unopened containers bearing the manufacturer's name and label as well as the following information: name of material, manufacturer's stock number, date of manufacture, thinning instructions, application instructions and the SDS for the material.

C. Worker Protection: Before beginning work with any material for which an SDS has been submitted, provide workers with any required personal protective equipment. The required personal protective equipment shall be used whenever exposure to the material might occur. In addition to OSHA/specification requirements for respiratory protection, a paint pre-filter and an organic vapor cartridge, at a minimum, shall be used in addition to the HEPA filter when an organic solvent based encapsulant or other solvent is used. The CPIH/CIH shall be responsible for provision of adequate respiratory protection. Note: Flammable and combustible encapsulants or solvents shall not be used, unless authorized in writing by the VA.

D. Encapsulation of Scratch Coat Plaster or Piping:

1. Apply two coats of lockdown encapsulant to the scratch coat plaster or piping after all ACM has been removed. Apply in strict accordance with the manufacturer's instructions. Any deviation from the instructions must be approved by the VA's representative in writing prior to commencing the work.
2. Apply the lockdown encapsulant with an airless sprayer at a pressure and using a nozzle orifice as recommended by the manufacturer. Apply the first coat while the scratch coat is still damp from the asbestos removal process, after passing the visual inspection. If the surface has been allowed to dry, wet wipe or HEPA vacuum prior to spraying with encapsulant. Apply a second coat over the first coat in strict conformance with the manufacturer's instructions. Color the lockdown encapsulant and contrast the color in the second coat so that visual confirmation of completeness and uniform coverage of each coat is possible. Adhere to the manufacturer's instructions for coloring. At the completion of the encapsulation, the surface must be a uniform third color produced by the mixture.

E. Sealing Exposed Edges: Seal edges of ACM exposed by removal work which is inaccessible, such as a sleeve, wall penetration, etc., with two coats of bridging encapsulant. Prior to sealing, permit the exposed edges to dry completely to permit penetration of the bridging encapsulant. Apply in accordance with 3.3.4 (B).

3.4 DISPOSAL OF ACM WASTE MATERIALS

A. General: Dispose of waste ACM and debris which is packaged in accordance with these specifications, in accordance with OSHA, EPA, State, Local and DOT requirements. The landfill requirements for packaging must also be met. Transport will be in compliance with 49 CFR 171-180 regulations. Disposal shall be done at an approved landfill. Disposal of non-friable ACM shall be done in accordance with applicable regulations.

B. Procedures:

1. The VA must be notified at least 24 hours in advance of any waste removed from the containment.
2. Asbestos waste shall be packaged and moved through the W/EDF into a covered transport container in accordance with procedures is this specification. Waste shall be double-bagged and wetted with amended water prior to disposal. Wetted waste can be very heavy. Bags shall not be overfilled. Bags shall be evacuated with HEPA vacuum and securely sealed to prevent accidental opening and/or leakage. The top shall be tightly twisted and goose necked prior to tightly sealing with at least three wraps of duct tape. Ensure that unauthorized persons do not have access to the waste material once it is outside the regulated area. All transport containers must be covered at all times when not in use. NESHAP signs must be on containers during loading and unloading. Material shall not be transported in open vehicles. If drums are used for packaging, the drums shall be labeled properly and shall not be re-used.
3. Waste Load Out: Waste load out shall be done in accordance with the procedures in W/EDF Decontamination Procedures. Sealed waste bags shall be decontaminated on exterior surfaces by wet cleaning and HEPA vacuuming before being placed in the second waste bag and sealed, which then must also be wet wiped and HEPA vacuumed.
4. Asbestos waste with sharp edged components, i.e., nails, screws, lath, strapping, tin sheeting, jacketing, metal mesh, etc., which might tear poly bags shall be wrapped securely in burlap before packaging and, if needed, use a poly lined fiber drum as the second container, prior to disposal.

3.5 PROJECT DECONTAMINATION

A. General:

1. The entire work related to project decontamination shall be performed under the close supervision and monitoring of the CPIH/CIH.
2. If the asbestos abatement work is in an area which was contaminated prior to the start of abatement, the decontamination will be done by cleaning the primary barrier poly prior to its removal and cleanings of the surfaces of the regulated area after the primary barrier removal.
3. If the asbestos abatement work is in an area which was uncontaminated prior to the start of abatement, the decontamination will be done by cleaning the primary barrier poly prior to its

removal, thus preventing contamination of the building when the regulated area critical barriers are removed.

B. Regulated Area Clearance: Clearance air testing and other requirements which must be met before release of the Contractor and re-occupancy of the regulated area space are specified in Final Testing Procedures.

C. Work Description: Decontamination includes the clearance air testing in the regulated area and the decontamination and removal of the enclosures/facilities installed prior to the abatement work including primary/critical barriers, PDF and W/EDF facilities, and negative pressure systems.

D. Pre-Decontamination Conditions:

1. Before decontamination starts, all ACM waste from the regulated area shall be collected and removed, and the loose 6-mil layer of poly removed while being adequately wetted with amended water and disposed of along with any gross debris generated by the work.
2. At the start of decontamination, the following shall be in place:
    a. Primary barriers consisting of 2 layers of 6-mil poly on the floor and 4 mil poly on the walls.
    b. Critical barriers consisting of 2 layers of 6-mil poly which is the sole barrier between the regulated area and openings to the rest of the building or outside.
    c. Decontamination facilities for personnel and equipment in operating condition and the negative pressure system in operation.

E. First Cleaning: Carry out a first cleaning of all surfaces of the regulated area including items of remaining poly sheeting, tools, scaffolding, ladders/staging by wet methods and HEPA vacuuming. Do not use dry dusting/sweeping/air blowing methods. Use each surface of a wetted cleaning cloth one time only and then dispose of as contaminated waste. Continue this cleaning until there is no visible residue from abated surfaces or poly or other surfaces. Remove all filters in the air handling system and dispose of as ACM waste in accordance with these specifications. The negative pressure system shall remain in operation during this time. Additional cleaning(s) may be needed as determined by the CPIH/VPIH/CIH.

F. Pre-Clearance Inspection and Testing: The CPIH/CIH and VPIH/CIH will perform a thorough and detailed visual inspection at the end of the cleaning to determine whether there is any visible residue in the regulated area. If the visual inspection is acceptable, the CPIH/CIH will perform pre-clearance sampling using aggressive clearance as detailed in 40 CFR 763 Subpart E (AHERA) Appendix A (III)(B)(7)(d). If the sampling results show values below 0.01 f/cc, then the Contractor shall notify the VA's representative of the results with a brief report from the CPIH/CIH documenting the inspection and sampling results and a statement verifying that the regulated area is ready for lockdown encapsulation. The VA reserves the right to utilize their own VPIH/CIH to perform a pre-clearance inspection and testing for verification.

G. Lockdown Encapsulation of Abated Surfaces: With the express written permission of the VA's representative, perform lockdown encapsulation of all surfaces from which asbestos was abated in accordance with the procedures in this specification. Negative pressure shall be maintained in the regulated area during the lockdown application.

3.6 FINAL VISUAL INSPECTION AND AIR CLEARANCE TESTING

A. General: Notify the VA representative 24 hours in advance for the performance of the final visual inspection and testing. The final visual inspection and testing will be performed by the VPIH/CIH starting after the final cleaning.

B. Final Visual Inspection: Final visual inspection will include the entire regulated area, the PDF, all poly sheeting, seals over HVAC openings, doorways, windows, and any other openings. If any debris, residue, dust or any other suspect material is detected, the final cleaning shall be repeated at no additional cost to the VA. Dust/material samples may be collected and analyzed at no additional cost to the VA at the discretion of the VPIH/CIH to confirm visual findings. When the regulated area is visually clean the final testing can be done.

C. Final Air Clearance Testing:

1. After an acceptable final visual inspection by the VPIH/CIH and VA Representative, the VPIH/CIH will perform the final clearance testing. Air samples will be collected and analyzed in accordance with procedures for AHERA in this specification. If work is less than 260 lf/160 sf/35 cf, 5 PCM samples shall be collected for clearance and a minimum of two field blank. If work is equal to or more than 260 lf/160 sf/35 cf, AHERA TEM sampling shall be performed for clearance. TEM analysis shall be done in accordance with procedures for EPA AHERA presented in this specification. If the release criteria are not met, the Contractor shall repeat the final cleaning and continue decontamination procedures until clearance is achieved. **All Additional inspection and testing costs will be borne by the Contractor**.
2. If release criteria are met, proceed to perform the abatement closeout and to issue the certificate of completion in accordance with these specifications.

D. Final Air Clearance Procedures:

1. Contractor's Release Criteria: Work in a regulated area is complete when the regulated area is visually clean and airborne fiber levels have been reduced to or below 0.01 f/cc as measured by the AHERA PCM protocol and < 70 AHERA asbestos structures per square millimeter (s/mm2) by AHERA TEM. No averaging of results will be used for this project. All five (5) TEM samples inside the regulated area shall be at or below 70 asbestos s/mm2 to satisfy the project final clearance criteria.
2. Air Monitoring and Final Clearance Sampling: To determine if the elevated airborne fiber counts encountered during abatement operations have been reduced to the specified level, the VPIH/CIH will secure samples and analyze them according to the following procedures:

a. Fibers Counted: “Fibers” referred to in this section shall be either all fibers regardless of composition as counted in the NIOSH 7400 PCM method or asbestos fibers counted using the AHERA TEM method.

b. Aggressive Sampling: All final air testing samples shall be collected using aggressive sampling techniques. Samples will be collected on 0.8µ MCE filters for PCM analysis and 0.45µ MCE for TEM. A minimum of 3850 Liters of air using calibrated sampling pumps shall be collected for PCM samples and a minimum of 1200 Liters of air using calibrated sampling pumps shall be collected for TEM clearance samples. Before pumps are started, initiate aggressive air mixing sampling as detailed in 40 CFR 763 Subpart E (AHERA) Appendix A (III)(B)(7)(d). Air samples will be collected in areas subject to normal air circulation away from corners, obstructed locations, and locations near windows, doors, or vents. After air sampling pumps have been shut off, circulating fans shall be shut off. The negative pressure system shall continue to operate.

E. Clearance Sampling Using PCM – Less than 260LF/160SF:

1. The VPIH/CIH will perform clearance samples as indicated by the specification.
2. The NIOSH 7400 PCM method will be used for clearance sampling with a minimum collection volume of 3850 Liters of air. A minimum of 5 PCM clearance samples shall be collected. All samples must be equal to or less than 0.01 f/cc or the highest level obtained from pre abatement sampling to clear the regulated area.

F. Clearance Sampling Using Tem – Equal to or more than 260LF/160SF: TEM

1. Clearance requires 13 samples be collected; 5 inside the regulated area; 5 outside the regulated area; and 3 field blanks.
2. The TEM method will be used for clearance sampling with a minimum collection volume of 1200 Liters of air. A minimum of 13 clearance samples shall be collected. All samples must be equal to or less than 70 AHERA structures per square millimeter (s/mm2) AHERA TEM, no averaging of results for this specific project.

G. Laboratory Testing of PCM Clearance Samples: The services of an AIHA accredited laboratory will be employed by the VA to perform analysis for the PCM air samples. The accredited laboratory shall be successfully participating in the AIHA Proficiency Analytical Testing (PAT) program. Samples will be sent daily by the VPIH/CIH so that verbal/faxed reports can be received within 24-36 hours. A complete record, certified by the laboratory, of all air monitoring tests and results will be furnished to the VA’s representative and the Contractor.

H. Laboratory Testing of TEM Samples: Samples shall be sent by the VPIH/CIH to a NIST NVLAP accredited laboratory for analysis by TEM. The laboratory shall be successfully participating in the NIST Airborne Asbestos Analysis (TEM) program. Verbal/faxed results from the laboratory shall be available within 24-36 hours after receipt of the samples. A complete record, certified by the laboratory, of all TEM results shall be furnished to the VA's representative and the Contractor.

I. Laboratory Testing of Bulk Samples: Samples shall be sent by the VPIH/CIH or CPIH/CIH to a NIST NVLAP accredited laboratory for analysis by PLM. The laboratory shall successfully participate in the NIST NVLAP Bulk Asbestos Analysis (PLM) program. Verbal/faxed results from the laboratory shall be available within 24-36 hours after receipt of the samples. A complete record, certified by the laboratory, of all PLM and/or TEM results shall be furnished to the VA's representative and the Contractor.

3.7 ABATEMENT CLOSEOUT

A. Completion of Abatement Work:
   1. After thorough decontamination, seal negative air machines with 2 layers of 6-mil poly and duct tape to form a tight seal at the intake/outlet ends before removal from the regulated area. Complete asbestos abatement work upon meeting the regulated area visual and air clearance criteria and fulfilling the following:
      a. Remove all equipment and materials from the project area.
      b. Dispose of all packaged ACM waste as required.
      c. Repair or replace all interior finishes damaged during the abatement work, as required.
      d. Fulfill other project closeout requirements as required in this specification.

B. Work Shifts: All work shall generally be done during administrative hours (7:00 AM to 5:00 PM) Monday - Friday excluding Federal Holidays. Any change in the work schedule must be approved in writing by the VA Representative.

C. Re-Insulation: If required as part of the contract, replace all asbestos containing insulation with suitable non-asbestos material. Provide SDS’s for all replacement materials in advance of installation for VA approval. Refer to Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION.

ATTACHMENT #1
CERTIFICATE OF WORKER'S ACKNOWLEDGMENT

PROJECT NAME:_____ DATE:_____

PROJECT ADDRESS:_____

ABATEMENT CONTRACTOR'S NAME:_____

WORKING WITH ASBESTOS CAN BE HAZARDOUS TO YOUR HEALTH. INHALING ASBESTOS HAS BEEN LINKED WITH VARIOUS TYPES OF CANCERS. IF YOU SMOKE AND INHALE ASBESTOS FIBERS, YOUR CHANCES OF DEVELOPING LUNG CANCER IS GREATER THAN THAT OF THE NON-SMOKING PUBLIC.

Your employer's contract with the owner for the above project requires that: You must be supplied with the proper personal protective equipment including an adequate respirator and be trained in its use. You must be trained in safe and healthy work practices and in the use of the equipment found at an asbestos abatement project. You must receive/have a current medical examination for working with asbestos. These things shall be provided at no cost to you. By signing this certificate of worker's acknowledgement you are indicating to the owner that your employer has met these obligations.

RESPIRATORY PROTECTION: I have been trained in the proper use of respirators and have been informed of the type of respirator to be used on the above indicated project. I have a copy of the written Respiratory Protection Program issued by my employer. I have been provided for my exclusive use, at no cost, with a respirator to be used on the above indicated project.

TRAINING COURSE: I have been trained by a third party, State/EPA accredited trainer in the requirements for an AHERA/OSHA Asbestos Abatement Worker training course, 32-hours minimum duration. I currently have a valid State accreditation certificate. The topics covered in the course include, as a minimum, the following:

Physical Characteristics and Background Information on Asbestos
Potential Health Effects Related to Exposure to Asbestos
Employee Personal Protective Equipment
Establishment of a Respiratory Protection Program
State of the Art Work Practices
Personal Hygiene
Additional Safety Hazards
Medical Monitoring
Air Monitoring
Relevant Federal, State and Local Regulatory Requirements, Procedures, and Standards
Asbestos Waste Disposal

MEDICAL EXAMINATION: I have had a medical examination within the past 12 months which was paid for by my employer. This examination included: health history, occupational history, pulmonary function test, and may have included a chest x-ray evaluation. The physician issued a positive written opinion after the examination.

Signature:_____

Printed Name:_____

Social Security Number:_____

Witness:_____

ATTACHMENT #2
AFFIDAVIT OF MEDICAL SURVEILLANCE, RESPIRATORY PROTECTION AND TRAINING/ACCREDITATION

VA PROJECT NAME AND NUMBER:_____

VA MEDICAL FACILITY:_____

ABATEMENT CONTRACTOR'S NAME AND ADDRESS:_____

1. I verify that the following individual

Name:_____ Social Security Number:_____
who is proposed to be employed in asbestos abatement work associated with the above project by the named Abatement Contractor, is included in a medical surveillance program in accordance with 29 CFR 1926.1101(m), and that complete records of the medical surveillance program as required by 29 CFR 1926.1101(m)(n) and 29 CFR 1910.20 are kept at the offices of the Abatement Contractor at the following address.

Address:_____

2. I verify that this individual has been trained, fit-tested and instructed in the use of all appropriate respiratory protection systems and that the person is capable of working in safe and healthy manner as expected and required in the expected work environment of this project.

3. I verify that this individual has been trained as required by 29 CFR 1926.1101(k). This individual has also obtained a valid State accreditation certificate. Documentation will be kept on-site.

4. I verify that I meet the minimum qualifications criteria of the VA specifications for a CPIH.

Signature of CPIH/CIH:_____ Date:_____

Printed Name of CPIH/CIH:_____

Signature of Contractor:_____ Date:_____

Printed Name of Contractor:_____

ATTACHMENT #3
ABATEMENT CONTRACTOR/COMPETENT PERSON(S) REVIEW AND ACCEPTANCE OF THE VA'S ASBESTOS SPECIFICATIONS

VA Project Location:_____

VA Project #:_____

VA Project Description:_____

1. This form shall be signed by the Asbestos Abatement Contractor Owner and the Asbestos Abatement Contractor's Competent Person(s) prior to any start of work at the VA related to this Specification. If the Asbestos Abatement Contractor's/Competent Person(s) has not signed this form, they shall not be allowed to work on-site.

2 I, the undersigned, have read VA's Asbestos Specification regarding the asbestos abatement requirements. I understand the requirements of the VA's Asbestos Specification and agree to follow these requirements as well as all required rules and regulations of OSHA/EPA/DOT and State/Local requirements. I have been given ample opportunity to read the VA's Asbestos Specification and have been given an opportunity to ask any questions regarding the content and have received a response related to those questions. I do not have any further questions regarding the content, intent and requirements of the VA's Asbestos Specification.

3. At the conclusion of the asbestos abatement, I will certify that all asbestos abatement work was done in accordance with the VA's Asbestos Specification and all ACM was removed properly and no fibrous residue remains on any abated surfaces.

Abatement Contractor Owner's Signature_____Date_____

- - - E N D - - -

8001 Baymeadows Way Suite 1
Jacksonville, Florida 32256
P 904-900-6494
TERRACON.COM

February 16, 2024

RDC/John Poe Architects
116 E. 3rd Street
Dayton, Ohio 45402-2130

Attn: Mr. Ken Raiteri
Project Manager
Cell: 800-362-1523
Email: KRAITERI@RDCJOHNPOE.COM

RE: Asbestos and Lead Paint Survey Report
Department of Veterans Affairs Medical Center
1601 SW Archer Rd
Gainesville, Florida 32608
Terracon Project EQ227408

Dear Mr. Raiteri:

Terracon Consultants, Inc. (Terracon) is pleased to provide RDC/John Poe Architects (client) with this report regarding asbestos and lead surveys conducted at the above-referenced site. The survey activities were limited to areas denoted in drawings (designated areas) provided by you to Terracon. The drawings were amended versions of drawings initially provided to Terracon for the preparation of our proposal. A description of survey activities and other project-related documents are contained in the attached report and appendices.

Asbestos was identified in 36 samples of 12 materials obtained from 103 materials in the designated areas. Lead was assumed present in one sample of paint and identified in 10 samples of paint which were collected from 69 testing combinations in the designated areas.

We appreciate the opportunity to be of service to you on this project. If there are any questions concerning the report, or if we may be of further assistance, please contact Pete Thompson at 904-330-4405 or Pete.Thompson@Terracon.Com.

Sincerely,
Terracon Consultants, Inc.
Asbestos Business License ZA337

P. Thompson

Peter Thompson
AHERA Certified Building Inspector
Certificate # 240081-1896

Mark Fricke, CIH, CSP
FL Licensed Asbestos Consultant
License AX132

Asbestos and Lead Survey Report

Department of Veterans Affairs Medical Center
Malcom Randall VA Hospital
1601 SW Archer Road,
Gainesville, Florida 32608

February 16, 2024
Terracon Project EQ227237

Prepared for:

RDC/John Poe Architects
Dayton, Ohio

Prepared by:

Terracon Consultants, Inc
Jacksonville, Florida

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ASBESTOS AND LEAD PAINT SURVEY
MALCOM RANDALL MEDICAL CENTER
1601 SOUTHWEST ARCHER ROAD
GAINESVILLE, FLORIDA 32608
FEBRUARY 16, 2024
TERRACON PROJECT EQ227237

1.0 INTRODUCTION

Terracon Consultants, Inc. (Terracon) conducted a limited pre-renovation asbestos survey and a limited paint survey for lead paint in the designated areas. The surveys were limited to materials in the Path of Construction (POC) of the hospital's upcoming EHRM project. Terracon performed the surveys on various days between December 16, 2023 and January 24, 2024. Several scheduling delays occurred which were outside Terracon's control such as extended unavailability of required hospital-provided escorts over the Christmas and New Year holidays and general unavailability of the only qualified hospital-provided escort.

The limited asbestos survey was conducted by Mr. Ron Cooperwood, an Asbestos Hazard Emergency Response Act (AHERA)-accredited building inspector. A copy of Mr. Cooperwood's asbestos inspector certificate is attached as Appendix D.

The limited survey of paint for lead content was conducted by Mr. Ron Cooperwood. Mr. Cooperwood is a U.S. Environmental Protection Agency (EPA)-certified lead paint inspector. A copy of Mr. Cooperwood's lead paint inspector certificate is attached as Appendix D.

The limited surveys were performed based on information and drawings provided by the client and included six floors in Building 1, Buildings 11, 12, 14, 28, 30 and Buildings BT-01A, BT-02 to BT11. The interior building components from the designated areas were surveyed and homogeneous areas of suspect asbestos-containing materials (ACM) and applicable painted surfaces were visually identified and documented.

Although reasonable effort was made to survey all accessible suspect materials, additional suspect but un-sampled materials could be located in walls, in voids or in other concealed areas.

1.1 Project Objective

Terracon understands the purpose of these surveys was to provide information to the client regarding asbestos and lead content in materials likely to be disturbed during the installation of data lines and modification of some rooms to become data rooms. EPA regulation 40 CFR 61, Subpart M, NESHAP, prohibits the release of asbestos fibers to the atmosphere during renovation or demolition activities. The asbestos NESHAP requires that potentially regulated asbestos-containing building materials be identified, classified, and quantified prior to planned disturbances or demolition activities. Suspect ACM samples were collected in general accordance with the sampling protocols outlined in EPA AHERA regulation, 40 CFR 763.86. Samples were delivered to an accredited laboratory for analysis by Polarized Light Microscopy (PLM).

The OSHA Lead in Construction standard 29 CFR 1926.62 regulates lead paints or coatings that are disturbed during construction or renovation activities. Paint and coatings with the potential to contain lead were identified visually by surface color and sampled by scraping to the substrate. Samples were delivered to an accredited laboratory for analysis by Flame Atomic Absorption.

2.0 BUILDING DESCRIPTION

The designated areas comprise 17 structures which were constructed at different times which form the main structure and satellite buildings of various unknown construction dates. Uses of the buildings and included areas ranged from medical uses to administration, workshop, mechanical and support services. Typical interior building components from the designated areas consisted of drywall systems, drop-in ceiling tiles and vinyl floor tiles (VFT), ceramic floor and wall tiles and associated beddings, grouts, and thinset, cove bases (with associated adhesives), resilient sheet flooring, fire stop putties, mastics, and caulks. Building materials which were visually similar but installed in known different locations were considered to be the same materials by our inspector unless evidence to the contrary was available.

3.0 FIELD ACTIVITIES

Terracon were present at the site to conduct the surveys on eight days between December 16, 2023, and January 24, 2024. A summary of survey activities is provided below.

3.1 Asbestos Survey Activities

The survey was conducted in general accordance with the sample collection protocols established in EPA regulation AHERA, 40 CFR 763.86. Our survey activities began with visual observation of the interior building components from the designated areas to identify apparent homogeneous areas of suspect ACM. A homogeneous area consists of building materials that appear similar throughout in terms of color, texture and date of application. The assessment was conducted throughout visually accessible areas of the designated work area. Building materials identified as glass, wood, metal or rubber are not considered suspect ACM. Concrete was not expected to be included in renovation activities and was not included in the survey.

Terracon lifted floor coverings in selected locations and did not observe additional floor coverings/layers except as noted in the report. However, as Terracon could not assess beneath all flooring areas due to the restrictions listed above, there may be areas of additional suspect material present beneath floor coverings.

3.2 Physical Assessment

A physical assessment of each homogeneous area of suspect ACM was conducted to assess the friability and condition of the materials. A friable material is defined by the EPA as a material which can be crumbled, pulverized, or reduced to powder by hand pressure when dry. Friability was assessed by observation and by physically touching suspect materials.

3.3 Sample Collection

Based on results of the visual observation, bulk samples of suspect ACM were collected in general accordance with AHERA sampling protocols. Random samples of suspect materials were collected in each homogeneous area. Samples were collected using wet methods as applicable to reduce the potential for fiber release. Samples were placed in sealable containers and labeled with unique sample numbers using an indelible marker.

A total of 317 bulk samples from the designated areas were collected from 103 homogeneous areas (HAs) of suspect ACM from the designated areas. A listing of suspect ACM observed and sampled from the designated areas during the survey can be found in Appendix A.

3.4 Sample Analysis

Bulk samples were submitted under chain of custody to Cates Labs (Cates) in Dallas, Texas, for analysis by Polarized Light Microscopy per EPA methodology EPA/600/R-93/116. The percentage of asbestos, where applicable, was determined by microscopic visual estimation or point counting. Cates is accredited by the National Institute for Science and Technology (NIST) under the National Voluntary Laboratory Accreditation Program (NVLAP) for bulk-asbestos sample analysis.

3.5 Paint Containing Lead Survey Activities

Terracon performed a visual assessment to identify suspect lead containing paint (LCP) and document the general location of the materials and the condition of the materials, including noting areas of damaged, peeling, or flaking paint. Terracon collected representative paint chip samples of applicable suspect coatings identified on surfaces in the designated areas. A summary of LCP sampling activities is provided below.

3.6 Sample Collection

Terracon collected 69 suspect LCP chip samples from different color/substrate testing combinations the structure. Samples were placed in sealable containers and labeled with unique sample numbers using an indelible marker. Sample locations were chosen to include unique color/substrate combinations.

3.7 Sample Analysis

Paint sampling included visual observations of applicable coated surfaces (i.e., paints, varnishes) to identify potential LCP-coated components and to collect paint chip samples. Samples were submitted to EMSL Analytical of Orlando, Florida for analysis by EPA Methods SW-846 3050B Acid Digestion of Sediments, Sludges, and Soils and 7000B Flame Atomic Absorption Spectrophotometry. EMSL is accredited by the AIHA® Laboratory Accreditation Programs, LLC under the Environmental Lead Laboratory Accreditation Program (ELLAP).

4.0 Regulatory Review

The asbestos NESHAP (40 CFR Part 61, Subpart M) regulates asbestos fiber emissions and asbestos waste disposal practices. It also requires the identification and classification of existing building materials prior to demolition or renovation activity. Under NESHAP, asbestos-containing building materials are classified as either friable, Category I non-friable or Category II non-friable ACM. Friable materials are those that, when dry, may be crumbled, pulverized or reduced to powder by hand pressure. Category I non-friable ACM includes packings, gaskets, resilient floor coverings and asphalt roofing products containing more than 1% asbestos. Category II non-friable ACM are any materials other than Category I materials that contain more than 1% asbestos.

Friable ACM, Category I and Category II non-friable ACM which is in poor condition and has become friable or which will be subjected to drilling, sanding, grinding, cutting or abrading and which could be crushed or pulverized during anticipated renovation or demolition activities is considered regulated ACM (RACM).

In the State of Florida, asbestos activities are regulated by the Florida Department of Environmental Protection (FDEP). RACM must be removed prior to renovation or demolition activities which will disturb the materials. The owner or operator must provide the FDEP with written notification of asbestos abatement activities and/or planned demolition activities at least 10 working days prior to the commencement of such activities.

The U.S. Occupational Safety and Health Administration (OSHA) Asbestos standard for construction (29 CFR 1926.1101) regulates workplace exposure to asbestos. The OSHA standard requires that employee exposure to airborne asbestos fibers be maintained at or below 0.1 asbestos fibers per cubic centimeter of air (0.1 f/cc) as an eight-hour time weighted average (TWA) and not exceed 1.0 fibers per cubic centimeter of air (1.0 f/cc) over a 30-minute time period known as an excursion limit (EL). The TWA and EL are known as OSHA's permissible exposure limits (PELs). The OSHA standard classifies construction and maintenance activities which could disturb ACM and specifies work practices and precautions which employers must follow when engaging in each class of regulated work. States which administer their own federally-approved state OSHA programs may require additional precautions.

OSHA regulations governing exposure to airborne lead can be found in 29 CFR 1910.1925 and 29 CFR 1926.62. This regulation establishes a permissible exposure limit (PEL) of 50 µg/m^3 of lead over an eight-hour time-weighted-average for all employees covered. The standard also sets an action level of 30 µg/m^3, at which an employer must begin specific compliance activities. The OSHA standard prescribes worker protection requirements and precautions which employers must follow when engaging in lead activities.

5.0 FINDINGS AND RECOMMENDATIONS

5.1 Asbestos

Asbestos was detected in 36 samples of 12 materials obtained from 317 samples collected from 103 homogeneous areas in the 17 structures in the designated areas. The identified asbestos-containing materials are listed in Table 1 below and in Appendix A. The asbestos laboratory analytical report and chain-of-custody are provided in Appendix B. Photographs of identified asbestos containing material are provided in Appendix C. The Inspector Certification is provided in Appendix D.

Laboratory analysis identified asbestos in samples of the following materials in the table on the following page:

IDENTIFIED ASBESTOS-CONTAINING MATERIALS

HA	Material Description	Sampled Locations	NESHAP Category	Estimated Quantity of ACM	Asbestos Content and Type
1	9" X 9" VFT/Mastic	A027 Floor 1, A441 Floor 4, H543 Floor 5	CAT I NF	800 SF	Tile: Chrysotile 2% Mastic: Chrysotile 5%
3	Texture on Plaster Drywall Ceiling	A027 Floor 1	RACM	300 SF	Chrysotile 2%
11	12" X 12" VFT/Mastic White/Grey	A030-1 Basement A132 Floor 1 EB51A-1 Basement	CAT I NF	800 SF	Tile: Chrysotile 2% Mastic: Chrysotile 5%
12	Brown 9" X 9"/VFT Mastic	B050C-1, A132A	CAT I NF	300 SF	Tile: Chrysotile 2% Mastic: Chrysotile 5%
17	Mastic associated with 3 X 3' Vinyl Sheeting	EB83-1	CAT II NF	300 SF	Chrysotile 5%
19	Off-White Mastic on ceiling ducts	EB83-1, E449-1	CAT II NF	60 SF	Chrysotile 5%
24	Off-White Mastic on fiberglass ceiling ducts	A027-1 Floor 1	CAT II NF	60 SF	Chrysotile 3%
29	Black Mastic Pipe under ceiling	A263A-1 Floor 1, A341-1 Floor 3	CAT II NF	120 SF	Chrysotile 5%
40	White Mastic 6"-8" Ceiling Pipe	E261-1 Floor 2, A341 Floor 3, E458A Floor 4	CAT II NF	100 SF	Chrysotile 20%
50	Black Mastic Wall	Building 14 122-14, Building 14 106-4, Building 14 106-14	CAT II NF	400 SF	Chrysotile 10%
51	White Mastic Fiberglass Duct Insulation on ceiling	Building 14 122-14, Building 14 106-14	CAT II NF	60 SF	Chrysotile 20%
60	White Mastic Fiberglass Duct Insulation on ceiling	Building 11 117	CAT II NF	60 SF	Chrysotile 20%

Asbestos Recommendations

- The flooring materials - HAs 1, 11, 12, 17 are Category I Non-Friable (CAT I NF) ACM in good to fair condition. Per F.S. 469 removal of the ACM is required to be performed by a Licensed Asbestos Abatement Contractor as an OSHA Work Class II activity and in compliance with OSHA regulations as contained in 29 CFR 1926.1101 which require specialized training, work practices, exposure assessments, disposal, engineering controls, and waste handling.
- The various mastics – HAs 19, 24, 29, 40, 50, 51, 60 are Category II Non-Friable (CAT II NF) ACM in good condition which if disturbed such as during any renovation activities are likely to become friable. Per F.S. 469 removal of the ACM is required to be performed by a Licensed Asbestos Abatement Contractor as an OSHA Work Class II activity and in compliance with OSHA regulations as contained in 29 CFR 1926.1101 which require specialized training, work practices, exposure assessments, disposal, engineering controls, and waste handling.
- The ceiling treatment – HA 3 is a regulated asbestos containing material (RACM) in good condition which if disturbed such as during any renovation activities may present a danger to the health of the general public. Per F.S. 469 removal of the ACM must be performed by a Licensed Asbestos Abatement Contractor as an OSHA Class 1 activity and in compliance with OSHA regulations as contained in 29 CFR 1926.1101 which require specialized training, work practices, exposure assessments, disposal, engineering controls, and waste handling.

It should be noted that suspect materials, other than those identified during the interior NESHAP survey, may exist within the designated areas of the building. If suspect materials other than those which were identified during this survey are discovered prior to or during the renovation process, those materials should be assumed to be asbestos-containing until sampling and analysis can establish the presence or absence of asbestos. In particular, black mastic on flooring or associated with floor tiles should be assumed to be ACM and abated appropriately.

5.2 Lead Paint Findings

Detectable levels of lead were identified in 10 samples of paint and assumed present in one further sample which were collected from the designated areas. The identified lead-containing paints are listed in the table on the following page and in Appendix A. The laboratory analytical report and chain of custody are provided in Appendix B. Photographs of lead paint surfaces are provided in Appendix C. The Inspector Certification is provided in Appendix D.

The painting history of a given location in an older building often will vary from point to point due to such factors as variability in paints used, paint film thickness, variable retention of older paint layers before repainting, demolition/installation of walls during renovations, and unknown historic non-homogenous painting schemes. As such, a given color and building component combination that is apparent to our inspector may not provide consistent testing results for lead.

IDENTIFIED LEAD CONTAINING PAINT

Sample #	Color	Substrate	Locations	Lead content % wt.
1	Light Gray	Metal	Basement Door Frame	0.14 % wt.
7	Gray	Wood	Basement Wall	0.27% wt.
21	Off White	Wood	Floor 1 Door	0.019% wt.
34	Light Gray	Wood	Floor 2 Door	0.12% wt.
35	Light Gray	Metal	Floor 2 Door Frame	1.1% wt.
45	Off White	Metal	Door Frame	0.13% wt.
46	Off White	Metal	Door	0.048% wt.
52	Light Blue	Metal	Door Frame	0.017% wt.
54	Off White	Metal	Door Frame	0.043% wt.
62	*Brown*	*Metal*	*Door Frame*	*<0.013% wt.*

Note: Sample 62 should be assumed to be lead containing paint due to an insufficient amount of substrate collected

5.3 Lead Paint Recommendations

The identified lead-containing coatings associated with the above locations were all in good to fair condition at the time of our survey. Terracon recommends that contractors performing work in these locations be made aware of the results of this survey. Contractors must comply with the OSHA Lead in Construction standard 29 CFR 1926.62 when disturbing paints or coatings with detectable concentrations of lead.

The above is not a comprehensive survey of all coated surfaces in the building. Coatings on building components similar to identified lead-coated components should also be treated as lead coatings unless specific testing results prove otherwise, regardless of surface color, as lead coating layers are often not the top (visible) layer.

6.0 GENERAL COMMENTS

The hospital was in full operation during our survey and several areas which may potentially contain suspect asbestos or lead containing materials were inaccessible for sampling for reasons such as patient privacy, overcrowded and cluttered offices, the presence of immovable equipment, or physical inaccessibility given the restrictive surroundings. All of the areas included in the survey were locked—Terracon was provided with an escort by the hospital in order to gain admittance or obtain approval to enter required spaces. Each room in the designated areas and identified in the client's request was accessed.

This asbestos survey was conducted in a manner consistent with the level of care and skill ordinarily exercised by members of the profession currently practicing under similar conditions in the same locale. The results, findings, conclusions, and recommendations expressed in this report are based on conditions observed during our survey of the building. The information contained in this report is

relevant to the date on which this survey was performed and should not be relied upon to represent conditions at a later date. This report has been prepared on behalf of and exclusively for use by the client for specific application to their project as discussed. This report is not a bidding document. Contractors or consultants reviewing this report must draw their own conclusions regarding further investigation or remediation deemed necessary. Terracon does not warrant the work of regulatory agencies, laboratories or other third parties supplying information which may have been used in the preparation of this report. No warranty, express or implied is made.

APPENDIX A

ASBESTOS SAMPLE SUMMARY

LEAD PAINT SAMPLE SUMMARY

Identified Suspect Asbestos Containing Materials

HA	Material Description	Location	Asbestos Type and Content	NESHAP/ OSHA Class	Estimated Quantity of ACM (SF)
1	9" X 9" VFT/Mastic Brown Floor	Floor 1, A027 Floor 4, A441 Floor 5, H543	Chrysotile 2% Floor Tile Chrysotile 5% Black Mastic	CAT I NF Class 2	800
2	6" Beige Cove Base Wall	Floor 1, A027 Floor 1, A030 Floor 2, A132	NAD	-	-
3	Plaster Drywall Ceiling	Floor 1, A027 Floor 1, A027 Floor 5, H543	Chrysotile 2% Paint Texture	RACM Class 1	300
4	Red Firestop Wall	Floor 1, A027 Floor 2, C263A, E156 Floor 4, J441-1	NAD	-	-
5	2" X 2" Ceramic Tile Thinset/Grout	Floor 1, A027 Basement, C070-1 Floor 2, A210-1	NAD	-	-
6	Plaster Wall	Floor 1, A027 Floor 1, A030-1 Floor 1, A030-1 Floor 5, H543 Floor 5, H543	NAD	-	-
7	2' X 4' Pinhole Ceiling Tile Small Holes Fissure	Ceiling, Floor 1, A027 Basement, B050C Basement, B050C	NAD	-	-
8	Tan Mastic/Ceiling Duct	Floor 1, A027 Floor 1, A027 Floor 1, A027	NAD	-	-
9	2' X 2' Ceiling Tile Pinhole/Fissure	Floor, A030-1 Basement, B050C Interview Room	NAD	-	-
10	2' X 4' Ceiling Tile Fissure 1" Ceiling	Basement, B050C-1 Floor 4, E447 Floor 4, E449	NAD	-	-
11	12" X 12" VFT/Mastic White/Grey	Basement, A030-1 Floor 1, A132 Basement, EB51A-1	Chrysotile 2% Floor Tile 2 Chrysotile 5% Black Mastic	CAT I NF Class 2	800
12	Adhesive Carpet/Sub-Layer Brown 9" X 9"/VFT Mastic	Basement, B050C-1 A132A A132A	Chrysotile 2% Floor Tile Chrysotile 5% Black Mastic	CAT I NF Class 2	300
13	2" X 2" Ceramic Tile Pink/White Floor Thinset/Grout	Basement, C070-11 Basement, EB51A Floor 4, J427-1	NAD	-	-
14	Black Mastic 4"-5" Drainpipe Ceiling	C070-1 Floor 1, C263A Floor 3, A341	NAD	-	-
15	Tape/Mastic Duct/AC	Boiler Room Boiler Room Boiler Room	NAD	-	-

Identified Suspect Asbestos Containing Materials

HA	Material Description	Location	Asbestos Type and Content	NESHAP/ OSHA Class	Estimated Quantity of ACM (SF)
16	Mortar Wall	Basement, A027 Boiler Room Boiler Room	NAD	-	-
17	3" X 3" Vinyl Sheeting Flooring/Mastic	EB83-1 EB83-1 EB83-1	Chrysotile 5% Black Mastic	CAT I NF Class 2	300
18	6" Brown Cove Base Wall	Basement, EB83-1 Floor 4, A441-1 Floor 5, A543-1	NAD	-	-
19	Off-White Mastic Fiberglass Metal Duct Ceiling	EB83-1 Floor 4, E449-1 Floor 4, E449-1	Chrysotile 5%	CAT II NF Class 2	60
20	6" Grey Cove Base	Basement, EB51A-1 Floor 1, E156-1 Floor 1, E156-1	NAD	-	-
21	Drywall/Joint Compound Wall	Basement, EB51A-1 Basement, FB14-1 Floor 4, E447 Floor 1, H133-1 Floor 1, E156-1 Floor 1, J14D Floor 2, H239-1 Floor 3, H339 Floor 4, J441	NAD	-	-
22	2' X 2' Small Smooth Hole Ceiling Tile	Basement, EB51A-1 Floor 1, J140 E523	NAD	-	-
23	4" Grey Cove Base Adhesive Wall	Basement, FB28K Floor 1, F122 Floor 1, FB14-1	NAD	-	-
24	Off-White Mastic Fiberglass Duct Ceiling	Floor 1, A027-1 Floor 1, A027-1 Floor 1, A027-1	Chrysotile 3%	CAT II NF Class 2	60
25	Wallpaper Adhesive	Basement, B0506-1 Basement, B0506-1 Basement, B0506-1	NAD	-	-
26	6" Beige Cove Base Wall	Floor 1, A132-1 Floor 1, A132-1 Floor 1, A132-1	NAD	-	-
27	12" X 12" VFT White/Mastic Grey	Floor 1, A132-1 Floor 1, G161-1 Floor 1, G161-1	NAD	-	-
28	12" X 12" VFT/Mastic Cream	Floor 1, A263A-1 Floor 1, A305 Floor 4, E449-1	NAD	-	-

Identified Suspect Asbestos Containing Materials

HA	Material Description	Location	Asbestos Type and Content	NESHAP/ OSHA Class	Estimated Quantity of ACM (SF)
29	Black Mastic Pipe Ceiling	Floor 1, A263A-1 Floor 3, A341-1 Floor 3, A341-1	Chrysotile 5%	CAT II NF Class 2	120
30	Resilient Sheet Flooring Grey	Floor 1, C263-1 Floor 1, C263-1 Floor 1, C263-1	NAD	-	-
31	Drywall/Joint Compound Ceiling	Floor 1, C263-1 Floor 1, A027 Floor 1, A027	NAD	-	-
32	Mastic White/Wrap 6"-8" Pipe Ceiling	Floor 1, D311A Floor 1, D311A Floor 1, D311A	NAD	-	-
33	Brown Firestop	Brown Firestop, D311-A Floor 4, H439-1 Floor 4, H439-1	NAD	-	-
34	Pink Firestop	Floor 1, E156-1 Floor 2, J241 Floor 3, H339-1	NAD	-	-
35	Grey Mastic Ceiling Duct	Floor 1, E156-1 Floor 4, J427-1 Floor 4, J427-1	NAD	-	-
36	4" Beige Cove Base	Floor 1, J138-1 Floor 3, A305 Floor 4, A402-1	NAD	-	-
37	2' X 2' Drop-in Ceiling Tile	Floor 1, J121-1 Floor 2, H235-1 Floor 2, J227-1	NAD	-	-
38	4" Ceramic Floor Tile Tan Thinset/Grout	Floor 1, J140-1 Floor 1, J140-1 Floor 1, J140-1	NAD	-	-
39	6" Ceramic Wall Tile Tan Thinset/Grout	Floor 1, J140-1 Floor 1, J140-1 Floor 1, J140-1	NAD	-	-
40	White Mastic Adhesive Wrap 6"-8" Pipe Ceiling	Floor 2, E261-1 Floor 3, A341 Floor 4, E458A	Chrysotile 20%	CAT II NF Class 2	100
41	Brown Mastic/Adhesive Wall	Floor 3, A241 Floor 3, A241 Floor 3, A241	NAD	-	-
42	Joint Compound Wall	Floor 3, A241 Floor 3, A241 Floor 3, A241	NAD	-	-
43	Plank Floor Adhesive 4' X 6" Floor	Floor 2, A2101-1 Floor 2, J227-1 Floor 3, J227-1, H2351	NAD	-	-

Identified Suspect Asbestos Containing Materials

HA	Material Description	Location	Asbestos Type and Content	NESHAP/ OSHA Class	Estimated Quantity of ACM (SF)
44	6" Black Cove Base Wall/Adhesive	Floor 2, H235-1 Floor 3, A341 Floor 3, E357A-1	NAD	-	-
45	Wallpaper/Adhesive	Floor 3, A-341 Floor 3, A-341 Floor 3, A-341	NAD	-	-
46	Yellow Mastic Computer Floor	Floor 4, E449-1 Floor 4, E449-1 Floor 4, E449-1	NAD	-	-
47	Grey Mastic Floor Support Stand	Floor 4, E449-1 Floor 4, E449-1 Floor 4, E449-1	NAD	-	-
48	6" X 3' Dark Plank Flooring/Adhesive	Floor 4, H425-1 Floor 4, H425-1 Floor 4, H425-1	NAD	-	-
49	2' X 4' Ceiling Tile Pinhole & Fissure	Floor 5, E503-1 Floor 5, E503-1 Floor 5, E503-1	NAD	-	-
50	Black Mastic Wall	Building 14, 122-14 Building 14, 106-4 Building 14, 106-14	Chrysotile 10%	CAT II NF Class 2	400
51	White Mastic Fiberglass Duct Insulation Ceiling	Building 14, 122-14 Building 14, 106-14 Building 14, 106-14	Chrysotile 20%	CAT II NF Class 2	60
52	2' X 2' Ceiling Tile Pinhole & Fissure Ceiling	Building 14, 122-14 Building 14, 122-14 Building 14, 122-14	NAD	-	-
53	Drywall/Joint Compound Wall	Building 14, 122-14 Building 14, 106-14 Building 14, 106-14	NAD	-	-
54	6" Cove Base Beige/Adhesive	Building 14, 122-14 Building 14, 122-14 Building 14, 122-14	NAD	-	-
55	12" X 12" VFT Mastic	Building 14, 122-14 Building 14, 122-14 Building 14, 122-14	NAD	-	-
56	2' X 4' Ceiling Tile Pinhole & Fissure Ceiling	Building 14, 106-14 Building 14, 106-14 Building 14, 106-14	NAD	-	-
57	6" Cove Base Black/Adhesive	Building 14, 106-14 Building 14, 106-14 Building 14, 106-14	NAD	-	-
58	6" X 3' Vinyl Plank Brown Flooring	Building 14, 106-14 Building 14, 106-14 Building 14, 106-14	NAD	-	-

Identified Suspect Asbestos Containing Materials

HA	Material Description	Location	Asbestos Type and Content	NESHAP/ OSHA Class	Estimated Quantity of ACM (SF)
59	2' X 4' Ceiling Tile Pinhole & Fissure	Building 14, 117 Building 14, 117 Building 14, 117	NAD	-	-
60	White Mastic Fiberglass Duct Insulation Ceiling	Building 11, 117 Building 11, 117 Building 11, 117	Chrysotile 20%	CAT II NF Class 2	60
61	Drywall/Joint Compound Wall	Building 11, 117 Building 11, 117 Building 11, 117	NAD	-	-
62	4" Cove Base/Adhesive Wall	Building 11, 117 Building 11, 117 Building 11, 117	NAD	-	-
63	12" X 12" VFT Mastic Reddish Brown Streaks Floor	Building 11, 117 Building 11, 117 Building 11, 117	NAD	-	-
64	4"-6" Pipe White Mastic Ceiling	Building 11, 117 Building 11, 117 Building 11, 117	NAD	-	-
65	Plaster Ceiling	Building 11, 117 Building 11, 117 Building 11, 117	NAD	-	-
66	Red Fire Putty	Building 11, 117 Building 11, 117 Building 11, 117	NAD	-	-
67	Plaster Ceiling	Building 11, 117 Building 11, 117 Building 11, 117	NAD	-	-
68	Pink Fire Putty	Building 11, Closet 117 Building 11, Closet 117 Building 11, Closet 117	NAD	-	-
69	6"-8" Pipe White Mastic Ceiling	Building 12, 110-12 Building 12, 110-12 Building 12, 110-12	NAD	-	-
70	Pink Fire Putty	Building 12, 110-12 Building 12, 110-12 Building 12, 110-12	NAD	-	-
71	Drywall/Joint Compound Wall	Building 12, 110-12 Building 12, 247-12 Building 12, 247-12	NAD	-	-
72	4" Brown Cove Base/Wall Adhesive	Building 12, 110-12 Building 12, 110-12 Building 12, 110-12	NAD	-	-
73	Olive Green Mastic Duct Ceiling	Building 12, 110-12 Building 12, 247-12 Building 12, 247-12	NAD	-	-

Identified Suspect Asbestos Containing Materials

HA	Material Description	Location	Asbestos Type and Content	NESHAP/ OSHA Class	Estimated Quantity of ACM (SF)
74	Black Glass Rock 8" Pipe TSI Mastic Ceiling	Building 12, 110-12 Building 12, 110-12 Building 12, 110-12	NAD	-	-
75	Yellow Mastic Floor	Building 12, 110-12 Building 12, 110-12 Building 12, 110-12	NAD	-	-
76	2' X 2' Ceiling Tile Pinhole & Fissure Ceiling	Building 12, 247-12 Building 12, 247-12 Building 12, 247-12	NAD	-	-
77	6" Black Cove Base/Adhesive Wall	Building 12, 247-12 Building 12, 247-12 Building 12, 247-12	NAD	-	-
78	6" X 6" Thinset/Grout Wall	Building 12, 247-12 Building 12, 247-12 Building 12, 247-12	NAD	-	-
79	6" X 3' Vinyl Plank Floor Light Brown	Building 12, 247-12 Building 12, 247-12 Building 12, 247-12	NAD	-	-
80	White Mastic Duct System Ceiling	Building 12, 247-2 Building 12, 247-2 Building 12, 247-2	NAD	-	-
81	4" Beige Cove Base/Adhesive Wall	Building 204-28 Building 204-28 Building 204-28	NAD	-	-
82	Drywall/Joint Compound Wall	Building 204-28 Building 204-28 Building 204-28	NAD	-	-
83	Plaster Ceiling	Building 204-28 Building 204-28 Building 204-28	NAD	-	-
84	2' X 2' Ceiling Tile Smooth Fissure Ceiling	BT01A-109-TIA BT03-107 BT03-107	NAD	-	-
85	4" Cove Base Mastic Beige Wall	BT01A-109-TIA BT03-107 BT03-107	NAD	-	-
86	12" X 12" VFT Mastic Floor	BT01A-109-TIA BT03-107 BT03-107	NAD	-	-
87	Wallpaper Adhesive Wall	BT01A-109-TIA BT03-107 BT03-107	NAD	-	-
88	Gypsum Wall	BT01A-109-TIA BT03-107 BT08-107	NAD	-	-

Identified Suspect Asbestos Containing Materials

HA	Material Description	Location	Asbestos Type and Content	NESHAP/ OSHA Class	Estimated Quantity of ACM (SF)
89	2' X 2' Ceiling Tile Fissure & Pinhole Ceiling	BT02 110-T2 BT08-107 BT10-109	NAD	-	-
90	4" Cove Base Grey Adhesive Wall	BT02 110 BT04 107 BT06 105	NAD	-	-
91	Wallpaper Adhesive Wall	BT02 110 BT11 121 BT04 107	NAD	-	-
92	Gypsum Wall	BT02 110 BT11 121 BT04 105	NAD	-	-
93	6" X 3' Vinyl Plank Floor/Adhesive Floor	BT02 110 BT11 121 BT11 121	NAD	-	-
94	12" X 12" VFT Adhesive Tan Floor	BT05 113 BT04 107 BT07 113	NAD	-	-
95	2' X 2' Ceiling Tile Pinhole/Fissure	BT05 113 BT11 121 BT04 107	NAD	-	-
96	Gypsum Wall	BT05 113 BT04 107 BT06 107	NAD	-	-
97	4" Tan Cove Base/Adhesive Wall	BT05 113 BT07 113 BT08 107	NAD	-	-
98	Wallpaper/Off-white Adhesive Wall	BT05 113 BT09 111 BT09 111	NAD	-	-
99	6" Cove Base Adhesive Black Wall	BT11 121 BT11 121 BT11 121	NAD	-	-
100	White Mastic Duct Ceiling	BT04 107 BT04 107 BT04 107	NAD	-	-
101	Brown Fire Putty	BT04 107 BT04 107 BT04 107	NAD	-	-
102	Vinyl Sheeting Olive Green Floor	BT06 107 BT06 107 BT06 107	NAD	-	-
103	Fire Putty Red Wall	BT08 107 BT08 107 BT08 107	NAD	-	-

Identified Suspect Lead Containing Paint

Sampled Paint Combinations				
Sample #	Color	Substrate	Locations	Lead content % wt.
1	Light Gray	Metal	Basement Door Frame	0.14% wt.
2	Light Gray	Metal	Basement Door	<0.0080% wt.
3	Off White	Drywall	Basement Wall	<0.0080% wt.
4	Black	Wood	Basement Wall	<0.0089% wt.
5	White	Plaster	Basement Ceiling	<0.0080% wt.
6	White	CMU	Basement Wall	<0.0080% wt.
7	Gray	Wood	Basement Wall	0.27% wt.
8	Off White	Drywall	Basement Wall	<0.0080% wt.
9	Teal	Plaster	Basement Wall	<0.0080% wt.
10	Gray	Plaster	Basement Wall	<0.0080% wt.
11	Gray	Wood	Basement Door	<0.0080% wt.
12	White	Wood	Basement Wall	<0.0080% wt.
13	Silver	CMU	Boiler Room Wall	<0.0080% wt.
14	Red	Cement	Boiler Room Floor	<0.0080% wt.
15	Off White	Plaster	Floor 1 Wall	<0.0080% wt.
16	Off White	Wood	Floor 1 Wall	<0.0080% wt.
17	White	CMU	Floor 1 Wall	<0.0080% wt.
18	Off White	Metal	Floor 1 Door Frame	<0.0080% wt.
19	Gray	Cement	Floor 1 Floor	<0.0080% wt.
20	Teal	Metal	Floor 1 Door Frame	<0.0080% wt.
21	Off White	Wood	Floor 1 Door	0.019% wt.
22	White	Metal	12”x12” Ceiling Tile	<0.0096% wt.
23	Gray	Wood	Floor 1 Door	<0.0080% wt.
24	Gray	Metal	Floor 1 Door Frame	<0.0080% wt.
25	Off White	Wood	Floor 1 Wall	<0.0080% wt.
26	Off White	Plaster	Floor 2 Ceiling	<0.0080% wt.
27	Off White	Metal	Floor 2 Door Frame	<0.0080% wt.

Identified Suspect Lead Containing Paint

Sampled Paint Combinations				
Sample #	Color	Substrate	Locations	Lead content % wt.
28	White	Wood	Floor 2 Wall	<0.0080% wt.
29	Red	Metal	Floor 2 Door Frame	<0.0080% wt.
30	White	Cement	Floor 2 Ceiling	<0.0080% wt.
31	Green	Metal	Floor 2 Door Frame	0.025% wt.
32	Off White	Wood	Floor 2 Wall	<0.0080% wt.
33	Off White	Drywall	Floor 2 Wall	<0.0080% wt.
34	Light Gray	Wood	Floor 2 Door	0.12% wt.
35	Light Gray	Metal	Floor 2 Door Frame	1.1% wt.
36	Light Blue	Drywall	Floor 3 Wall	<0.0080% wt.
37	Off White	Metal	Floor 3 Door Frame	<0.0080% wt.
38	Gray	Cement	Floor 3 Floor	<0.0082% wt.
39	Dark Green	Metal	Floor 4 Door Frame	<0.0080% wt.
40	Off White	Metal	Floor 4 Door Frame	<0.0080% wt.
41	Off White	Metal	Floor 5 Door Frame	<0.0080% wt.
42	Maroon	Metal	Floor 5 Door Frame	<0.0080% wt.
43	Gray	Metal	Door Frame	<0.0080% wt.
44	Off White	Drywall	Wall	<0.0080% wt.
45	Off White	Metal	Door Frame	0.13% wt.
46	Off White	Metal	Door	0.048% wt.
47	Yellow	Drywall	Wall	<0.0080% wt.
48	Off White	Plaster	Ceiling	<0.0080% wt.
49	Black	Wood	Wall	<0.0080% wt.
50	Off White	Wood	Wall	<0.0080% wt.
51	Off White	Drywall	Wall	<0.0080% wt.
52	Light Blue	Metal	Door Frame	0.017% wt.
53	Off White	Cement	Wall	<0.0080% wt.
54	Off White	Metal	Door Frame	0.043% wt.

Identified Suspect Lead Containing Paint

Sampled Paint Combinations				
Sample #	Color	Substrate	Locations	Lead content % wt.
55	Off White	Metal	Door	<0.0080% wt.
56	Off White	Drywall	Wall	<0.0080% wt.
57	Off White	Wood	Wall	<0.0080% wt.
58	White	Plaster	Ceiling	<0.0080% wt.
59	Off White	Metal	Door Frame	<0.0080% wt.
60	Beige	Wood	Door	<0.0080% wt.
61	Gray	Wood	Wall	<0.0080% wt.
62	Brown	Metal	Door Frame	<0.013% wt.
63	Off White	Drywall	Wallpaper	<0.0080% wt.
64	Off White	Wood	Wallpaper	<0.0080% wt.
65	Beige	Wood	Door	<0.0080% wt.
66	Gray	Wood	Door Frame	<0.0080% wt.
67	Gray	Wood	Door	<0.0080% wt.
68	Tan	Metal	Door Frame	<0.0080% wt.
69	Gray	Wood	Wall	<0.0080% wt.

APPENDIX B

ASBESTOS AND LEAD ANALYTICAL LABORATORY DATA

CATES LABORATORIES

CHAIN OF CUSTODY

CL Project No PLM 36087
(Lab Only) SET 51622

Company: Terracon

Contact/Results to: Pete Thompson Verbal ☐ Email ☑ Fax ☐ (check all that apply)

Email(s): Pete.Thompson@Terracon.com

Telephone No.: 904-330-4405 Fax No.: —

Project Information

Project: RDC VA Hospital Project No.: EQ227237

Address: 1601 SW Archer Rd. Gainesville, FL P.O. No.:

Turnaround (check one)

CLEARANCE (PCM) ☐ ASAP (SAME DAY) ☐ (IMMEDIATE) ☐ RUSH (1-DAY) ☐ STANDARD (2-DAY) ☐ 3-4-DAY ☐ 5-DAY ☑

Testing Services (check all that apply)

Asbestos

PLM-BULK
EPA 600/R-93/116 ☑
Point Count (400) ☐

PCM-AIR
NIOSH 7400 ☐
OSHA TWA ☐

IAQ - Mold (Non-Viable)

AIR (spore trap) - Standard Profile (count/genus identification) ☐
AIR (spore trap) - Expanded Profile (w/insect parts/pollen/skin) ☐
BULK (tape lift, swab) - Standard Profile (genus identification) ☐

CatesLab No. Range (Lab Only)	Sample Date	
1223634 - 1223949	1/23/24	No of Samples: ~~297~~ 316-317 Positive Stop Yes ☐ No ☑

Sample No.	H224134 Sample Description/Location	Volume (air only)
1 - A	9x9 VFT/Mastic Brown Floor A027 Fl. 1	1/11/24
B	A441 4	
C	H543 5	
2 - A	6" Beige Cove Wall Base A027 1	
B	A030-1 1	
C	A132 2	
3 - A	Plaster D/W Ceiling A027 1	
B	1 1	
C	H543 5	
4 - A	Red Fire Stop Wall A027 1	
B	C263A E156 2	
C	J445-1 4	

Relinquished By:	Date/Time:	Received By:	Date/Time:
[signature]	1/11/24	[signature] 1/25/24	9:56

AF72017-09 - Issued 4/3/2017 Walk-In ☐ D-Drop ☐ P-Drop ☑ FedEx ☐ UPS ☐ Lonestar ☐ USPS ☐

CATES LABORATORIES

CHAIN OF CUSTODY

CL Project No PLM 36851
(Lab Only) SET 51622

Additional Sample Page

Project Name RWC UA Hospital Project No EQ227237

Sample No.	Sample Description/Location			Volume (air only)
5 - A	2"x2" Thinset Ceramic Tile	A027	FL. 1	
B		C070-1	Basement	
C		A210-1	FL. 2	
6 - A	Plaster Wall	A027	FL. 1	
B		A030-1	FL. 1	
C		"	" 1	
D		M543	FL. 5	
E		"	FL. 5	
7 - A	2'x4' PH CT Small Fissure Holes	A027	Ceiling FL 1	
B		B050C	Basement	
C		"	"	
8 - A	TAN Mastic / Ceiling Duct	A027	FL. 1	
B		"	"	
C		"	"	
9 - A	2'x2' CT PH/Fissure Ceiling	A030-1	FL. 1	
B		B050C	Basement	
C		at Entrance Rm.		
10 - A	2'x4' CT Fissure 1" Ceiling	B050C-1	Basement	
B		E447	FL. 4	
C		E449	"	
11 - A	12"x12" VFT/mastic White Gray Floor	A030-1	Basement	
B		A132	FL. 1	
C		EB51A-1	Basement	

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NVLAP Code 200569-0, TDSHS-Asbestos 30-0287 TDSHS-Mold LAB1034, AZ Lab Cert AZ0948

CATES LABORATORIES

Additional Sample Page

CHAIN OF CUSTODY

CL Project No PUM 36087
(Lab Only) SET 51622

Project Name RDC VA Hospital Project No E0227237

Sample No.	Sample Description/Location	Volume (air only)
12 - A	Adhesive Carpet Queen / Sub layer Brown 9"x9" / Floor VFT Mastic Basement B050C-1	1/11/24
B	Floor A132A	
C		
13 - A	2"x2" Pink CT White Floor Thinset Cement Basement C070-1	
B	Basement EB51A	
C	J427-1 FL.4	
14 - A	Black Mastic 4'-5" Drain Pipe Ceiling C070-1	
B	C263A FL.1	
C	A341 FL.3	
15 - A	Tape/Mastic Duct/AC Boiler Rm	
B		
C		
16 - A	Mortar Wall Basement A027	
B	Boiler Rm	
C		
17 - A	3'x3' Vynal Sheeting FL./Mastic Floor EB83-1	
B		
C		
18 - A	6" Brown Cove Glass Wall Basement EB83-1	
B	FL4 A441-1	
C	FL5 A543-1	
19 - A	off white Mastic Fiber glass Metal Duct Ceiling EB83-1	
B	FL. 4 E449-1	
C		

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CATES LABORATORIES

Additional Sample Page

CHAIN OF CUSTODY

CL Project No PLM 36087
(Lab Only) SET 51622

Project Name RDC VA Hospital Project No EQ227237

Sample No.	Sample Description/Location	Volume (air only)
20 - A	6" Gray Cove Base Wall EB51A-1 Basement	1/11/24
B	E156-1 FL.1	1/12/24
C		
21 - A	DW/JC Wall EB51A-1 Basement	
B	FB14-1 Basement	
C	E447 FL.4	
22 - A	2'x2' Small Smooth Hole CT EB51A-1 Basement	
B	J140 FL.1	
C	E523	
23 - A	4" Gray Cove base Adhesive Wall FB28K Basement	
B	F122 FL.1	
C	FB14-1	
24 - A	Off White Fiber Glass Mastic Duct Ceiling A027-1 FL.1	
B		
C		
25 - A	Wall Paper Adhesive Wall B0506-1 Basement	
B		
C		
21 - D	DW/JC Wall H133-1 FL.1	
E	E156-1	
26 - A	6" Beige Cove Base Wall A132-1 FL.1	
B		
C		
21 - F	DW/JC Wall J140 FL.1	

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* 21-D

CATES LABORATORIES

Additional Sample Page

CHAIN OF CUSTODY

CL Project No PUM 36087
(Lab Only) SET 51622

Project Name RDC VA Hospital Project No EQ227237

Sample No	Sample Description/Location	Volume (air only)
27- A	12"x12" VFT Mastic White Gray A132-1 Fl. 1	1/12/24
B	G161-1 FL. 1	
C		
28- A	12"x12" VFT Mastic Cream Floor A263A-1 FL. 1	
B	A305	
C	E449-1 FL. 4	
29- A	Black Mastic Pipe Ceiling A263A-1 FL. 1	
B	A341-1 3	
C		
30- A	Resilient Flooring Sheet Gray Floor C263-1 Fl. 1	
B		
C		
31- A	DWLSC Ceiling C263-1 FL. 1	
B	A027	
C		
32- A	Mastic White/Wrap 6"-8" Pipe Ceiling D311A Fl. 1	
B		
C		
33- A	Brown Fire Stop Wall D311-A FL. 1	
B	H439-1 FL. 4	
C		
34- A	Pink E156-1 FL. 1	
B	J241 FL. 2	
C	H339-1 FL. 3	

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CATES LABORATORIES

CHAIN OF CUSTODY

CL Project No (Lab Only) PLM 36087 SET 51622

Additional Sample Page

Project Name RR VA Hospital Project No EQ 227237

Sample No.	Sample Description/Location			Volume (air only)
35 - A	Ceramic Mastic Ceiling Duct	E156-1	FL. 1	1/12/24
B		J427-1	FL. 4	
C				
36 - A	4" Beige Base Back Wall	J138-1	FL. 1	
B		A305	3	
C		A402-1	FL. 4	
37 - A	2x2' Ceiling Tile Drop In CT Ceiling	J121-1	FL. 1	
B		H235-1	FL. 2	
C		J227-1	FL. 2	
38 - A	4" Ceramic Tile Floor Tan Thinset Grout	J140-1	FL. 1	
B				
C				
39 - A	6" Ceramic Tile Wall Tan	J140-1	FL. 1	
B				
C				
40 - A	White Mastic 6"-8" Pipe Ceiling	E261-1	FL. 2	1/18/24
B	Asbestos Wrap	A341	FL 3	
C		E458A	FL. 4	
41 - A	Ceramic Mastic/Adhesive Wall	A241	FL 3	
B				
C				
42 - A	JC Wall	A241	FL. 3	
B				
C				

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CATES LABORATORIES

CHAIN OF CUSTODY

Additional Sample Page

CL Project No (Lab Only) PLM 36087 SET 51622

Project Name RDC UA Hospital Project No EQ227237

Sample No.	Sample Description/Location				Volume (air only)
43- A	Plant FL. Adhesive 4x6"		A210-1	FL. 2	
B	"	Floor	J227-1	2	
C	"	"	J229-1 H2357	3	
21- G	DW/SC Wall		H239-1	FL. 2	
H	"	"	H339	FL3	
44- A	6" Black Cove Base	Wall/Adhesive	H235-1	FL 2	
B	"	"	A341	FL3	
C	"	"	E357A-1	FL.3	
45- A	Wall Paper/Adhesive		A-341	FL.3	
B	"	"	"	"	
C	"	"	"	"	
46- A	Yellow Mastic FL.		FL4	E449-1	1/19/24
B	"	Computer Floor	"	"	
C	"	"	"	"	
47- A	Gray Mastic FL.	Support Stand			
B	"	"			
C	"	"			
48- A	6"x8' Plank Floor	Flooring/Adhesive	FL.4	H435-1	
B	"	"	"	"	
C	"	"	"	"	
49- A	2'x4' CT Fissure	Pinhole Ceiling	FL.5	E503-1	
B	"	"	"	"	
C	"	"	"	"	
21-1	DW/SC	Wall	FL.4	J441	

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CATES LABORATORIES

CHAIN OF CUSTODY

CL Project No (Lab Only) PLM 36087 SET 51622

Additional Sample Page

Project Name RJC-VA Hospital Project No EQ 227237

Sample No.	Sample Description/Location			Volume (air only)
50 - A	Black Mastic Wall	Bldg. 14	122-14	1-15
B			106-14	
C				
51 - A	White Fiberglass Mastic Duct Ins Ceiling		122-14	
B			106-14	
C				
52 - A	2'x2' CT Pinhole Fissure Ceiling		122-14	
B				
C				
53 - A	DWISE Wall		122-14	
B			106-14	
C				
54 - A	6" Cove Base Beige/Adhesive Wall		122-14	
B				
C				
55 - A	12"x12" VFT Mastic Floor		122-14	
B				
C				
56 - A	2'x4' CT Pinhole Fissure Ceiling	Bldg 14	106-14	
B				
C				
57 - A	6" Cove Base Black/Adhesive Wall		106-14	
B				
C				

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CATES LABORATORIES

CHAIN OF CUSTODY

CL Project No (Lab Only) PVM 34087 SET 91602

Additional Sample Page

Project Name RDC - VA Hospital Project No EQ227237

Sample No.	Sample Description/Location	Volume (air only)
58 - A	6"x3" Vinyl Plank Brown Fl. Bldg 14 106-14	1/18/24
B		
C		
59 - A	2x4' PH CT Fissure Ceiling 11 - 117	
B		
C		
60 - A	White Fibergless Mastic Duct Ins. Ceiling Bldg. 11 - 117	
B		
C		
61 - A	DWJC Wall Bldg. 11 - 117	
B		
C		
62 - A	4" CBU Base/Adhesive Wall Bldg. 11 - 117	
B		
C		
63 - A	12"x12" VFT Mastic Red/Brown Stripes Fl. Bldg. 11 - 117	
B		
C		
64 - A	4"-6" White Pipe Mastic Ceiling Bldg. 11 - 117	
B		
C		
65 - A	Plaster Ceiling Bldg. 11 - 117	
B		
C		

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NVLAP Code 200569-0, TDSHS-Asbestos 30-0287, TDSHS-Mold LAB1034, AZ Lab Cert AZ0948

CATES LABORATORIES

CHAIN OF CUSTODY

CL Project No (Lab Only) PLM 36087 SET 51622

Additional Sample Page

Project Name RDC - VA Hospital Project No EQ22T237

Sample No.	Sample Description/Location	Volume (air only)
66 - A	Red Fine Putty Wall Bldg. 11 - 117	1/19/24
B		
C		
67 - A	Plaster Ceiling Bldg. 11 - 117	
B		
C		
68 - A	Pink Fine Putty Wall Bldg. 11 - Closet 117	
B		
C		
69 - A	6"-8" Pipe Ceiling White Mastic Bldg. 12 110-12	
B		
C		
70 - A	Pink Fine Putty Wall Bldg 12 110-12	
B		
C		
71 - A	DWISC Wall Bldg. 12 110-12	
B	12 247-12	
C		
72 - A	4" Brown Coveebase/Adhesive Wall Bldg 12 110-12	
B		
C		
73 - A	Blue Green Mastic Duct Ceiling Bldg. 12 110-12	
B	247-12	
C		

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	1/19/24		1/25/24 9.56

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CATES LABORATORIES

CHAIN OF CUSTODY

CL Project No PUM 36087
(Lab Only) SET 51622

Additional Sample Page

Project Name: RJC-VA Hospital Project No: EQ227237

Sample No.	Sample Description/Location	Volume (air only)
74 - A	Black glass Rock Ceiling 8" Pipe TSI Mastic Bldg. 12 - 110-12	1/22/24
B		
C		
75 - A	Yellow Mastic FL, Bldg. 12 - 110-12	
B		
C		
76 - A	2x2' Pinhole CT Fissure Ceiling Bldg. 12 - 247-12	
B		
C		
77 - A	6" Black Cove Base/Adhesive Wall Bldg. 12 - 247-12	
B		
C		
78 - A	6"x6" Thin set Lavent Wall Bldg. 12 247-12	
B		
C		
79 - A	6"x3' Vynal Plank Fl, Lt. Brown Floor Bldg. 12 247-12	
B		
C		
80 - A	White Mastic Duct Sys. Seam Ceiling Bldg. 12 247-2	
B		
C		
81 - A	4" Beige Cove Base/Adhesive Wall Bldg 204 - 28	
B		
C		

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CATES LABORATORIES

CHAIN OF CUSTODY

CL Project No (Lab Only) PLM 34087 SET 51622

Additional Sample Page

Project Name RJCVA Hospital Project No EQ227237

Sample No.	Sample Description/Location	Volume (air only)
B2 - A	DW/JC Wall Bldg. 204-28	1/22/24
B		
C		
B3 - A	Plaster Ceiling Bldg. 204-28	
B		
C		
B4 - A	2x2' CT Summer Fissured Ceiling BTO1A - 109-T1A	
B	BTO3 - 107	
C		
B5 - A	4" Cove Base Mastic Beige Wall BTO1A - 109-T1A	
B	BTO3 - 107	
C		
B6 - A	12"x12" VAT White Cove Mastic Floor BTO1A - 109-T1A	
B	BTO3 - 107	
C		
B7 - A	Wall Paper Adhesive Wall BTO1A - 109-T1A	
B	BTO3 - 107	
C	BTO8 107	
B8 - A	Gypsum Wall BTO1A - 109-T1A	
B	BTO3 - 107	
C	BTO8 107	
B9 - A	2x2' CT Fissured Pin Hole Ceiling BTO2 110-T2	
B	BTO8 107	
C	BTO 109	

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NVLAP Code 200569-0, TDSHS-Asbestos: 30-0287, TDSHS-Mold LAB1034, AZ Lab Cert AZ0948

CATES LABORATORIES

Additional Sample Page

CHAIN OF CUSTODY

CL Project No PVM 36087
(Lab Only) SET 51622

Project Name RDC VA Hospital Project No EQ227237

Sample No.	Sample Description/Location			Volume (air only)
90 - A	4" Cove Base Gray Adhesive Wall	BT02	110	1/23/24
B		BT04	107	
C		BT06	105	
91 - A	Wall Paper Adhesive Wall	BT02	110	
B		BT11	121	
C		BT04	107	
92 - A	Gypsum Wall	BT02	110	
B		BT11	121	
C		BT04	105	
93 - A	6"x3' Planck Vynal FL./Adhesive Floor	BT02	110	
B		BT11	121	
C				
94 - A	12"x12" VFT Adhesive Tan Floor	BT05	113	
B		BT04	107	
C		BT07	113	
95 - A	2'x2' CT Pin Hole Fissure Ceiling	BT05	113	
B		BT11	121	
C		BT04	107	
96 - A	Gypsum Wall	BT05	113	
B		BT04	107	
C		BT06	107	
97 - A	4" Tan Cove Base/Adhesive Wall	BT05	113	
B		BT07	113	
C		BT08	107	

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CATES LABORATORIES

CHAIN OF CUSTODY

CL Project No (Lab Only) PLM 31087 SET 51622

Additional Sample Page

Project Name: RJC VA Hospital Project No EQ22723T

Sample No.	Sample Description/Location				Volume (air only)
98 - A	Wall Putty/Adhesive on White Wall		BT05	113	1/23/24
B	"	"	BT09	111	"
C	"	"	"	"	"
99 - A	6" Cove Base Adhesive on Black Wall		BT11	121	"
B	"	"	"	"	"
C	"	"	"	"	"
100 - A	White mastic	Dust ceiling	BT04	107	"
B	"	"	"	"	"
C	"	"	"	"	"
101 - A	Brown Five Putty	Wall	BT04	107	"
B	"	"	"	"	"
C	"	"	"	"	"
102 - A	Vinyl Olive colored Sheeting	Floor	BT06	107	"
B	"	"	"	"	"
C	"	"	"	"	"
103 - A	Five Putty Red	Wall	BT08	107	"
B	"	"	"	"	"
C	"	"	"	"	"

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PLM REPORT SUMMARY

Cates Laboratories
1339 Motor Circle
Dallas, Texas 75207 (214) 920-5006

NVLAP Lab No. 200569-0
TDSHS License No. 30-0287

Client: Terracon
Project (Line 1): RDC VA Hospital
Project (Line 2): 1601 SW Archer Road, Gainesville, FL
Project No: EQ227237
Identification: Asbestos, Bulk Sample Analysis
Test Method: Polarized Light Microscopy/Dispersion Staining (PLM/DS)
EPA Method 600/R-93/116

Lab Job No.: PLM-36087
Set No.: 51622
Report Date: 2/1/2024
Sample Date: 1/23/2024

On 1/25/2024, three-hundred seventeen (317) bulk samples were submitted by a representative of Terracon for asbestos analysis by PLM/DS. Copies of the lab data sheets are attached; additional information may be found therein. The results are summarized below:

Lab Sample No.	Client Field I.D.	Sample Description/Location	Asbestos Content
CL1223634	1-A	9" X 9" VFT/Mastic Brown Floor - A027 Floor 1	2% Chrysotile - Floor Tile 5% Chrysotile - Black Mastic
CL1223635	1-B	9" X 9" VFT/Mastic Brown Floor - A441 Floor 4	2% Chrysotile - Floor Tile 5% Chrysotile - Black Mastic
CL1223636	1-C	9" X 9" VFT/Mastic Brown Floor - H543 Floor 5	2% Chrysotile - Floor Tile 5% Chrysotile - Black Mastic
CL1223637	2-A	6" Beige Cove Base Wall - A027 Floor 1	None Detected - Cove Base None Detected - Brown Mastic
CL1223638	2-B	6" Beige Cove Base Wall - A030-1 Floor 1	None Detected - Cove Base None Detected - Brown Mastic
CL1223639	2-C	6" Beige Cove Base Wall - A132 Floor 2	None Detected - Cove Base None Detected - Brown Mastic
CL1223640	3-A	Plaster Drywall Ceiling - A027 Floor 1	2% Chrysotile - Paint Texture None Detected - Paper None Detected - Wallboard Material
CL1223641	3-B	Plaster Drywall Ceiling - A027 Floor 1	2% Chrysotile - Paint Texture None Detected - Paper None Detected - Wallboard Material
CL1223642	3-C	Plaster Drywall Ceiling - H543 Floor 5	2% Chrysotile - Paint Texture None Detected - Paper None Detected - Wallboard Material
CL1223643	4-A	Red Firestop Wall - A027 Floor 1	None Detected
CL1223644	4-B	Red Firestop Wall - C263A E156 Floor 2	None Detected
CL1223645	4-C	Red Firestop Wall - J441-1 Floor 4	None Detected
CL1223646	5-A	2" X 2" Ceramic Tile Thinset/Grout - A027 Floor 1	None Detected - Ceramic Tile None Detected - Grout None Detected - Thinset

These samples were analyzed by layers. The overall percent asbestos for the sample is reported when relevant. The EPA considers a material to be asbestos containing only if it contains greater than one percent asbestos by Calibrated Visual Area Estimation (CVAE). EPA regulations also indicate that Regulated Asbestos Containing Materials (RACM) – materials that are friable or may become friable – be further analyzed by point counting when the results indicate less than ten percent asbestos by CVAE. CatesLab utilizes CVAE on a routine basis and does not include point counting unless specifically requested by the client. The results may not be reproduced except in full.

PLM REPORT SUMMARY

Cates Laboratories
1339 Motor Circle
Dallas, Texas 75207 (214) 920-5006

NVLAP Lab No. 200569-0
TDSHS License No. 30-0287

Client: Terracon
Project (Line 1): RDC VA Hospital
Project (Line 2): 1601 SW Archer Road, Gainesville, FL
Project No: EQ227237
Identification: Asbestos, Bulk Sample Analysis
Test Method: Polarized Light Microscopy/Dispersion Staining (PLM/DS)
EPA Method 600/R-93/116

Lab Job No.: PLM-36087
Set No.: 51622
Report Date: 2/1/2024
Sample Date: 1/23/2024

On 1/25/2024, three-hundred seventeen (317) bulk samples were submitted by a representative of Terracon for asbestos analysis by PLM/DS. Copies of the lab data sheets are attached; additional information may be found therein. The results are summarized below:

Lab Sample No.	Client Field I.D.	Sample Description/Location	Asbestos Content
CL1223647	5-B	2" X 2" Ceramic Tile Thinset/Grout - C070-1 Basement	None Detected - Ceramic Tile None Detected - Grout None Detected - Thinset
CL1223648	5-C	2" X 2" Ceramic Tile Thinset/Grout - A210-1 Floor 2	None Detected - Ceramic Tile None Detected - Grout None Detected - Thinset
CL1223649	6-A	Plaster Wall - A027 Floor 1	None Detected - Paint Texture None Detected - Plaster
CL1223650	6-B	Plaster Wall - A030-1 Floor 1	None Detected - Paint Texture None Detected - Plaster
CL1223651	6-C	Plaster Wall - A030-1 Floor 1	None Detected - Paint Texture None Detected - Plaster
CL1223652	6-D	Plaster Wall - H543 Floor 5	None Detected - Paint Texture None Detected - Plaster
CL1223653	6-E	Plaster Wall - H543 Floor 5	None Detected - Paint Texture None Detected - Plaster
CL1223654	7-A	2' X 4' Pinhole Ceiling Tile Small Holes Fissure - A027 Ceiling Floor 1	None Detected
CL1223655	7-B	2' X 4' Pinhole Ceiling Tile Small Holes Fissure - B050C Basement	None Detected
CL1223656	7-C	2' X 4' Pinhole Ceiling Tile Small Holes Fissure - B050C Basement	None Detected
CL1223657	8-A	Tan Mastic/Ceiling Duct - A027 Floor 1	None Detected
CL1223658	8-B	Tan Mastic/Ceiling Duct - A027 Floor 1	None Detected
CL1223659	8-C	Tan Mastic/Ceiling Duct - A027 Floor 1	None Detected
CL1223660	9-A	2' X 2' Ceiling Tile Pinhole/Fissure - A030-1 Floor	None Detected
CL1223661	9-B	2' X 2' Ceiling Tile Pinhole/Fissure - B050C Basement	None Detected
CL1223662	9-C	2' X 2' Ceiling Tile Pinhole/Fissure - at Interview Room	None Detected

These samples were analyzed by layers. The overall percent asbestos for the sample is reported when relevant. The EPA considers a material to be asbestos containing only if it contains greater than one percent asbestos by Calibrated Visual Area Estimation (CVAE). EPA regulations also indicate that Regulated Asbestos Containing Materials (RACM) – materials that are friable or may become friable – be further analyzed by point counting when the results indicate less than ten percent asbestos by CVAE. CatesLab utilizes CVAE on a routine basis and does not include point counting unless specifically requested by the client. The results may not be reproduced except in full.

PLM REPORT SUMMARY

Cates Laboratories
1339 Motor Circle
Dallas, Texas 75207 (214) 920-5006

NVLAP Lab No. 200569-0
TDSHS License No. 30-0287

Client: Terracon
Project (Line 1): RDC VA Hospital
Project (Line 2): 1601 SW Archer Road, Gainesville, FL
Project No: EQ227237
Identification: Asbestos, Bulk Sample Analysis
Test Method: Polarized Light Microscopy/Dispersion Staining (PLM/DS)
EPA Method 600/R-93/116

Lab Job No.: PLM-36087
Set No.: 51622
Report Date: 2/1/2024
Sample Date: 1/23/2024

On 1/25/2024, three-hundred seventeen (317) bulk samples were submitted by a representative of Terracon for asbestos analysis by PLM/DS. Copies of the lab data sheets are attached; additional information may be found therein. The results are summarized below:

Lab Sample No.	Client Field I.D.	Sample Description/Location	Asbestos Content
CL1223663	10-A	2' X 4' Ceiling Tile Fissure 1" Ceiling - B050C-1 Basement	None Detected
CL1223664	10-B	2' X 4' Ceiling Tile Fissure 1" Ceiling - E447 Floor 4	None Detected
CL1223665	10-C	2' X 4' Ceiling Tile Fissure 1" Ceiling - E449 Floor 4	None Detected
CL1223666	11-A	12" X 12" VFT/Mastic White/Grey - A030-1 Basement	None Detected - Floor Tile 1 None Detected - Yellow/Green Mastic 2% Chrysotile - Floor Tile 2 5% Chrysotile - Black Mastic
CL1223667	11-B	12" X 12" VFT/Mastic White/Grey - A132 Floor 1	None Detected - Floor Tile 1 None Detected - Yellow/Green Mastic 2% Chrysotile - Floor Tile 2 5% Chrysotile - Black Mastic
CL1223668	11-C	12" X 12" VFT/Mastic White/Grey - EB51A-1 Basement	None Detected - Floor Tile 1 None Detected - Yellow/Green Mastic 2% Chrysotile - Floor Tile 2 5% Chrysotile - Black Mastic
CL1223669	12-A	Adhesive Carpet/Sub-Layer Brown 9" X 9"/VFT Mastic - B050C-1 Basement	None Detected - Carpet None Detected - Yellow/Green Mastic 2% Chrysotile - Floor Tile 5% Chrysotile - Black Mastic
CL1223670	12-B	Adhesive Carpet/Sub-Layer Brown 9" X 9"/VFT Mastic - A132A	None Detected - Carpet None Detected - Yellow/Green Mastic 2% Chrysotile - Floor Tile 5% Chrysotile - Black Mastic
CL1223671	12-C	Adhesive Carpet/Sub-Layer Brown 9" X 9"/VFT Mastic - A132A	None Detected - Carpet None Detected - Yellow/Green Mastic 2% Chrysotile - Floor Tile 5% Chrysotile - Black Mastic
CL1223672	13-A	2" X 2" Ceramic Tile Pink/White Floor Thinset/Grout - Basement C070-11	None Detected - Ceramic Tile None Detected - Grout None Detected - Thinset

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PLM REPORT SUMMARY

Cates Laboratories
1339 Motor Circle
Dallas, Texas 75207 (214) 920-5006

NVLAP Lab No. 200569-0
TDSHS License No. 30-0287

Client: Terracon
Project (Line 1): RDC VA Hospital
Project (Line 2): 1601 SW Archer Road, Gainesville, FL
Project No: EQ227237
Identification: Asbestos, Bulk Sample Analysis
Test Method: Polarized Light Microscopy/Dispersion Staining (PLM/DS)
EPA Method 600/R-93/116

Lab Job No.: PLM-36087
Set No.: 51622
Report Date: 2/1/2024
Sample Date: 1/23/2024

On 1/25/2024, three-hundred seventeen (317) bulk samples were submitted by a representative of Terracon for asbestos analysis by PLM/DS. Copies of the lab data sheets are attached; additional information may be found therein. The results are summarized below:

Lab Sample No.	Client Field I.D.	Sample Description/Location	Asbestos Content
CL1223673	13-B	2" X 2" Ceramic Tile Pink/White Floor Thinset/Grout - Basement EB51A	None Detected - Ceramic Tile None Detected - Grout None Detected - Thinset
CL1223674	13-C	2" X 2" Ceramic Tile Pink/White Floor Thinset/Grout - J427-1 Floor 4	None Detected - Ceramic Tile None Detected - Grout None Detected - Thinset
CL1223675	14-A	Black Mastic 4"-5" Drain Pipe Ceiling - C070-1	None Detected
CL1223676	14-B	Black Mastic 4"-5" Drain Pipe Ceiling - C263A Floor 1	None Detected
CL1223677	14-C	Black Mastic 4"-5" Drain Pipe Ceiling - A341 Floor 3	None Detected
CL1223678	15-A	Tape/Mastic Duct/AC - Boiler Room	None Detected - Paint Layer None Detected - Grey Mastic
CL1223679	15-B	Tape/Mastic Duct/AC - Boiler Room	None Detected - Paint Layer None Detected - Grey Mastic
CL1223680	15-C	Tape/Mastic Duct/AC - Boiler Room	None Detected - Paint Layer None Detected - Grey Mastic
CL1223681	16-A	Mortar Wall - Basement A027	None Detected - Paint Layer None Detected - CMU Block None Detected - Mortar
CL1223682	16-B	Mortar Wall - Boiler Room	None Detected - Paint Layer None Detected - CMU Block None Detected - Mortar
CL1223683	16-C	Mortar Wall - Boiler Room	None Detected - Paint Layer None Detected - CMU Block None Detected - Mortar
CL1223684	17-A	3" X 3" Vinyl Sheeting Flooring/Mastic - EB83-1	None Detected - Sheet Flooring 5% Chrysotile - Black Mastic
CL1223685	17-B	3" X 3" Vinyl Sheeting Flooring/Mastic - EB83-1	None Detected - Sheet Flooring 5% Chrysotile - Black Mastic

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1339 Motor Circle
Dallas, Texas 75207 (214) 920-5006

NVLAP Lab No. 200569-0
TDSHS License No. 30-0287

Client: Terracon
Project (Line 1): RDC VA Hospital
Project (Line 2): 1601 SW Archer Road, Gainesville, FL
Project No: EQ227237
Identification: Asbestos, Bulk Sample Analysis
Test Method: Polarized Light Microscopy/Dispersion Staining (PLM/DS)
EPA Method 600/R-93/116

Lab Job No.: PLM-36087
Set No.: 51622
Report Date: 2/1/2024
Sample Date: 1/23/2024

On 1/25/2024, three-hundred seventeen (317) bulk samples were submitted by a representative of Terracon for asbestos analysis by PLM/DS. Copies of the lab data sheets are attached; additional information may be found therein. The results are summarized below:

Lab Sample No.	Client Field I.D.	Sample Description/Location	Asbestos Content
CL1223686	17-C	3" X 3" Vinyl Sheeting Flooring/Mastic - EB83-1	None Detected - Sheet Flooring 5% Chrysotile - Black Mastic
CL1223687	18-A	6" Brown Cove Base Wall - Basement EB83-1	None Detected - Cove Base None Detected - Yellow Mastic None Detected - Brown Mastic
CL1223688	18-B	6" Brown Cove Base Wall - Floor 4 A441-1	None Detected - Cove Base None Detected - Yellow Mastic None Detected - Brown Mastic
CL1223689	18-C	6" Brown Cove Base Wall - Floor 5 A543-1	None Detected - Cove Base None Detected - Yellow Mastic None Detected - Brown Mastic
CL1223690	19-A	Off-White Mastic Fiberglass Metal Duct Ceiling - EB83-1	5% Chrysotile - Off White Mastic None Detected - Wrap
CL1223691	19-B	Off-White Mastic Fiberglass Metal Duct Ceiling - Floor 4 E449-1	5% Chrysotile - Off White Mastic None Detected - Wrap
CL1223692	19-C	Off-White Mastic Fiberglass Metal Duct Ceiling - Floor 4 E449-1	5% Chrysotile - Off White Mastic None Detected - Wrap
CL1223693	20-A	6" Grey Cove Base - EB51A-1 Basement	None Detected - Cove Base None Detected - Cream Mastic
CL1223694	20-B	6" Grey Cove Base - E156-1 Floor 1	None Detected - Cove Base None Detected - Cream Mastic
CL1223695	20-C	6" Grey Cove Base - E156-1 Floor 1	None Detected - Cove Base None Detected - Cream Mastic
CL1223696	21-A	Drywall/Joint Compound Wall - EB51A-1 Basement	None Detected - Paint Layer None Detected - Joint Tape None Detected - Joint Compound None Detected - Paper None Detected - Wallboard Material

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NVLAP Lab No. 200569-0
TDSHS License No. 30-0287

Client: Terracon
Project (Line 1): RDC VA Hospital
Project (Line 2): 1601 SW Archer Road, Gainesville, FL
Project No: EQ227237
Identification: Asbestos, Bulk Sample Analysis
Test Method: Polarized Light Microscopy/Dispersion Staining (PLM/DS)
EPA Method 600/R-93/116

Lab Job No.: PLM-36087
Set No.: 51622
Report Date: 2/1/2024
Sample Date: 1/23/2024

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Lab Sample No.	Client Field I.D.	Sample Description/Location	Asbestos Content
CL1223697	21-B	Drywall/Joint Compound Wall - FB14-1 Basement	None Detected - Paint Layer None Detected - Joint Tape None Detected - Joint Compound None Detected - Paper None Detected - Wallboard Material
CL1223698	21-C	Drywall/Joint Compound Wall - E447 Floor 4	None Detected - Paint Layer None Detected - Joint Tape None Detected - Joint Compound None Detected - Paper None Detected - Wallboard Material
CL1223699	22-A	2' X 2' Small Smooth Hole Ceiling Tile - EB51A-1 Basement	None Detected
CL1223700	22-B	2' X 2' Small Smooth Hole Ceiling Tile - J140 Floor 1	None Detected
CL1223701	22-C	2' X 2' Small Smooth Hole Ceiling Tile - E523	None Detected
CL1223702	23-A	4" Grey Cove Base Adhesive Wall - FB28K Basement	None Detected - Cove Base None Detected - Cream Mastic
CL1223703	23-B	4" Grey Cove Base Adhesive Wall - F122 Floor 1	None Detected - Cove Base None Detected - Cream Mastic
CL1223704	23-C	4" Grey Cove Base Adhesive Wall - FB14-1 Floor 1	None Detected - Cove Base None Detected - Cream Mastic
CL1223705	24-A	Off-White Mastic Fiberglass Duct Ceiling - A027-1 Floor 1	3% Chrysotile - Off White Mastic None Detected - Wrap None Detected - Insulation
CL1223706	24-B	Off-White Mastic Fiberglass Duct Ceiling - A027-1 Floor 1	3% Chrysotile - Off White Mastic None Detected - Wrap None Detected - Insulation
CL1223707	24-C	Off-White Mastic Fiberglass Duct Ceiling - A027-1 Floor 1	3% Chrysotile - Off White Mastic None Detected - Wrap None Detected - Insulation
CL1223708	25-A	Wallpaper Adhesive - B0506-1 Basement	None Detected

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NVLAP Lab No. 200569-0
TDSHS License No. 30-0287

Client: Terracon
Project (Line 1): RDC VA Hospital
Project (Line 2): 1601 SW Archer Road, Gainesville, FL
Project No: EQ227237
Identification: Asbestos, Bulk Sample Analysis
Test Method: Polarized Light Microscopy/Dispersion Staining (PLM/DS)
EPA Method 600/R-93/116

Lab Job No.: PLM-36087
Set No.: 51622
Report Date: 2/1/2024
Sample Date: 1/23/2024

On 1/25/2024, three-hundred seventeen (317) bulk samples were submitted by a representative of Terracon for asbestos analysis by PLM/DS. Copies of the lab data sheets are attached; additional information may be found therein. The results are summarized below:

Lab Sample No.	Client Field I.D.	Sample Description/Location	Asbestos Content
CL1223709	25-B	Wallpaper Adhesive - B0506-1 Basement	None Detected
CL1223710	25-C	Wallpaper Adhesive - B0506-1 Basement	None Detected
CL1223711	21-D	Drywall/Joint Compound Wall - H133-1 Floor 1	None Detected - Paint Layer None Detected - Joint Tape None Detected - Joint Compound None Detected - Paper None Detected - Wallboard Material
CL1223712	21-E	Drywall/Joint Compound Wall - E156-1 Floor 1	None Detected - Paint Layer None Detected - Joint Compound None Detected - Paper None Detected - Wallboard Material
CL1223713	26-A	6" Beige Cove Base Wall - A132-1 Floor 1	None Detected - Cove Base None Detected - Yellow Mastic None Detected - Brown Mastic
CL1223714	26-B	6" Beige Cove Base Wall - A132-1 Floor 1	None Detected - Cove Base None Detected - Cream Mastic None Detected - Yellow Mastic
CL1223715	26-C	6" Beige Cove Base Wall - A132-1 Floor 1	None Detected - Cove Base None Detected - Cream Mastic None Detected - Yellow Mastic
CL1223716	21-F	Drywall/Joint Compound Wall - J14D Floor 1	None Detected - Paint Layer None Detected - Joint Compound None Detected - Paper None Detected - Wallboard Material
CL1223717	27-A	12" X 12" VFT White/Mastic Grey - A132-1 Floor 1	None Detected - Floor Tile None Detected - Yellow Mastic
CL1223718	27-B	12" X 12" VFT White/Mastic Grey - G161-1 Floor 1	None Detected - Floor Tile None Detected - Yellow Mastic
CL1223719	27-C	12" X 12" VFT White/Mastic Grey - G161-1 Floor 1	None Detected - Floor Tile None Detected - Yellow Mastic

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NVLAP Lab No. 200569-0
TDSHS License No. 30-0287

Client: Terracon
Project (Line 1): RDC VA Hospital
Project (Line 2): 1601 SW Archer Road, Gainesville, FL
Project No: EQ227237
Identification: Asbestos, Bulk Sample Analysis
Test Method: Polarized Light Microscopy/Dispersion Staining (PLM/DS)
EPA Method 600/R-93/116

Lab Job No.: PLM-36087
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On 1/25/2024, three-hundred seventeen (317) bulk samples were submitted by a representative of Terracon for asbestos analysis by PLM/DS. Copies of the lab data sheets are attached; additional information may be found therein. The results are summarized below:

Lab Sample No.	Client Field I.D.	Sample Description/Location	Asbestos Content
CL1223720	28-A	12" X 12" VFT/Mastic Cream - A263A-1 Floor 1	None Detected - Floor Tile None Detected - Cream Mastic
CL1223721	28-B	12" X 12" VFT/Mastic Cream - A305 Floor 1	None Detected - Floor Tile None Detected - Cream Mastic
CL1223722	28-C	12" X 12" VFT/Mastic Cream - E449-1 Floor 4	None Detected - Floor Tile None Detected - Cream Mastic
CL1223723	29-A	Black Mastic Pipe Ceiling - A263A-1 Floor 1	5% Chrysotile - Black Mastic None Detected - Wrap None Detected - Insulation
CL1223724	29-B	Black Mastic Pipe Ceiling - A341-1 Floor 3	5% Chrysotile - Black Mastic None Detected - Wrap None Detected - Insulation
CL1223725	29-C	Black Mastic Pipe Ceiling - A341-1 Floor 3	5% Chrysotile - Black Mastic None Detected - Wrap None Detected - Insulation
CL1223726	30-A	Resilient Sheet Flooring Grey - C263-1 Floor 1	None Detected - Flooring None Detected - Black Mastic
CL1223727	30-B	Resilient Sheet Flooring Grey - C263-1 Floor 1	None Detected - Flooring None Detected - Black Mastic
CL1223728	30-C	Resilient Sheet Flooring Grey - C263-1 Floor 1	None Detected - Flooring None Detected - Black Mastic
CL1223729	31-A	Drywall/Joint Compound Ceiling - C263-1 Floor 1	None Detected - Paint Layer None Detected - Paper None Detected - Wallboard Material
CL1223730	31-B	Drywall/Joint Compound Ceiling - A027 Floor 1	None Detected - Paint Layer None Detected - Paper None Detected - Wallboard Material

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NVLAP Lab No. 200569-0
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Client: Terracon
Project (Line 1): RDC VA Hospital
Project (Line 2): 1601 SW Archer Road, Gainesville, FL
Project No: EQ227237
Identification: Asbestos, Bulk Sample Analysis
Test Method: Polarized Light Microscopy/Dispersion Staining (PLM/DS)
EPA Method 600/R-93/116

Lab Job No.: PLM-36087
Set No.: 51622
Report Date: 2/1/2024
Sample Date: 1/23/2024

On 1/25/2024, three-hundred seventeen (317) bulk samples were submitted by a representative of Terracon for asbestos analysis by PLM/DS. Copies of the lab data sheets are attached; additional information may be found therein. The results are summarized below:

Lab Sample No.	Client Field I.D.	Sample Description/Location	Asbestos Content
CL1223731	31-C	Drywall/Joint Compound Ceiling - A027 Floor 1	None Detected - Paint Layer None Detected - Paper None Detected - Wallboard Material
CL1223732	32-A	Mastic White/Wrap 6"-8" Pipe Ceiling - D311A Floor 1	None Detected - Wrap
CL1223733	32-B	Mastic White/Wrap 6"-8" Pipe Ceiling - D311A Floor 1	None Detected - Yellow Mastic None Detected - Wrap None Detected - Insulation
CL1223734	32-C	Mastic White/Wrap 6"-8" Pipe Ceiling - D311A Floor 1	None Detected - Wrap
CL1223735	33-A	Brown Firestop - D311-A Floor 1	None Detected
CL1223736	33-B	Brown Firestop - H439-1 Floor 4	None Detected
CL1223737	33-C	Brown Firestop - H439-1 Floor 4	None Detected
CL1223738	34-A	Pink Firestop - E156-1 Floor 1	None Detected
CL1223739	34-B	Pink Firestop - J241 Floor 2	None Detected
CL1223740	34-C	Pink Firestop - H339-1 Floor 3	None Detected
CL1223741	35-A	Grey Mastic Ceiling Duct - E156-1 Floor 1	None Detected
CL1223742	35-B	Grey Mastic Ceiling Duct - J427-1 Floor 4	None Detected
CL1223743	35-C	Grey Mastic Ceiling Duct - J427-1 Floor 4	None Detected
CL1223744	36-A	4" Beige Cove Base - J138-1 Floor 1	None Detected - Cove Base None Detected - Cream Mastic
CL1223745	36-B	4" Beige Cove Base - A305 Floor 3	None Detected - Cove Base None Detected - Cream Mastic
CL1223746	36-C	4" Beige Cove Base - A402-1 Floor 4	None Detected - Cove Base None Detected - Cream Mastic
CL1223747	37-A	2' X 2' Drop-in Ceiling Tile - J121-1 Floor 1	None Detected

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PLM REPORT SUMMARY

Cates Laboratories
1339 Motor Circle
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NVLAP Lab No. 200569-0
TDSHS License No. 30-0287

Client: Terracon
Project (Line 1): RDC VA Hospital
Project (Line 2): 1601 SW Archer Road, Gainesville, FL
Project No: EQ227237
Identification: Asbestos, Bulk Sample Analysis
Test Method: Polarized Light Microscopy/Dispersion Staining (PLM/DS)
EPA Method 600/R-93/116

Lab Job No.: PLM-36087
Set No.: 51622
Report Date: 2/1/2024
Sample Date: 1/23/2024

On 1/25/2024, three-hundred seventeen (317) bulk samples were submitted by a representative of Terracon for asbestos analysis by PLM/DS. Copies of the lab data sheets are attached; additional information may be found therein. The results are summarized below:

Lab Sample No.	Client Field I.D.	Sample Description/Location	Asbestos Content
CL1223748	37-B	2' X 2' Drop-in Ceiling Tile - H235-1 Floor 2	None Detected
CL1223749	37-C	2' X 2' Drop-in Ceiling Tile - J227-1 Floor 2	None Detected
CL1223750	38-A	4" Ceramic Floor Tile Tan Thinset/Grout - J140-1 Floor 1	None Detected - Ceramic Tile None Detected - Grout None Detected - Thinset
CL1223751	38-B	4" Ceramic Floor Tile Tan Thinset/Grout - J140-1 Floor 1	None Detected - Ceramic Tile None Detected - Grout None Detected - Thinset
CL1223752	38-C	4" Ceramic Floor Tile Tan Thinset/Grout - J140-1 Floor 1	None Detected - Ceramic Tile None Detected - Grout None Detected - Thinset
CL1223753	39-A	6" Ceramic Wall Tile Tan Thinset/Grout - J140-1 Floor 1	None Detected - Ceramic Tile None Detected - Grout None Detected - Thinset
CL1223754	39-B	6" Ceramic Wall Tile Tan Thinset/Grout - J140-1 Floor 1	None Detected - Ceramic Tile None Detected - Grout None Detected - Thinset
CL1223755	39-C	6" Ceramic Wall Tile Tan Thinset/Grout - J140-1 Floor 1	None Detected - Ceramic Tile None Detected - Grout None Detected - Thinset
CL1223756	40-A	White Mastic 6"-8" Pipe Ceiling - E261-1 Floor 2	20% Chrysotile - White Mastic None Detected - Wrap None Detected - Insulation
CL1223757	40-B	White Mastic Adhesive Wrap 6"-8" Pipe Ceiling - A341 Floor 3	20% Chrysotile - White Mastic None Detected - Wrap None Detected - Insulation
CL1223758	40-C	White Mastic Adhesive Wrap 6"-8" Pipe Ceiling - E458A Floor 4	20% Chrysotile - White Mastic None Detected - Wrap None Detected - Insulation

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NVLAP Lab No. 200569-0
TDSHS License No. 30-0287

Client: Terracon
Project (Line 1): RDC VA Hospital
Project (Line 2): 1601 SW Archer Road, Gainesville, FL
Project No: EQ227237
Identification: Asbestos, Bulk Sample Analysis
Test Method: Polarized Light Microscopy/Dispersion Staining (PLM/DS)
EPA Method 600/R-93/116

Lab Job No.: PLM-36087
Set No.: 51622
Report Date: 2/1/2024
Sample Date: 1/23/2024

On 1/25/2024, three-hundred seventeen (317) bulk samples were submitted by a representative of Terracon for asbestos analysis by PLM/DS. Copies of the lab data sheets are attached; additional information may be found therein. The results are summarized below:

Lab Sample No.	Client Field I.D.	Sample Description/Location	Asbestos Content
CL1223759	41-A	Brown Mastic/Adhesive Wall - A241 Floor 3	None Detected
CL1223760	41-B	Brown Mastic/Adhesive Wall - A241 Floor 3	None Detected
CL1223761	41-C	Brown Mastic/Adhesive Wall - A241 Floor 3	None Detected
CL1223762	42-A	Joint Compound Wall - A241 - Floor 3	None Detected
CL1223763	42-B	Joint Compound Wall - A241 - Floor 3	None Detected
CL1223764	42-C	Joint Compound Wall - A241 - Floor 3	None Detected
CL1223765	43-A	Plank Floor Adhesive 4' X 6" Floor - A2101-1 Floor 2	None Detected - Flooring None Detected - Tan Mastic
CL1223766	43-B	Plank Floor Adhesive 4' X 6" Floor - J227-1 Floor 2	None Detected - Flooring None Detected - Tan Mastic
CL1223767	43-C	Plank Floor Adhesive 4' X 6" Floor - J227-1 H2351 Floor 3	None Detected - Flooring None Detected - Tan Mastic
CL1223768	21-G	Drywall/Joint Compound Wall - H239-1 Floor 2	None Detected - Paint Layer None Detected - Joint Tape None Detected - Joint Compound None Detected - Paper None Detected - Wallboard Material
CL1223769	21-H	Drywall/Joint Compound Wall - H339 Floor 3	None Detected - Paint Layer None Detected - Joint Tape None Detected - Joint Compound None Detected - Paper None Detected - Wallboard Material
CL1223770	44-A	6" Black Cove Base Wall/Adhesive - H235-1 Floor 2	None Detected - Cove Base None Detected - White Mastic
CL1223771	44-B	6" Black Cove Base Wall/Adhesive - A341 Floor 3	None Detected - Cove Base None Detected - White Mastic
CL1223772	44-C	6" Black Cove Base Wall/Adhesive - E357A-1 Floor 3	None Detected - Cove Base None Detected - White Mastic

These samples were analyzed by layers. The overall percent asbestos for the sample is reported when relevant. The EPA considers a material to be asbestos containing only if it contains greater than one percent asbestos by Calibrated Visual Area Estimation (CVAE). EPA regulations also indicate that Regulated Asbestos Containing Materials (RACM) – materials that are friable or may become friable – be further analyzed by point counting when the results indicate less than ten percent asbestos by CVAE. CatesLab utilizes CVAE on a routine basis and does not include point counting unless specifically requested by the client. The results may not be reproduced except in full.

PLM REPORT SUMMARY

Cates Laboratories
1339 Motor Circle
Dallas, Texas 75207 (214) 920-5006

NVLAP Lab No. 200569-0
TDSHS License No. 30-0287

Client: Terracon
Project (Line 1): RDC VA Hospital
Project (Line 2): 1601 SW Archer Road, Gainesville, FL
Project No: EQ227237
Identification: Asbestos, Bulk Sample Analysis
Test Method: Polarized Light Microscopy/Dispersion Staining (PLM/DS)
EPA Method 600/R-93/116

Lab Job No.: PLM-36087
Set No.: 51622
Report Date: 2/1/2024
Sample Date: 1/23/2024

On 1/25/2024, three-hundred seventeen (317) bulk samples were submitted by a representative of Terracon for asbestos analysis by PLM/DS. Copies of the lab data sheets are attached; additional information may be found therein. The results are summarized below:

Lab Sample No.	Client Field I.D.	Sample Description/Location	Asbestos Content
CL1223773	45-A	Wallpaper/Adhesive - A-341 Floor 3	None Detected - Wall Covering None Detected - Yellow Adhesive
CL1223774	45-B	Wallpaper/Adhesive - A-341 Floor 3	None Detected - Wall Covering None Detected - Yellow Adhesive
CL1223775	45-C	Wallpaper/Adhesive - A-341 Floor 3	None Detected - Wall Covering None Detected - Yellow Adhesive
CL1223776	46-A	Yellow Mastic Computer Floor - E449-1 Floor 4	None Detected
CL1223777	46-B	Yellow Mastic Computer Floor - E449-1 Floor 4	None Detected
CL1223778	46-C	Yellow Mastic Computer Floor - E449-1 Floor 4	None Detected
CL1223779	47-A	Grey Mastic Floor Support Stand - E449-1 Floor 4	None Detected
CL1223780	47-B	Grey Mastic Floor Support Stand - E449-1 Floor 4	None Detected
CL1223781	47-C	Grey Mastic Floor Support Stand - E449-1 Floor 4	None Detected
CL1223782	48-A	6" X 3' Dark Plank Flooring/Adhesive - H425-1 Floor 4	None Detected - Flooring None Detected - Yellow Mastic
CL1223783	48-B	6" X 3' Dark Plank Flooring/Adhesive - H425-1 Floor 4	None Detected - Flooring None Detected - Yellow Mastic
CL1223784	48-C	6" X 3' Dark Plank Flooring/Adhesive - H425-1 Floor 4	None Detected - Flooring None Detected - Yellow Mastic
CL1223785	49-A	2' X 4' Ceiling Tile Pinhole & Fissure - E503-1 Floor 5	None Detected
CL1223786	49-B	2' X 4' Ceiling Tile Pinhole & Fissure - E503-1 Floor 5	None Detected
CL1223787	49-C	2' X 4' Ceiling Tile Pinhole & Fissure - E503-1 Floor 5	None Detected
CL1223788	21-I	Drywall/Joint Compound Wall - J441 Floor 4	None Detected - Joint Tape None Detected - Joint Compound None Detected - Paper None Detected - Wallboard Material

These samples were analyzed by layers. The overall percent asbestos for the sample is reported when relevant. The EPA considers a material to be asbestos containing only if it contains greater than one percent asbestos by Calibrated Visual Area Estimation (CVAE). EPA regulations also indicate that Regulated Asbestos Containing Materials (RACM) – materials that are friable or may become friable – be further analyzed by point counting when the results indicate less than ten percent asbestos by CVAE. CatesLab utilizes CVAE on a routine basis and does not include point counting unless specifically requested by the client. The results may not be reproduced except in full.

PLM REPORT SUMMARY

Cates Laboratories
1339 Motor Circle
Dallas, Texas 75207 (214) 920-5006

NVLAP Lab No. 200569-0
TDSHS License No. 30-0287

Client: Terracon
Project (Line 1): RDC VA Hospital
Project (Line 2): 1601 SW Archer Road, Gainesville, FL
Project No: EQ227237
Identification: Asbestos, Bulk Sample Analysis
Test Method: Polarized Light Microscopy/Dispersion Staining (PLM/DS)
EPA Method 600/R-93/116

Lab Job No.: PLM-36087
Set No.: 51622
Report Date: 2/1/2024
Sample Date: 1/23/2024

On 1/25/2024, three-hundred seventeen (317) bulk samples were submitted by a representative of Terracon for asbestos analysis by PLM/DS. Copies of the lab data sheets are attached; additional information may be found therein. The results are summarized below:

Lab Sample No.	Client Field I.D.	Sample Description/Location	Asbestos Content
CL1223789	50-A	Black Mastic Wall - Building 14 122-14	10% Chrysotile
CL1223790	50-B	Black Mastic Wall - Building 14 106-4	10% Chrysotile
CL1223791	50-C	Black Mastic Wall - Building 14 106-14	10% Chrysotile
CL1223792	51-A	White Mastic Fiberglass Duct Insulation Ceiling - Building 14 122-14	20% Chrysotile - White Mastic None Detected - Wrap None Detected - Insulation
CL1223793	51-B	White Mastic Fiberglass Duct Insulation Ceiling - Building 14 106-14	20% Chrysotile - White Mastic None Detected - Wrap None Detected - Insulation
CL1223794	51-C	White Mastic Fiberglass Duct Insulation Ceiling - Building 14 106-14	20% Chrysotile - White Mastic None Detected - Wrap None Detected - Insulation
CL1223795	52-A	2' X 2' Ceiling Tile Pinhole & Fissure Ceiling - Building 14 122-14	None Detected
CL1223796	52-B	2' X 2' Ceiling Tile Pinhole & Fissure Ceiling - Building 14 122-14	None Detected
CL1223797	52-C	2' X 2' Ceiling Tile Pinhole & Fissure Ceiling - Building 14 122-14	None Detected
CL1223798	53-A	Drywall/Joint Compound Wall - Building 14 122-14	None Detected - Joint Tape None Detected - Joint Compound None Detected - Paper None Detected - Wallboard Material
CL1223799	53-B	Drywall/Joint Compound Wall - Building 14 106-14	None Detected - Joint Tape None Detected - Joint Compound None Detected - Paper None Detected - Wallboard Material
CL1223800	53-C	Drywall/Joint Compound Wall - Building 14 106-14	None Detected - Joint Compound None Detected - Paper None Detected - Wallboard Material
CL1223801	54-A	6" Cove Base Beige/Adhesive - Building 14 122-14	None Detected - Cove Base None Detected - Yellow Mastic

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1339 Motor Circle
Dallas, Texas 75207 (214) 920-5006

NVLAP Lab No. 200569-0
TDSHS License No. 30-0287

Client: Terracon
Project (Line 1): RDC VA Hospital
Project (Line 2): 1601 SW Archer Road, Gainesville, FL
Project No: EQ227237
Identification: Asbestos, Bulk Sample Analysis
Test Method: Polarized Light Microscopy/Dispersion Staining (PLM/DS)
EPA Method 600/R-93/116

Lab Job No.: PLM-36087
Set No.: 51622
Report Date: 2/1/2024
Sample Date: 1/23/2024

On 1/25/2024, three-hundred seventeen (317) bulk samples were submitted by a representative of Terracon for asbestos analysis by PLM/DS. Copies of the lab data sheets are attached; additional information may be found therein. The results are summarized below:

Lab Sample No.	Client Field I.D.	Sample Description/Location	Asbestos Content
CL1223802	54-B	6" Cove Base Beige/Adhesive - Building 14 122-14	None Detected - Cove Base None Detected - Yellow Mastic
CL1223803	54-C	6" Cove Base Beige/Adhesive - Building 14 122-14	None Detected - Cove Base None Detected - Yellow Mastic
CL1223804	55-A	12" X 12" VFT Mastic - Building 14 122-14	None Detected - Floor Tile None Detected - Yellow Mastic
CL1223805	55-B	12" X 12" VFT Mastic - Building 14 122-14	None Detected - Floor Tile None Detected - Yellow Mastic
CL1223806	55-C	12" X 12" VFT Mastic - Building 14 122-14	None Detected - Floor Tile None Detected - Yellow Mastic
CL1223807	56-A	2' X 4' Ceiling Tile Pinhole & Fissure Ceiling - Building 14 106-14	None Detected
CL1223808	56-B	2' X 4' Ceiling Tile Pinhole & Fissure Ceiling - Building 14 106-14	None Detected
CL1223809	56-C	2' X 4' Ceiling Tile Pinhole & Fissure Ceiling - Building 14 106-14	None Detected
CL1223810	57-A	6" Cove Base Black/Adhesive - Building 14 106-14	None Detected - Cove Base None Detected - Off White Mastic
CL1223811	57-B	6" Cove Base Black/Adhesive - Building 14 106-14	None Detected - Cove Base None Detected - Off White Mastic
CL1223812	57-C	6" Cove Base Black/Adhesive - Building 14 106-14	None Detected - Cove Base None Detected - Off White Mastic
CL1223813	58-A	6" X 3' Vinyl Plank Brown Flooring - Building 14 106-14	None Detected - Flooring None Detected - Yellow Mastic
CL1223814	58-B	6" X 3' Vinyl Plank Brown Flooring - Building 14 106-14	None Detected - Flooring None Detected - Yellow Mastic
CL1223815	58-C	6" X 3' Vinyl Plank Brown Flooring - Building 14 106-14	None Detected - Flooring None Detected - Yellow Mastic
CL1223816	59-A	2' X 4' Ceiling Tile Pinhole & Fissure - Building 14 117	None Detected

These samples were analyzed by layers. The overall percent asbestos for the sample is reported when relevant. The EPA considers a material to be asbestos containing only if it contains greater than one percent asbestos by Calibrated Visual Area Estimation (CVAE). EPA regulations also indicate that Regulated Asbestos Containing Materials (RACM) – materials that are friable or may become friable – be further analyzed by point counting when the results indicate less than ten percent asbestos by CVAE. CatesLab utilizes CVAE on a routine basis and does not include point counting unless specifically requested by the client. The results may not be reproduced except in full.

PLM REPORT SUMMARY

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Dallas, Texas 75207 (214) 920-5006

NVLAP Lab No. 200569-0
TDSHS License No. 30-0287

Client: Terracon
Project (Line 1): RDC VA Hospital
Project (Line 2): 1601 SW Archer Road, Gainesville, FL
Project No: EQ227237
Identification: Asbestos, Bulk Sample Analysis
Test Method: Polarized Light Microscopy/Dispersion Staining (PLM/DS)
EPA Method 600/R-93/116

Lab Job No.: PLM-36087
Set No.: 51622
Report Date: 2/1/2024
Sample Date: 1/23/2024

On 1/25/2024, three-hundred seventeen (317) bulk samples were submitted by a representative of Terracon for asbestos analysis by PLM/DS. Copies of the lab data sheets are attached; additional information may be found therein. The results are summarized below:

Lab Sample No.	Client Field I.D.	Sample Description/Location	Asbestos Content
CL1223817	59-B	2' X 4' Ceiling Tile Pinhole & Fissure - Building 14 117	None Detected
CL1223818	59-C	2' X 4' Ceiling Tile Pinhole & Fissure - Building 14 117	None Detected
CL1223819	60-A	White Mastic Fiberglass Duct Insulation Ceiling - Building 11 117	20% Chrysotile - White Mastic None Detected - Wrap None Detected - Insulation
CL1223820	60-B	White Mastic Fiberglass Duct Insulation Ceiling - Building 11 117	20% Chrysotile - White Mastic None Detected - Wrap None Detected - Insulation
CL1223821	60-C	White Mastic Fiberglass Duct Insulation Ceiling - Building 11 117	20% Chrysotile - White Mastic None Detected - Wrap None Detected - Insulation
CL1223822	61-A	Drywall/Joint Compound Wall - Building 11 117	None Detected - Joint Compound None Detected - Paper None Detected - Wallboard Material
CL1223823	61-B	Drywall/Joint Compound Wall - Building 11 117	None Detected - Joint Compound None Detected - Paper None Detected - Wallboard Material
CL1223824	61-C	Drywall/Joint Compound Wall - Building 11 117	None Detected - Joint Compound None Detected - Paper None Detected - Wallboard Material
CL1223825	62-A	4" Cove Base/Adhesive Wall - Building 11 117	None Detected - Cove Base None Detected - Brown Mastic
CL1223826	62-B	4" Cove Base/Adhesive Wall - Building 11 117	None Detected - Cove Base None Detected - Brown Mastic
CL1223827	62-C	4" Cove Base/Adhesive Wall - Building 11 117	None Detected - Cove Base None Detected - Brown Mastic
CL1223828	63-A	12" X 12" VFT Mastic Reddish Brown Streaks Floor - Building 11 117	None Detected - Floor Tile None Detected - Yellow Mastic

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Project (Line 1): RDC VA Hospital
Project (Line 2): 1601 SW Archer Road, Gainesville, FL
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Lab Sample No.	Client Field I.D.	Sample Description/Location	Asbestos Content
CL1223829	63-B	12" X 12" VFT Mastic Reddish Brown Streaks Floor - Building 11 117	None Detected - Floor Tile None Detected - Yellow Mastic
CL1223830	63-C	12" X 12" VFT Mastic Reddish Brown Streaks Floor - Building 11 117	None Detected - Floor Tile None Detected - Yellow Mastic
CL1223831	64-A	4"-6" Pipe White Mastic Ceiling - Building 11 117	None Detected - White Mastic None Detected - Wrap None Detected - White Mastic None Detected - Insulation
CL1223832	64-B	4"-6" Pipe White Mastic Ceiling - Building 11 117	None Detected - White Mastic None Detected - Wrap None Detected - White Mastic None Detected - Insulation
CL1223833	64-C	4"-6" Pipe White Mastic Ceiling - Building 11 117	None Detected - White Mastic None Detected - Wrap None Detected - White Mastic None Detected - Insulation
CL1223834	65-A	Plaster Ceiling - Building 11 117	None Detected - Paint Texture None Detected - Paper None Detected - Wallboard Material
CL1223835	65-B	Plaster Ceiling - Building 11 117	None Detected - Paint Texture None Detected - Paper None Detected - Wallboard Material
CL1223836	65-C	Plaster Ceiling - Building 11 117	None Detected - Paint Texture None Detected - Paper None Detected - Wallboard Material
CL1223837	66-A	Red Fire Putty - Building 11 117	None Detected
CL1223838	66-B	Red Fire Putty - Building 11 117	None Detected
CL1223839	66-C	Red Fire Putty - Building 11 117	None Detected

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Lab Sample No.	Client Field I.D.	Sample Description/Location	Asbestos Content
CL1223840	67-A	Plaster Ceiling - Building 11 117	None Detected - Paint Layer None Detected - Plaster Topcoat None Detected - Plaster
CL1223841	67-B	Plaster Ceiling - Building 11 117	None Detected - Paint Layer None Detected - Plaster Topcoat None Detected - Plaster
CL1223842	67-C	Plaster Ceiling - Building 11 117	None Detected - Paint Layer None Detected - Plaster Topcoat None Detected - Plaster
CL1223843	68-A	Pink Fire Putty - Building 11 Closet 117	None Detected
CL1223844	68-B	Pink Fire Putty - Building 11 Closet 117	None Detected
CL1223845	68C-	Pink Fire Putty - Building 11 Closet 117	None Detected
CL1223846	69-A	6"-8" Pipe White Mastic Ceiling - Building 12 110-12	None Detected - White Mastic None Detected - Wrap
CL1223847	69-B	6"-8" Pipe White Mastic Ceiling - Building 12 110-12	None Detected - White Mastic None Detected - Wrap
CL1223848	69-C	6"-8" Pipe White Mastic Ceiling - Building 12 110-12	None Detected - White Mastic None Detected - Wrap
CL1223849	70-A	Pink Fire Putty - Building 12 110-12	None Detected
CL1223850	70-B	Pink Fire Putty - Building 12 110-12	None Detected
CL1223851	70-C	Pink Fire Putty - Building 12 110-12	None Detected
CL1223852	71-A	Drywall/Joint Compound Wall - Building 12 110-12	None Detected - Joint Tape None Detected - Joint Compound None Detected - Paper None Detected - Wallboard Material

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Lab Sample No.	Client Field I.D.	Sample Description/Location	Asbestos Content
CL1223853	71-B	Drywall/Joint Compound Wall - Building 12 247-12	None Detected - Joint Tape None Detected - Joint Compound None Detected - Paper None Detected - Wallboard Material
CL1223854	71-C	Drywall/Joint Compound Wall - Building 12 247-12	None Detected - Joint Tape None Detected - Joint Compound None Detected - Paper None Detected - Wallboard Material
CL1223855	72-A	4" Brown Cove Base/Wall Adhesive - Building 12 110-12	None Detected - Cove Base None Detected - Yellow Mastic
CL1223856	72-B	4" Brown Cove Base/Wall Adhesive - Building 12 110-12	None Detected - Cove Base None Detected - Yellow Mastic
CL1223857	72-C	4" Brown Cove Base/Wall Adhesive - Building 12 110-12	None Detected - Cove Base None Detected - Yellow Mastic
CL1223858	73-A	Olive Green Mastic Duct Ceiling - Building 12 110-12	None Detected
CL1223859	73-B	Olive Green Mastic Duct Ceiling - Building 12 247-12	None Detected
CL1223860	73-C	Olive Green Mastic Duct Ceiling - Building 12 247-12	None Detected
CL1223861	74-A	Black Glass Rock 8" Pipe TSI Mastic Ceiling - Building 12 110-12	None Detected - Wrap None Detected - Black Mastic None Detected - Insulation
CL1223862	74-B	Black Glass Rock 8" Pipe TSI Mastic Ceiling - Building 12 110-12	None Detected - Wrap None Detected - Black Mastic None Detected - Insulation
CL1223863	74-C	Black Glass Rock 8" Pipe TSI Mastic Ceiling - Building 12 110-12	None Detected - Wrap None Detected - Black Mastic None Detected - Insulation
CL1223864	75-A	Yellow Mastic Floor - Building 12 110-12	None Detected
CL1223865	75-B	Yellow Mastic Floor - Building 12 110-12	None Detected

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Project (Line 1): RDC VA Hospital
Project (Line 2): 1601 SW Archer Road, Gainesville, FL
Project No: EQ227237
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Lab Sample No.	Client Field I.D.	Sample Description/Location	Asbestos Content
CL1223866	75-C	Yellow Mastic Floor - Building 12 110-12	None Detected
CL1223867	76-A	2' X 2' Ceiling Tile Pinhole & Fissure Ceiling - Building 12 247-12	None Detected
CL1223868	76-B	2' X 2' Ceiling Tile Pinhole & Fissure Ceiling - Building 12 247-12	None Detected
CL1223869	76-C	2' X 2' Ceiling Tile Pinhole & Fissure Ceiling - Building 12 247-12	None Detected
CL1223870	77-A	6" Black Cove Base/Adhesive Wall - Building 12 247-12	None Detected - Cove Base None Detected - Yellow Mastic
CL1223871	77-B	6" Black Cove Base/Adhesive Wall - Building 12 247-12	None Detected - Cove Base None Detected - Yellow Mastic
CL1223872	77-C	6" Black Cove Base/Adhesive Wall - Building 12 247-12	None Detected - Cove Base None Detected - Yellow Mastic
CL1223873	78-A	6" X 6" Thinset/Grout Wall - Building 12 247-12	None Detected - Ceramic Tile None Detected - Grout None Detected - Thinset
CL1223874	78-B	6" X 6" Thinset/Grout Wall - Building 12 247-12	None Detected - Ceramic Tile None Detected - Grout None Detected - Thinset
CL1223875	78-C	6" X 6" Thinset/Grout Wall - Building 12 247-12	None Detected - Ceramic Tile None Detected - Grout None Detected - Thinset
CL1223876	79-A	6" X 3' Vinyl Plank Floor Light Brown - Building 12 247-12	None Detected - Flooring None Detected - Yellow Mastic
CL1223877	79-B	6" X 3' Vinyl Plank Floor Light Brown - Building 12 247-12	None Detected - Flooring None Detected - Yellow Mastic
CL1223878	79-C	6" X 3' Vinyl Plank Floor Light Brown - Building 12 247-12	None Detected - Flooring None Detected - Yellow Mastic
CL1223879	80-A	White Mastic Duct System Ceiling - Building 12 247-2	None Detected
CL1223880	80-B	White Mastic Duct System Ceiling - Building 12 247-2	None Detected

These samples were analyzed by layers. The overall percent asbestos for the sample is reported when relevant. The EPA considers a material to be asbestos containing only if it contains greater than one percent asbestos by Calibrated Visual Area Estimation (CVAE). EPA regulations also indicate that Regulated Asbestos Containing Materials (RACM) – materials that are friable or may become friable – be further analyzed by point counting when the results indicate less than ten percent asbestos by CVAE. CatesLab utilizes CVAE on a routine basis and does not include point counting unless specifically requested by the client. The results may not be reproduced except in full.

PLM REPORT SUMMARY

Cates Laboratories
1339 Motor Circle
Dallas, Texas 75207 (214) 920-5006

NVLAP Lab No. 200569-0
TDSHS License No. 30-0287

Client: Terracon
Project (Line 1): RDC VA Hospital
Project (Line 2): 1601 SW Archer Road, Gainesville, FL
Project No: EQ227237
Identification: Asbestos, Bulk Sample Analysis
Test Method: Polarized Light Microscopy/Dispersion Staining (PLM/DS)
EPA Method 600/R-93/116

Lab Job No.: PLM-36087
Set No.: 51622
Report Date: 2/1/2024
Sample Date: 1/23/2024

On 1/25/2024, three-hundred seventeen (317) bulk samples were submitted by a representative of Terracon for asbestos analysis by PLM/DS. Copies of the lab data sheets are attached; additional information may be found therein. The results are summarized below:

Lab Sample No.	Client Field I.D.	Sample Description/Location	Asbestos Content
CL1223881	80-C	White Mastic Duct System Ceiling - Building 12 247-2	None Detected
CL1223882	81-A	4" Beige Cove Base/Adhesive Wall - Building 204-28	None Detected - Cove Base None Detected - Cream Mastic
CL1223883	81-B	4" Beige Cove Base/Adhesive Wall - Building 204-28	None Detected - Cove Base None Detected - Cream Mastic
CL1223884	81-C	4" Beige Cove Base/Adhesive Wall - Building 204-28	None Detected - Cove Base None Detected - Cream Mastic
CL1223885	82-A	Drywall/Joint Compound Wall - Building 204-28	None Detected - Paint Layer None Detected - Joint Compound None Detected - Paper None Detected - Wallboard Material
CL1223886	82-B	Drywall/Joint Compound Wall - Building 204-28	None Detected - Paint Layer None Detected - Joint Tape None Detected - Joint Compound None Detected - Paper None Detected - Wallboard Material
CL1223887	82-C	Drywall/Joint Compound Wall - Building 204-28	None Detected - Paint Layer None Detected - Joint Tape None Detected - Joint Compound None Detected - Paper None Detected - Wallboard Material
CL1223888	83-A	Plaster Ceiling -- Building 204-28	None Detected - Paint Layer None Detected - Plaster
CL1223889	83-B	Plaster Ceiling -- Building 204-28	None Detected - Paint Layer None Detected - Plaster
CL1223890	83-C	Plaster Ceiling -- Building 204-28	None Detected - Paint Layer None Detected - Plaster
CL1223891	84-A	2' X 2' Ceiling Tile Smooth Fissure Ceiling - BT01A-109-TIA	None Detected
CL1223892	84-B	2' X 2' Ceiling Tile Smooth Fissure Ceiling - BT03-107	None Detected

These samples were analyzed by layers. The overall percent asbestos for the sample is reported when relevant. The EPA considers a material to be asbestos containing only if it contains greater than one percent asbestos by Calibrated Visual Area Estimation (CVAE). EPA regulations also indicate that Regulated Asbestos Containing Materials (RACM) – materials that are friable or may become friable – be further analyzed by point counting when the results indicate less than ten percent asbestos by CVAE. CatesLab utilizes CVAE on a routine basis and does not include point counting unless specifically requested by the client. The results may not be reproduced except in full.

PLM REPORT SUMMARY

Cates Laboratories
1339 Motor Circle
Dallas, Texas 75207 (214) 920-5006

NVLAP Lab No. 200569-0
TDSHS License No. 30-0287

Client: Terracon
Project (Line 1): RDC VA Hospital
Project (Line 2): 1601 SW Archer Road, Gainesville, FL
Project No: EQ227237
Identification: Asbestos, Bulk Sample Analysis
Test Method: Polarized Light Microscopy/Dispersion Staining (PLM/DS)
EPA Method 600/R-93/116

Lab Job No.: PLM-36087
Set No.: 51622
Report Date: 2/1/2024
Sample Date: 1/23/2024

On 1/25/2024, three-hundred seventeen (317) bulk samples were submitted by a representative of Terracon for asbestos analysis by PLM/DS. Copies of the lab data sheets are attached; additional information may be found therein. The results are summarized below:

Lab Sample No.	Client Field I.D.	Sample Description/Location	Asbestos Content
CL1223893	84-C	2' X 2' Ceiling Tile Smooth Fissure Ceiling - BT03-107	None Detected
CL1223894	85-A	4" Cove Base Mastic Beige Wall - BT01A-109-TIA	None Detected - Cove Base None Detected - Yellow Mastic
CL1223895	85-B	4" Cove Base Mastic Beige Wall - BT03-107	None Detected - Cove Base None Detected - Yellow Mastic
CL1223896	85-C	4" Cove Base Mastic Beige Wall - BT03-107	None Detected - Cove Base None Detected - Yellow Mastic
CL1223897	86-A	12" X 12" VFT Mastic Floor - BT01A-109-TIA	None Detected - Floor Tile None Detected - Green Mastic None Detected - Sub-floor Material
CL1223898	86-B	12" X 12" VFT Mastic Floor - BT03-107	None Detected - Floor Tile None Detected - Green Mastic None Detected - Sub-floor Material
CL1223899	86-C	12" X 12" VFT Mastic Floor - BT03-107	None Detected - Floor Tile None Detected - Green Mastic None Detected - Sub-floor Material
CL1223900	87-A	Wallpaper Adhesive Wall - BT01A-109-TIA	None Detected
CL1223901	87-B	Wallpaper Adhesive Wall - BT03-107	None Detected
CL1223902	87-C	Wallpaper Adhesive Wall - BT08-107	None Detected
CL1223903	88-A	Gypsum Wall - BT01A-109-TIA	None Detected - Wall Covering None Detected - Paper None Detected - Wallboard Material
CL1223904	88-B	Gypsum Wall - BT03-107	None Detected - Wall Covering None Detected - Paper None Detected - Wallboard Material
CL1223905	88-C	Gypsum Wall - BT08-107	None Detected - Wall Covering None Detected - Paper None Detected - Wallboard Material

These samples were analyzed by layers. The overall percent asbestos for the sample is reported when relevant. The EPA considers a material to be asbestos containing only if it contains greater than one percent asbestos by Calibrated Visual Area Estimation (CVAE). EPA regulations also indicate that Regulated Asbestos Containing Materials (RACM) – materials that are friable or may become friable – be further analyzed by point counting when the results indicate less than ten percent asbestos by CVAE. CatesLab utilizes CVAE on a routine basis and does not include point counting unless specifically requested by the client. The results may not be reproduced except in full.

PLM REPORT SUMMARY

Cates Laboratories
1339 Motor Circle
Dallas, Texas 75207 (214) 920-5006

NVLAP Lab No. 200569-0
TDSHS License No. 30-0287

Client: Terracon
Project (Line 1): RDC VA Hospital
Project (Line 2): 1601 SW Archer Road, Gainesville, FL
Project No: EQ227237
Identification: Asbestos, Bulk Sample Analysis
Test Method: Polarized Light Microscopy/Dispersion Staining (PLM/DS)
EPA Method 600/R-93/116

Lab Job No.: PLM-36087
Set No.: 51622
Report Date: 2/1/2024
Sample Date: 1/23/2024

On 1/25/2024, three-hundred seventeen (317) bulk samples were submitted by a representative of Terracon for asbestos analysis by PLM/DS. Copies of the lab data sheets are attached; additional information may be found therein. The results are summarized below:

Lab Sample No.	Client Field I.D.	Sample Description/Location	Asbestos Content
CL1223906	89-A	2' X 2' Ceiling Tile Fissure & Pinhole Ceiling - BT02 110-T2	None Detected
CL1223907	89-B	2' X 2' Ceiling Tile Fissure & Pinhole Ceiling - BT08-107	None Detected
CL1223908	89-C	2' X 2' Ceiling Tile Fissure & Pinhole Ceiling - BT10-109	None Detected
CL1223909	90-A	4" Cove Base Grey Adhesive Wall - BT02 110	None Detected - Cove Base None Detected - Tan Mastic
CL1223910	90-B	4" Cove Base Grey Adhesive Wall - BT04 107	None Detected - Cove Base None Detected - Tan Mastic
CL1223911	90-C	4" Cove Base Grey Adhesive Wall - BT06 105	None Detected - Cove Base None Detected - Tan Mastic
CL1223912	91-A	Wallpaper Adhesive Wall - BT02 110	None Detected
CL1223913	91-B	Wallpaper Adhesive Wall - BT11 121	None Detected
CL1223914	91-C	Wallpaper Adhesive Wall - BT04 107	None Detected
CL1223915	92-A	Gypsum Wall - BT02 110	None Detected - Wall Covering None Detected - Paper None Detected - Wallboard Material
CL1223916	92-B	Gypsum Wall - BT11 121	None Detected - Wall Covering None Detected - Paper None Detected - Wallboard Material
CL1223917	92-C	Gypsum Wall - BT04 105	None Detected - Wall Covering None Detected - Paper None Detected - Wallboard Material
CL1223918	93-A	6" X 3' Vinyl Plank Floor/Adhesive Floor - BT02 110	None Detected - Flooring None Detected - Yellow Mastic
CL1223919	93-B	6" X 3' Vinyl Plank Floor/Adhesive Floor - BT11 121	None Detected - Flooring None Detected - Yellow Mastic
CL1223920	93-C	6" X 3' Vinyl Plank Floor/Adhesive Floor - BT11 121	None Detected - Flooring None Detected - Yellow Mastic

These samples were analyzed by layers. The overall percent asbestos for the sample is reported when relevant. The EPA considers a material to be asbestos containing only if it contains greater than one percent asbestos by Calibrated Visual Area Estimation (CVAE). EPA regulations also indicate that Regulated Asbestos Containing Materials (RACM) – materials that are friable or may become friable – be further analyzed by point counting when the results indicate less than ten percent asbestos by CVAE. CatesLab utilizes CVAE on a routine basis and does not include point counting unless specifically requested by the client. The results may not be reproduced except in full.

PLM REPORT SUMMARY

Cates Laboratories
1339 Motor Circle
Dallas, Texas 75207 (214) 920-5006

NVLAP Lab No. 200569-0
TDSHS License No. 30-0287

Client: Terracon
Project (Line 1): RDC VA Hospital
Project (Line 2): 1601 SW Archer Road, Gainesville, FL
Project No: EQ227237
Identification: Asbestos, Bulk Sample Analysis
Test Method: Polarized Light Microscopy/Dispersion Staining (PLM/DS)
EPA Method 600/R-93/116

Lab Job No.: PLM-36087
Set No.: 51622
Report Date: 2/1/2024
Sample Date: 1/23/2024

On 1/25/2024, three-hundred seventeen (317) bulk samples were submitted by a representative of Terracon for asbestos analysis by PLM/DS. Copies of the lab data sheets are attached; additional information may be found therein. The results are summarized below:

Lab Sample No.	Client Field I.D.	Sample Description/Location	Asbestos Content
CL1223921	94-A	12" X 12" VFT Adhesive Tan Floor - BT05 113	None Detected - Floor Tile None Detected - Yellow Mastic
CL1223922	94-B	12" X 12" VFT Adhesive Tan Floor - BT04 107	None Detected - Floor Tile None Detected - Yellow Mastic
CL1223923	94-C	12" X 12" VFT Adhesive Tan Floor - BT07 113	None Detected - Floor Tile None Detected - Yellow Mastic
CL1223924	95-A	2' X 2' Ceiling Tile Pinhole/Fissure - BT05 113	None Detected
CL1223925	95-B	2' X 2' Ceiling Tile Pinhole/Fissure - BT11 121	None Detected
CL1223926	95-C	2' X 2' Ceiling Tile Pinhole/Fissure - BT04 107	None Detected
CL1223927	96-A	Gypsum Wall - BT05 113	None Detected - Joint Compound None Detected - Paper None Detected - Wallboard Material
CL1223928	96-B	Gypsum Wall - BT04 107	None Detected - Paper None Detected - Wallboard Material
CL1223929	96-C	Gypsum Wall - BT06 107	None Detected - Joint Compound None Detected - Paper None Detected - Wallboard Material
CL1223930	97-A	4" Tan Cove Base/Adhesive Wall - BT05 113	None Detected - Cove Base None Detected - Yellow Mastic
CL1223931	97-B	4" Tan Cove Base/Adhesive Wall - BT07 113	None Detected - Cove Base None Detected - Yellow Mastic
CL1223932	97-C	4" Tan Cove Base/Adhesive Wall - BT08 107	None Detected - Cove Base None Detected - Yellow Mastic
CL1223933	98-A	Wallpaper/Off-white Adhesive Wall - BT05 113	None Detected
CL1223934	98-B	Wallpaper/Off-white Adhesive Wall - BT09 111	None Detected
CL1223935	98-C	Wallpaper/Off-white Adhesive Wall - BT09 111	None Detected

These samples were analyzed by layers. The overall percent asbestos for the sample is reported when relevant. The EPA considers a material to be asbestos containing only if it contains greater than one percent asbestos by Calibrated Visual Area Estimation (CVAE). EPA regulations also indicate that Regulated Asbestos Containing Materials (RACM) – materials that are friable or may become friable – be further analyzed by point counting when the results indicate less than ten percent asbestos by CVAE. CatesLab utilizes CVAE on a routine basis and does not include point counting unless specifically requested by the client. The results may not be reproduced except in full.

PLM REPORT SUMMARY

Cates Laboratories
1339 Motor Circle
Dallas, Texas 75207 (214) 920-5006

NVLAP Lab No. 200569-0
TDSHS License No. 30-0287

Client: Terracon
Project (Line 1): RDC VA Hospital
Project (Line 2): 1601 SW Archer Road, Gainesville, FL
Project No: EQ227237
Identification: Asbestos, Bulk Sample Analysis
Test Method: Polarized Light Microscopy/Dispersion Staining (PLM/DS)
EPA Method 600/R-93/116

Lab Job No.: PLM-36087
Set No.: 51622
Report Date: 2/1/2024
Sample Date: 1/23/2024

On 1/25/2024, three-hundred seventeen (317) bulk samples were submitted by a representative of Terracon for asbestos analysis by PLM/DS. Copies of the lab data sheets are attached; additional information may be found therein. The results are summarized below:

Lab Sample No.	Client Field I.D.	Sample Description/Location	Asbestos Content
CL1223936	99-A	6" Cove Base Adhesive Black Wall - BT11 121	None Detected - Cove Base None Detected - White Mastic
CL1223937	99-B	6" Cove Base Adhesive Black Wall - BT11 121	None Detected - Cove Base None Detected - White Mastic
CL1223938	99-C	6" Cove Base Adhesive Black Wall - BT11 121	None Detected - Cove Base None Detected - White Mastic
CL1223939	100-A	White Mastic Duct Ceiling - BT04 107	None Detected - White Mastic None Detected - Wrap None Detected - Insulation
CL1223940	100-B	White Mastic Duct Ceiling - BT04 107	None Detected - White Mastic None Detected - Wrap None Detected - Insulation
CL1223941	100-C	White Mastic Duct Ceiling - BT04 107	None Detected - White Mastic None Detected - Wrap None Detected - Insulation
CL1223942	101-A	Brown Fire Putty - BT04 107	None Detected
CL1223943	101-B	Brown Fire Putty - BT04 107	None Detected
CL1223944	101-C	Brown Fire Putty - BT04 107	None Detected
CL1223945	102-A	Vinyl Sheeting Olive Green Floor - BT06 107	None Detected - Sheet Flooring None Detected - Backing/Mastic
CL1223946	102-B	Vinyl Sheeting Olive Green Floor - BT06 107	None Detected - Sheet Flooring None Detected - Backing/Mastic
CL1223947	102-C	Vinyl Sheeting Olive Green Floor - BT06 107	None Detected - Sheet Flooring None Detected - Backing/Mastic
CL1223948	103-A	Fire Putty Red Wall - BT08 107	None Detected
CL1223949	103-B	Fire Putty Red Wall - BT08 107	None Detected
CL1224134	103-C	Fire Putty Red Wall - BT08 107	None Detected

These samples were analyzed by layers. The overall percent asbestos for the sample is reported when relevant. The EPA considers a material to be asbestos containing only if it contains greater than one percent asbestos by Calibrated Visual Area Estimation (CVAE). EPA regulations also indicate that Regulated Asbestos Containing Materials (RACM) – materials that are friable or may become friable – be further analyzed by point counting when the results indicate less than ten percent asbestos by CVAE. CatesLab utilizes CVAE on a routine basis and does not include point counting unless specifically requested by the client. The results may not be reproduced except in full.

PLM REPORT SUMMARY

Cates Laboratories
1339 Motor Circle
Dallas, Texas 75207 (214) 920-5006

NVLAP Lab No. 200569-0
TDSHS License No. 30-0287

Client:	Terracon	Lab Job No.:	PLM-36087
Project (Line 1):	RDC VA Hospital	Set No.:	51622
Project (Line 2):	1601 SW Archer Road, Gainesville, FL	Report Date:	2/1/2024
Project No:	EQ227237	Sample Date:	1/23/2024
Identification:	Asbestos, Bulk Sample Analysis		
Test Method:	Polarized Light Microscopy/Dispersion Staining (PLM/DS) EPA Method 600/R-93/116		

On 1/25/2024, three-hundred seventeen (317) bulk samples were submitted by a representative of Terracon for asbestos analysis by PLM/DS.
Copies of the lab data sheets are attached; additional information may be found therein.

STATEMENT OF LABORATORY ACCREDITATION

The samples were analyzed in general accordance with the procedures outlined in the U.S. EPA Interim Method for the Determination of Asbestos in Bulk Insulation Samples as found in 40 CFR, Part 763, Subpart E, Appendix E (formerly Subpart F, Appendix A), or the current U.S. EPA method (EPA Method 600/R-93/116) for the analysis of asbestos in building materials, by polarized light microscopy. The results of each bulk sample relate only to the material tested and the results shall not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

Specific questions concerning bulk sample results shall be directed to the Laboratory Director.

Analyst: Kevin Bowman, John R. Cates, Darlene Dao, Curtis Grigg, Kathy Schosek

Laboratory Director: John R. Cates, P.G.

Approved Signatory:

NVLAP®

TESTING
NVLAP LAB CODE 200569-0

342401730

EMSL

107 Haddon Avenue, Westmont, New Jersey 08108 1-800-220-3675 http://www.emsl.com

EMSL ANALYTICAL, Inc. CHAIN OF CUSTODY

EMSL Rep:

Third Party Billing requires written authorization from third party

Your Name:		EMSL-Bill to:	
Company:	Tavacon		
Street:	1675 Lee Rd	Street:	
Box #:	Winter Park, FL. 32789	Box #:	
City/State:	Zip	City/State:	Zip
Phone Results to: Name:	Pete Thompson	Fax Results to: Name:	
Telephone #:	904-330-4405	Fax #:	
Project Name/Number:	EQ227237	Purchase Order #:	

TURNAROUND TIME

☐ 3 Hours	☐ 6 Hours	☐ 12 Hours	☐ 24 Hours	☐ 48 Hours	☐ 72 Hours	☐ 4 Days	☐ 5 Days	☐ 6-10 Days

SAMPLE MATRIX

☐ Air	☐ Bulk	☐ Soil	☐ Wipe	☐ Micro-Vac	☐ Drinking Water	☐ Wastewater	☐ Chips	☐ Other

ASBESTOS ANALYSIS

PCM - Air
- ☐ NIOSH 7400 (A) Issue 2: August 1994
- ☐ OSHA w/TWA

TEM AIR
- ☐ AHERA 40 CFR, Part 763 Subpart E
- ☐ NIOSH 7402 Issue 2
- ☐ EPA Level II

PLM - Bulk
- ☐ EPA 600/R-93/116
- ☐ NY Stratified Point Count
- ☐ California Air Resource Board (CARB) 435
- ☐ NIOSH 9002
- ☐ PLM NOB (Gravimetric) NYS 198.1
- ☐ EPA Point Count (400 Points)
- ☐ EPA Point Count (1,000 Points)
- ☐ Standard Addition Point Count

SOILS
- ☐ EPA Protocol Qualitative
- ☐ EPA Protocol Quantitative
- ☐ EMSL MSD 9000 Method fibers/gram
- ☐ Superfund EPA 540-R097-028 (dust generation)

TEM BULK
- ☐ Drop Mount (Qualitative)
- ☐ Chatfield SOP-1988-02
- ☐ TEM NOB (Gravimetric) NY 198.4

TEM MICROVAC
- ☐ ASTM D 5755-95 (Quantitative)

TEM WIPE
- ☐ ASTM D-6480-99
- ☐ Qualitative☐

TEM WATER
- ☐ EPA 100.1
- ☐ EPA 100.2
- ☐ NYS 198.2

OTHER:

LEAD ANALYSIS

Flame Atomic Absorption
- ☐ Wipe, SW846-7420☐ASTM ☐ non ASTM
- ☐ Soil, SW846-7420
- ☐ Air, NIOSH 7082
- ☒ Chips, SW846-7420 or AOAC 5.009 (974.02)
- ☐ Wastewater, SW 846-7420
- ☐ TCLP LEAD SW846-1311/7420

Graphite Furnace Atomic Absorption
- ☐ Air, NIOSH 7105
- ☐ Wastewater, SW846-7421
- ☐ Soil, SW846-7421
- ☐ Drinking Water, EPA 239.2

ICP – Inductively Coupled Plasma
- ☐Wipe, SW846-6010☐ASTM ☐ non ASTM
- ☐ Soil, SW846-6010
- ☐ Air, NIOSH 7300

MATERIALS ANALYSIS

- ☐ Full Particle Identification
- ☐ Optical Particle Identification
- ☐ Dust Mites and Insect Fragments
- ☐ Particle Size & Distribution
- ☐ Product Comparison
- ☐ Paint Characterizaton
- ☐ Failure Analysis
- ☐ Corrosion Analysis
- ☐ Glove Box Containment Study
- ☐ Petrographic Examination of Concrete
- ☐ Portland Cement in Workplace Atmospheres (OSHA ID-143)
- ☐ Man Made Vitrous Fibers – MMVF's
- ☐ Synthetic Fiber Identification
- ☐ Other:

MICROBIAL ANALYSIS

Air Samples
- ☐Mold & Fungi by Air O Cell
- ☐Mold & Fungi by Agar Plate count & id
- ☐Bacterial Count and Gram Stain
- ☐Bacterial Count and Identification

Water Samples
- ☐ Total Coliforms, Fecal Coliforms
- ☐ Escherichia Coli, Fecal Streptococcus
- ☐ Legionella
- ☐ Salmonella
- ☐ Giardia and Cryptosporidium

Wipe and Bulk Samples
- ☐ Mold & Fungi – Direct Examination
- ☐ Mold & Fungi – (Culture follow up to direct examination if necessary)
- ☐ Mold & Fungi – Culture (Count & ID)
- ☐ Mold & Fungi – Culture (Count only)
- ☐ Bacterial Count & Gram Stain
- ☐ Bacterial Count & Identification (3 most prominent types)
- ☐ Other:

IAQ ANALYSIS

- ☐ Nuisance Dust (NIOSH 0500 & 0600)
- ☐ Airborne Dust (PM10, TSP)
- ☐ Silica Analysis by XRD ☐Niosh 7500
- ☐ HVAC Efficiency
- ☐ Carbon Black
- ☐ Airborne Oil Mist
- ☐ Other:

Client Sample # (S)

TOTAL SAMPLE # 69

Relinquished:		Date: 1/24/24	Time:
Received:		Date: JAN 25 2024	Time: 2:10
Relinquished:		Date:	Time:
Received:		Date:	Time:

Page 1 of 5

OrderID: 342401730

342401730

EMSL Analytical, Inc.
3303 Parkway Center Court
Orlando, FL 32808

PHONE: (407) 599 - 5887
EMAIL: OrlandoLab@emsl.com

EMSL ANALYTICAL, INC.
TESTING LABS • PRODUCTS • TRAINING

Lead Chain of Custody

EMSL Order Number / Lab Use Only

Additional Pages of the Chain of Custody are only necessary if needed for additional sample information

Special Instructions and/or Regulatory Requirements (Sample Specifications, Processing Methods, Limits of Detection, etc.)

Sample Number	Sample Location		Substrate	Color	Condition
1	A027 Door Frame	Basement	Metal	Lt. Gray	Intact
2	Door		↓	↓	
3	Wall		DW	off White	
4	↓		Wood	Black	
5	Ceiling		Plaster	White	
6	Wall		CMU	White	
7	Wall		Wood	Gray	Intact
8	A030-1 Wall	BASEMENT	DW	OFF White	
9	B050C-1		Plaster	Teal	
10			↓	Gray	
11	Door		Wood	↓	
12	C070-1 Wall	Basement	↓	White	
13	Boiler Room Wall		CMU	Silver	Intact
14	↓ Floor		Cement	Red	
15	EB83-1 Wall	FL. 1	Plaster	OFF White	
16	↓ ↓		Wood	↓	
17	FB28C Wall	FL. 1	CMU	White	
18	H1331-1 Door Frame	FL. 1	Metal	OFF White	Intact
19	↓ Floor	↓	Cement	Gray	
20	A132-1 Door Frame	FL. 1	Metal	Teal	
21	Door		Wood	OFF White	
22	↓ Ceiling Tile 12"x12"		Metal	White	
23	C263A-1 Door	FL. 1	Wood	Gray	
24	Door Frame		Metal	↓	
25	↓ Wall	↓	Wood	OFF White	

Method of Shipment: Drop off

Sample Condition Upon Receipt:

Relinquished by	Date/Time	Received by	Date/Time
[signature]	1/29/24		
Relinquished by	Date/Time:	Received by:	Date/Time

Controlled Document - COC-25 Lead R16 4/19/2021

☐ AGREE TO ELECTRONIC SIGNATURE (By checking, I consent to signing this Chain of Custody document by electronic signature.)

EMSL Analytical, Inc.'s Laboratory Terms and Conditions are incorporated into this Chain of Custody by reference in their entirety. Submission of samples to EMSL Analytical, Inc. constitutes acceptance and acknowledgment of all terms and conditions by Customer.

OrderID: 342401730

342401730

EMSL ANALYTICAL, INC.
TESTING LABS • PRODUCTS • TRAINING

Lead Chain of Custody

EMSL Order Number / Lab Use Only

EMSL Analytical, Inc.
3303 Parkway Center Court
Orlando, FL 32808

PHONE: (407) 599 - 5887
EMAIL: OrlandoLab@emsl.com

Additional Pages of the Chain of Custody are only necessary if needed for additional sample information

Special Instructions and/or Regulatory Requirements (Sample Specifications, Processing Methods, Limits of Detection, etc.)

Sample Number	Sample Location			Substrate	Color	Condition
26	C263-1	Ceiling	FL 2	Plaster	OFF White	INTACT
27	J138-1	Door Frame	FL. 2	Metal	OFF White	
28	J138-1	Wall	〃	Wood	White	
29	G161-1	Door Frame	〃	metal	Red	
30	G161-1	Ceiling	FL. 2	Cement	White	
31	E261-1	Door Frame	FL 2	Metal	Green	INTACT
32	E261-1	Wall	〃	wood	OFF White	
33	E261-1	〃	FL. 2	DW	OFF White	
34	A241-1	Door	FL.2	Wood	LT. Gray	
35	A241-1	Door Frame	〃	Metal	LT. Gray	
36	A210-1	Wall	FL. 3	DW	LT. Blue	
37	A210-1	Door Frame	〃 3	Metal	OFF White	
38	A341	Floor	FL. 3	Cement	Gray	
39	E458A-1	Door Frame	〃 4	metal	DK. Green	INTACT
40	〃	〃	〃	〃	OFF White	
41	E571A-1	Door Frame	FL. 5	Metal	OFF White	
42	〃	〃	〃	〃	Maroon	

Method of Shipment: Drop off		Sample Condition Upon Receipt:	
Relinquished by:	Date/Time: 1/24/24	Received by:	Date/Time
Relinquished by:	Date/Time:	Received by:	Date/Time

Controlled Document - COC-25 Lead R16 4/19/2021

☐ AGREE TO ELECTRONIC SIGNATURE (By checking, I consent to signing this Chain of Custody document by electronic signature.)

EMSL Analytical, Inc.'s Laboratory Terms and Conditions are incorporated into this Chain of Custody by reference in their entirety. Submission of samples to EMSL Analytical, Inc. constitutes acceptance and acknowledgment of all terms and conditions by Customer.

3 of 5

Page 2 of 2

342401730

EMSL Analytical, Inc.
3303 Parkway Center Court
Orlando, FL 32808

PHONE: (407) 599 - 5887
EMAIL: OrlandoLab@emsl.com

EMSL ANALYTICAL, INC.
TESTING LABS • PRODUCTS • TRAINING

Lead Chain of Custody

EMSL Order Number / Lab Use Only

Additional Pages of the Chain of Custody are only necessary if needed for additional sample information

Special Instructions and/or Regulatory Requirements (Sample Specifications, Processing Methods, Limits of Detection, etc.)

Sample Number	Sample Location		Substrate	Color	Condition
43	Bldg-14 122-14	Door Frame	Metal	Gray	Intact
44	〃	Wall	DW	off white	〃
45	Bldg 11 117	Door Frame	Metal	off white	〃
46	〃	Door	〃	〃	〃
47	〃	Wall	DW	Yellow	〃
48	〃	Ceiling	Plaster	off white	〃
49	〃	Wall	Wood	Black	〃
50	Bldg 12 110-12	Wall	Wood	off white	〃
51	〃	Wall	DW	〃	〃
52	〃	Door Frame	Metal	Lt. Blue	〃
53	Bldg. 12 110-12	Wall	Cement	off white	〃
54	Bldg 204-28	Door Frame	Metal	〃	〃
55	〃	Door	〃	〃	〃
56	〃	Wall	DW	〃	〃
57	〃	Wall	〃	〃	〃
58	〃	Ceiling	Plaster	White	〃
59	BTOA 109	Door Frame	Metal	off white	〃
60	〃	Door	Wood	Beige	〃
61	〃	Wall	〃	Gray	〃
62	BTO2 110	Door Frame	Metal	Brown	〃
63	BTO5 113	Wall Paper	DW	off white	〃
64	〃	〃	Wood	〃	〃
65	BT11 121	Door	Wood	Beige	〃
66	BTO6 107	Door Frame	〃	Gray	〃
67	〃	Door	〃	〃	〃

Method of Shipment		Sample Condition Upon Receipt	
Relinquished by	Date/Time:	Received by:	Date/Time
Relinquished by	Date/Time:	Received by:	Date/Time

Controlled Document - COC-25 Lead R16 4/19/2021

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4 of 5

342401730

EMSL ANALYTICAL, INC.
TESTING LABS • PRODUCTS • TRAINING

Lead (Air, Bulk, Soil)

EMSL Order Number / Lab Use Only

EMSL Analytical, Inc.
3303 Parkway Center Court
Orlando, FL 32808

PHONE: (407) 599-5887
EMAIL: OrlandoLab@EMSL.com

Additional Pages of the Chain of Custody are only necessary if needed for additional sample information

Special Instructions and/or Regulatory Requirements (Sample Specifications, Processing Methods, Limits of Detection, etc.)

Sample Number	Sample Location	Substrate	Color	Condition
68	BTOT 113 Door Frame	Metal	Tan	Intact
69	1 Wall	Wood	Gray	

Method of Shipment:		Sample Condition Upon Receipt:	
Relinquished by:	Date/Time:	Received by:	Date/Time
Relinquished by:	Date/Time:	Received by:	Date/Time

Controlled Document - COC-05 Asbestos R15 4/23/2021

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5 of 5
Page ~~of~~

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http://www.EMSL.com orlandolab@emsl.com

EMSL Order:	342401730
CustomerID:	TRCF34
CustomerPO:	EQ227237
ProjectID:	

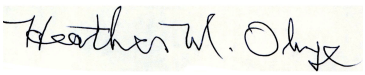
Attn: **Pete Thompson**
Terracon Consultants, Inc.
8001 Baymeadows Way, Suite 1
Jacksonville, FL 32256

Phone: (904) 419-7055
Fax:
Received: 1/25/2024 02:20 PM
Collected:

Project: **EQ227237**

Test Report: Lead in Paint Chips by Flame AAS (SW 846 3050B/7000B)*

Client Sample Description	*Lab ID*	*Collected*	*Analyzed*	*Weight*	*Lead Concentration*
1	*342401730-0001*		1/27/2024	0.2841 g	0.14 % wt
	Site: A027 Door Frame Basement, Metal, Lt. Gray				
2	*342401730-0002*		1/27/2024	0.2999 g	<0.0080 % wt
	Site: A027 Door Basement, Metal, Lt. Gray				
3	*342401730-0003*		1/27/2024	0.2656 g	<0.0080 % wt
	Site: A027 Wall Basement, DW, Off White				
4	*342401730-0004*		1/27/2024	0.2240 g	<0.0089 % wt
	Site: A027 Wall Basement, Wood, Black				
5	*342401730-0005*		1/27/2024	0.2505 g	<0.0080 % wt
	Site: A027 Ceiling Basement, Plaster, White				
6	*342401730-0006*		1/27/2024	0.2899 g	<0.0080 % wt
	Site: A027 Wall Basement, CMU, White				
7	*342401730-0007*		1/27/2024	0.2996 g	0.27 % wt
	Site: A027 Wall Basement, Wood, Gray				
8	*342401730-0008*		1/27/2024	0.2938 g	<0.0080 % wt
	Site: A030-1 Wall Basement, DW, Off White				
9	*342401730-0009*		1/27/2024	0.2578 g	<0.0080 % wt
	Site: B050C-1 Wall Basement, Plaster, Teal				
10	*342401730-0010*		1/27/2024	0.3035 g	<0.0080 % wt
	Site: B050C-1 Wall Basement, Plaster, Gray				
11	*342401730-0011*		1/27/2024	0.3165 g	<0.0080 % wt
	Site: B050C-1 Door Basement, Wood, Gray				
12	*342401730-0012*		1/27/2024	0.2792 g	<0.0080 % wt
	Site: C070-1 Wall Basement, Wood, White				
13	*342401730-0013*		1/27/2024	0.2886 g	<0.0080 % wt
	Site: Boiler Room Wall, CMU, Silver				
14	*342401730-0014*		1/27/2024	0.2710 g	<0.0080 % wt
	Site: Boiler Room Floor, Cement, Red				
15	*342401730-0015*		1/27/2024	0.2816 g	<0.0080 % wt
	Site: EB83-1 Wall Fl. 1, Plaster, Off White				



Heather Ohye, Metals Manager
or other approved signatory

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Samples analyzed by EMSL Analytical, Inc. Orlando, FL AIHA LAP, LLC-ELLAP Accredited #163563

Initial report from 01/31/2024 16:18:42

EMSL Analytical, Inc.
3303 PARKWAY CENTER COURT, Orlando, FL 32808
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http://www.EMSL.com orlandolab@emsl.com

EMSL Order:	342401730
CustomerID:	TRCF34
CustomerPO:	EQ227237
ProjectID:	

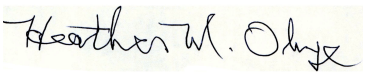
Attn: **Pete Thompson**
Terracon Consultants, Inc.
8001 Baymeadows Way, Suite 1
Jacksonville, FL 32256

Phone: (904) 419-7055
Fax:
Received: 1/25/2024 02:20 PM
Collected:

Project: **EQ227237**

Test Report: Lead in Paint Chips by Flame AAS (SW 846 3050B/7000B)*

Client Sample Description	Lab ID	Collected	Analyzed	Weight	Lead Concentration
16	342401730-0016		1/27/2024	0.2740 g	<0.0080 % wt
	Site: EB83-1 Wall Fl. 1, Wood, Off White				
17	342401730-0017		1/27/2024	0.2814 g	<0.0080 % wt
	Site: FB28C Wall Fl. 1, CMU, White				
18	342401730-0018		1/29/2024	0.2901 g	<0.0080 % wt
	Site: H1331-1 Door Frame Fl. 1, Metal, Off White				
19	342401730-0019		1/29/2024	0.3000 g	<0.0080 % wt
	Site: H1331-1 Floor Fl. 1, Cement, Gray				
20	342401730-0020		1/29/2024	0.2889 g	<0.0080 % wt
	Site: A132-1 Door Frame Fl. 1, Metal, Teal				
21	342401730-0021		1/29/2024	0.2738 g	0.019 % wt
	Site: A132-1 Door Fl. 1, Wood, Off White				
22	342401730-0022		1/29/2024	0.2085 g	<0.0096 % wt
	Site: A132-1 Ceiling Tile 12"x12" Fl. 1, Metal, White				
23	342401730-0023		1/29/2024	0.2609 g	<0.0080 % wt
	Site: C263A-1 Door Fl. 1, Wood, Gray				
24	342401730-0024		1/29/2024	0.2872 g	<0.0080 % wt
	Site: C263A-1 Door Frame Fl. 1, Metal, Gray				
25	342401730-0025		1/29/2024	0.2813 g	<0.0080 % wt
	Site: C263A-1 Wall Fl. 1, Wood, Off White				
26	342401730-0026		1/29/2024	0.2811 g	<0.0080 % wt
	Site: C263-1 Ceiling Fl. 2, Plaster, Off White				
27	342401730-0027		1/29/2024	0.2731 g	<0.0080 % wt
	Site: J138-1 Door Frame Fl. 2, Metal, Off White				
28	342401730-0028		1/29/2024	0.3159 g	<0.0080 % wt
	Site: J138-1 Wall Fl. 2, Wood, White				
29	342401730-0029		1/29/2024	0.3001 g	<0.0080 % wt
	Site: G161-1 Door Frame Fl. 2, Metal, Red				
30	342401730-0030		1/29/2024	0.2574 g	<0.0080 % wt
	Site: G161-1 Ceiling Fl. 2, Cement, White				



Heather Ohye, Metals Manager
or other approved signatory

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Samples analyzed by EMSL Analytical, Inc. Orlando, FL AIHA LAP, LLC-ELLAP Accredited #163563

Initial report from 01/31/2024 16:18:42

EMSL Analytical, Inc.
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http://www.EMSL.com orlandolab@emsl.com

EMSL Order:	342401730
CustomerID:	TRCF34
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ProjectID:	

Attn: **Pete Thompson**
Terracon Consultants, Inc.
8001 Baymeadows Way, Suite 1
Jacksonville, FL 32256

Phone: (904) 419-7055
Fax:
Received: 1/25/2024 02:20 PM
Collected:

Project: **EQ227237**

Test Report: Lead in Paint Chips by Flame AAS (SW 846 3050B/7000B)*

Client Sample Description	*Lab ID*	*Collected*	*Analyzed*	*Weight*	*Lead Concentration*
31	*342401730-0031*		1/29/2024	0.3050 g	0.025 % wt
	Site: E261-1 Door Frame Fl. 2, Metal, Green				
32	*342401730-0032*		1/29/2024	0.3048 g	<0.0080 % wt
	Site: E261-1 Wall Fl. 2, Wood, Off White				
33	*342401730-0033*		1/29/2024	0.2702 g	<0.0080 % wt
	Site: E261-1 Wall Fl. 2, DW, Off White				
34	*342401730-0034*		1/29/2024	0.2761 g	0.12 % wt
	Site: A241-1 Door Fl. 2, Wood, Lt. Gray				
35	*342401730-0035*		1/29/2024	0.3151 g	1.1 % wt
	Site: A241-1 Door Frame Fl. 2, Metal, Lt. Gray				
36	*342401730-0036*		1/29/2024	0.3063 g	<0.0080 % wt
	Site: A210-1 Wall Fl. 3, DW, Lt. Blue				
37	*342401730-0037*		1/30/2024	0.2524 g	<0.0080 % wt
	Site: A210-1 Door Frame Fl. 3, Metal, Off White				
38	*342401730-0038*		1/30/2024	0.2434 g	<0.0082 % wt
	Site: A341 Floor Fl. 3, Cement, Gray				
39	*342401730-0039*		1/30/2024	0.2813 g	<0.0080 % wt
	Site: E458A-1 Door Frame Fl. 4, Metal, Dr. Green				
40	*342401730-0040*		1/30/2024	0.2877 g	<0.0080 % wt
	Site: E458A-1 Door Frame Fl. 4, Metal, Off White				
41	*342401730-0041*		1/30/2024	0.2942 g	<0.0080 % wt
	Site: E571A-1 Door Frame Fl. 5, Metal, Off White				
42	*342401730-0042*		1/30/2024	0.2515 g	<0.0080 % wt
	Site: E571A-1 Door Frame Fl. 5, Metal, Maroon				
43	*342401730-0043*		1/30/2024	0.2548 g	<0.0080 % wt
	Site: Bldg - 14 122-14 Door Frame, Metal, Gray				
44	*342401730-0044*		1/30/2024	0.2597 g	<0.0080 % wt
	Site: Bldg - 14 122-14 Wall, DW, Off White				
45	*342401730-0045*		1/30/2024	0.2902 g	0.13 % wt
	Site: Bldg 11 117 Door Frame, Metal, Off White				

Heather Ohye, Metals Manager
or other approved signatory

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Samples analyzed by EMSL Analytical, Inc. Orlando, FL AIHA LAP, LLC-ELLAP Accredited #163563

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http://www.EMSL.com orlandolab@emsl.com

EMSL Order:	342401730
CustomerID:	TRCF34
CustomerPO:	EQ227237
ProjectID:	

Attn: **Pete Thompson**
Terracon Consultants, Inc.
8001 Baymeadows Way, Suite 1
Jacksonville, FL 32256

Phone: (904) 419-7055
Fax:
Received: 1/25/2024 02:20 PM
Collected:

Project: **EQ227237**

Test Report: Lead in Paint Chips by Flame AAS (SW 846 3050B/7000B)*

Client Sample Description	*Lab ID*	*Collected*	*Analyzed*	*Weight*	*Lead Concentration*
46	*342401730-0046*		1/30/2024	0.3123 g	0.048 % wt
	Site: Bldg 11 117 Door, Metal, Off White				
47	*342401730-0047*		1/30/2024	0.2614 g	<0.0080 % wt
	Site: Bldg 11 117 Wall, DW, Yellow				
48	*342401730-0048*		1/30/2024	0.3109 g	<0.0080 % wt
	Site: Bldg 11 117 Ceiling, Plaster, Off White				
49	*342401730-0049*		1/30/2024	0.3050 g	<0.0080 % wt
	Site: Bldg 11 117 Wall, Wood, Black				
50	*342401730-0050*		1/30/2024	0.2836 g	<0.0080 % wt
	Site: Bldg 12 110-12 Wall, Wood, Off White				
51	*342401730-0051*		1/30/2024	0.2549 g	<0.0080 % wt
	Site: Bldg 12 110-12 Wall, DW, Off White				
52	*342401730-0052*		1/30/2024	0.3012 g	0.017 % wt
	Site: Bldg 12 110-12 Door Frame, Metal, Lt. Blue				
53	*342401730-0053*		1/30/2024	0.2874 g	<0.0080 % wt
	Site: Bldg. 12 110-12 Wall, Cement, Off White				
54	*342401730-0054*		1/30/2024	0.2897 g	0.043 % wt
	Site: Bldg 204-28 Door Frame, Metal, Off White				
55	*342401730-0055*		1/30/2024	0.2994 g	<0.0080 % wt
	Site: Bldg 204-28 Door, Metal, Off White				
56	*342401730-0056*		1/29/2024	0.2553 g	<0.0080 % wt
	Site: Bldg 204-28 Wall, D, Off White				
57	*342401730-0057*		1/29/2024	0.3085 g	<0.0080 % wt
	Site: Bldg 204-28 Wall, W, Off White				
58	*342401730-0058*		1/29/2024	0.3014 g	<0.0080 % wt
	Site: Bldg 204-28 Ceiling, Plaster, White				
59	*342401730-0059*		1/29/2024	0.2843 g	<0.0080 % wt
	Site: BT01A 109 Door Frame, Metal, Off White				
60	*342401730-0060*		1/30/2024	0.2620 g	<0.0080 % wt
	Site: BT01A 109 Door, Wood, Beige				

Heather Ohye, Metals Manager
or other approved signatory

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EMSL Order:	342401730
CustomerID:	TRCF34
CustomerPO:	EQ227237
ProjectID:	

Attn: **Pete Thompson**
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8001 Baymeadows Way, Suite 1
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Phone: (904) 419-7055
Fax:
Received: 1/25/2024 02:20 PM
Collected:

Project: **EQ227237**

Test Report: Lead in Paint Chips by Flame AAS (SW 846 3050B/7000B)*

Client Sample Description	Lab ID	Collected	Analyzed	Weight	Lead Concentration
61	342401730-0061		1/30/2024	0.2859 g	<0.0080 % wt
	Site: BT01A 109 Wall, Wood, Gray				
62	342401730-0062		1/30/2024	0.1526 g	<0.013 % wt
	Site: BT02 110 Door Frame, Metal, Brown				
63	342401730-0063		1/30/2024	0.3063 g	<0.0080 % wt
	Site: BT05 113 Wall Paper, DW, Off White				
64	342401730-0064		1/30/2024	0.2807 g	<0.0080 % wt
	Site: BT05 113 Wall Paper, Wood, Off White				
65	342401730-0065		1/30/2024	0.2738 g	<0.0080 % wt
	Site: BT11 121 Door, Wood, Beige				
66	342401730-0066		1/30/2024	0.2518 g	<0.0080 % wt
	Site: BT06 107 Door Frame, Wood, Gray				
67	342401730-0067		1/30/2024	0.2691 g	<0.0080 % wt
	Site: BT06 107 Door, Wood, Gray				
68	342401730-0068		1/30/2024	0.2558 g	<0.0080 % wt
	Site: BT07 113 Door Frame, Metal, Tan				
69	342401730-0069		1/30/2024	0.2660 g	<0.0080 % wt
	Site: BT07 113 Wall, Wood, Gray				

Heather Ohye, Metals Manager
or other approved signatory

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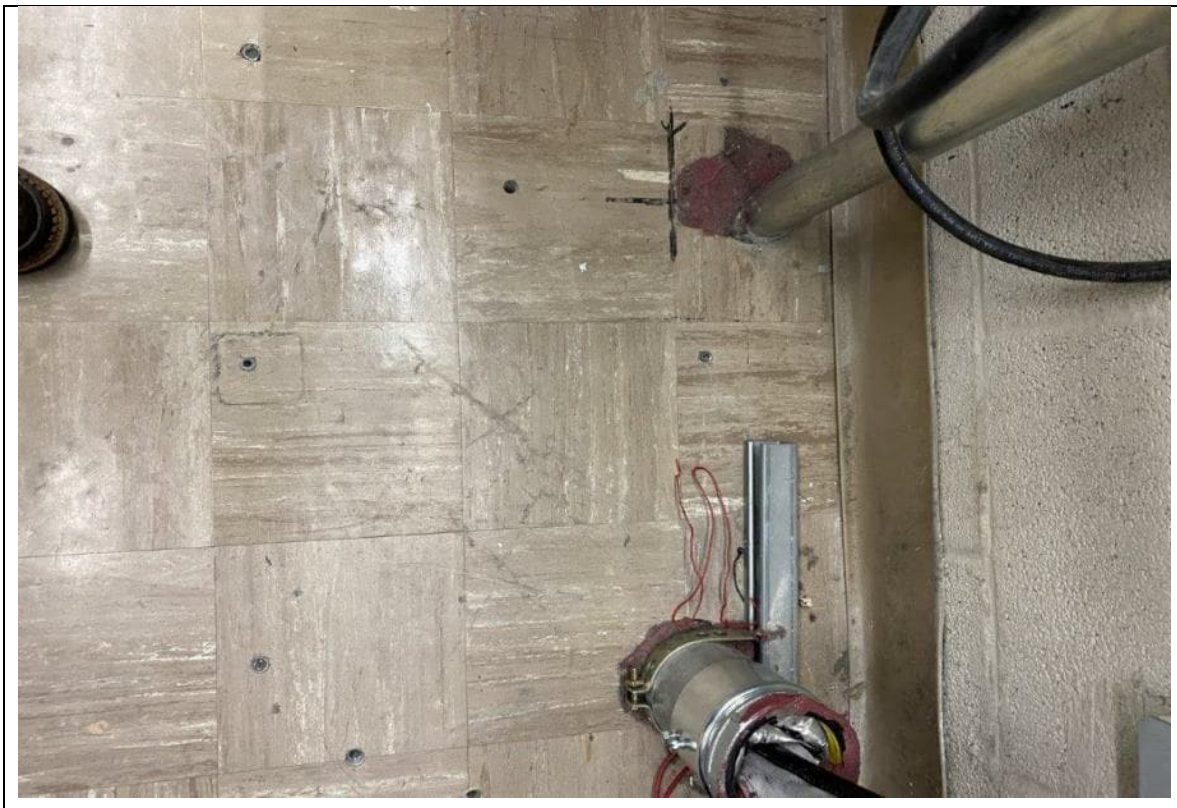
Initial report from 01/31/2024 16:18:42

APPENDIX C

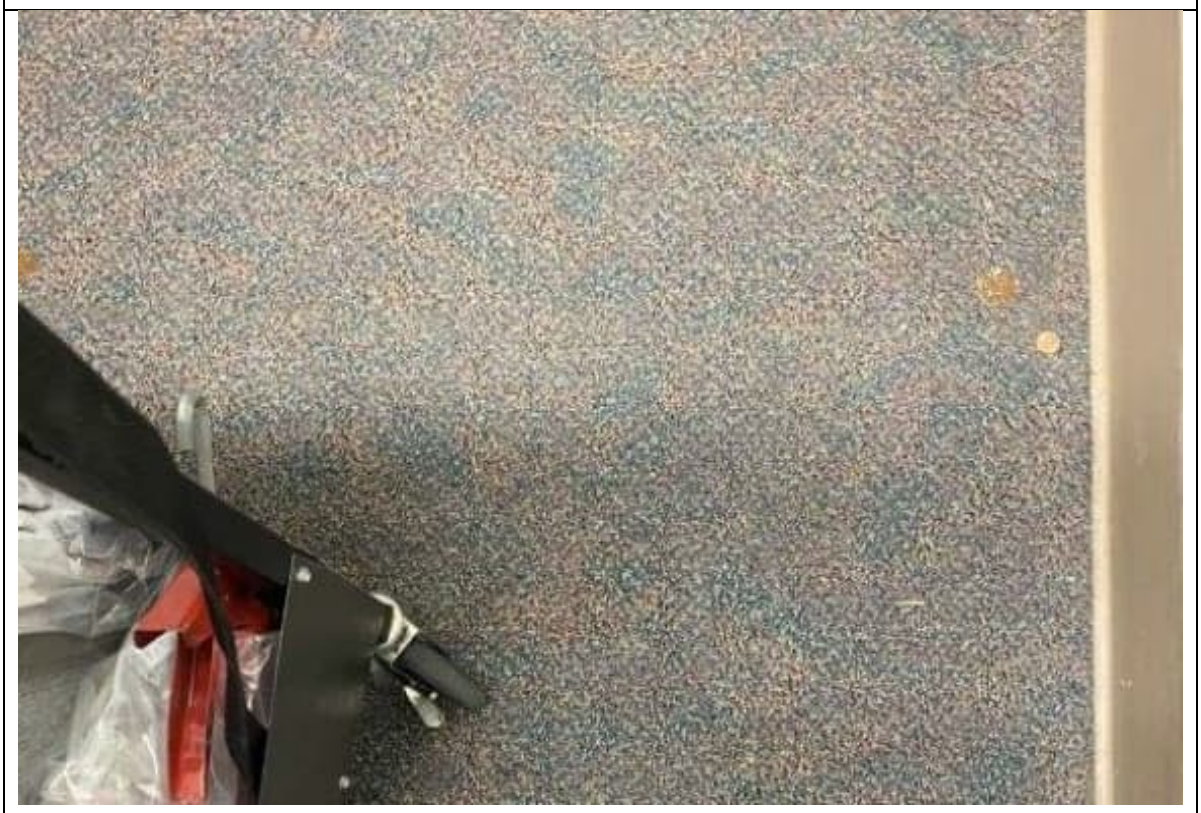
PHOTOGRAPHS



1 9" X 9" VFT/Mastic

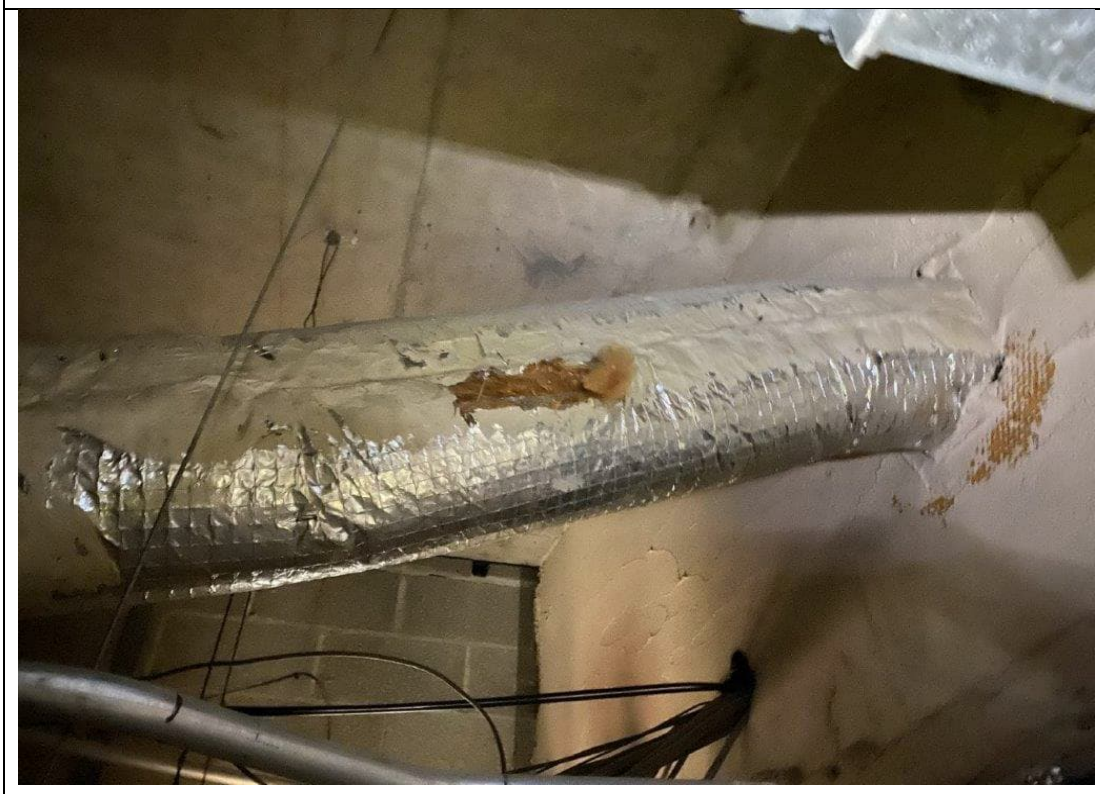
3 Texture on Plaster Drywall Ceiling

11 12" X 12" VFT/Mastic White/Grey



12 Brown 9" X 9"/VFT Mastic (Under Carpet)

17 Mastic associated with 3" X 3" Vinyl Sheeting



19 Off-White Mastic on ceiling ducts

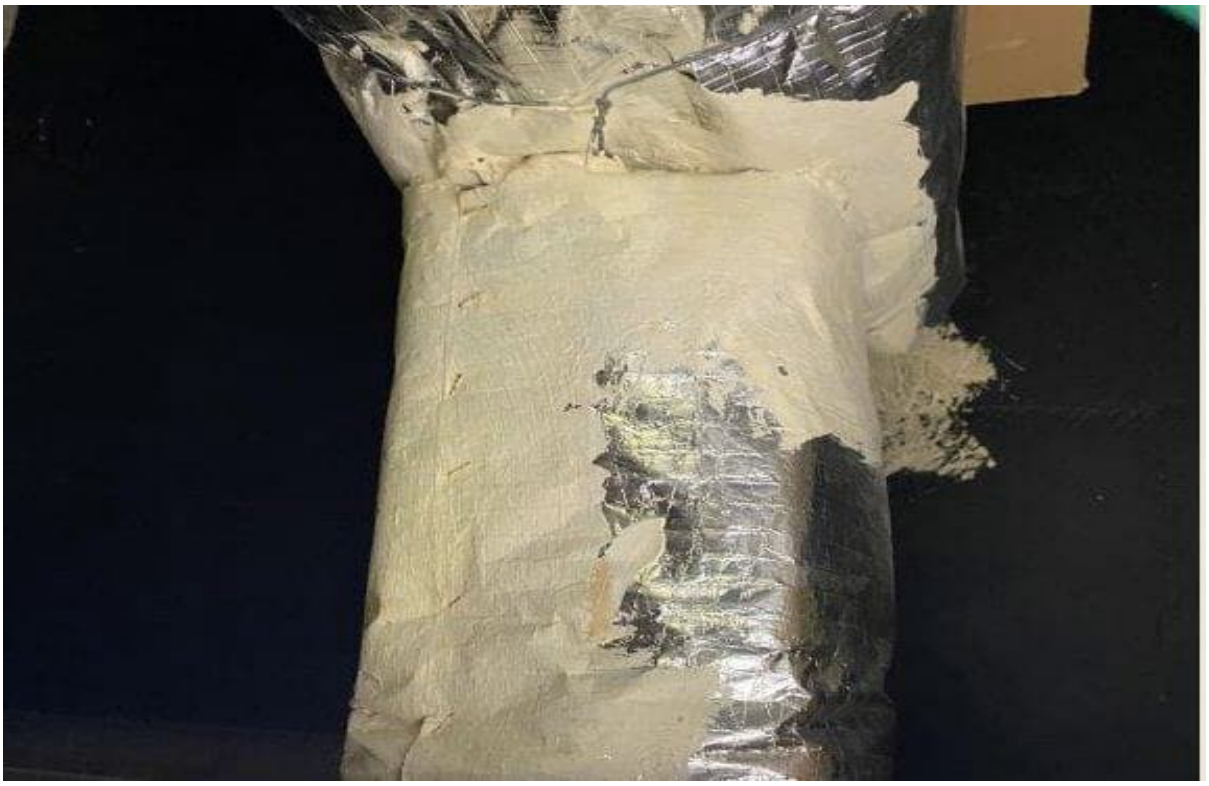
24 Off-White Mastic on fiberglass ceiling ducts

29 Black Mastic Pipe under ceiling

40 White Mastic 6"-8" Ceiling Pipe

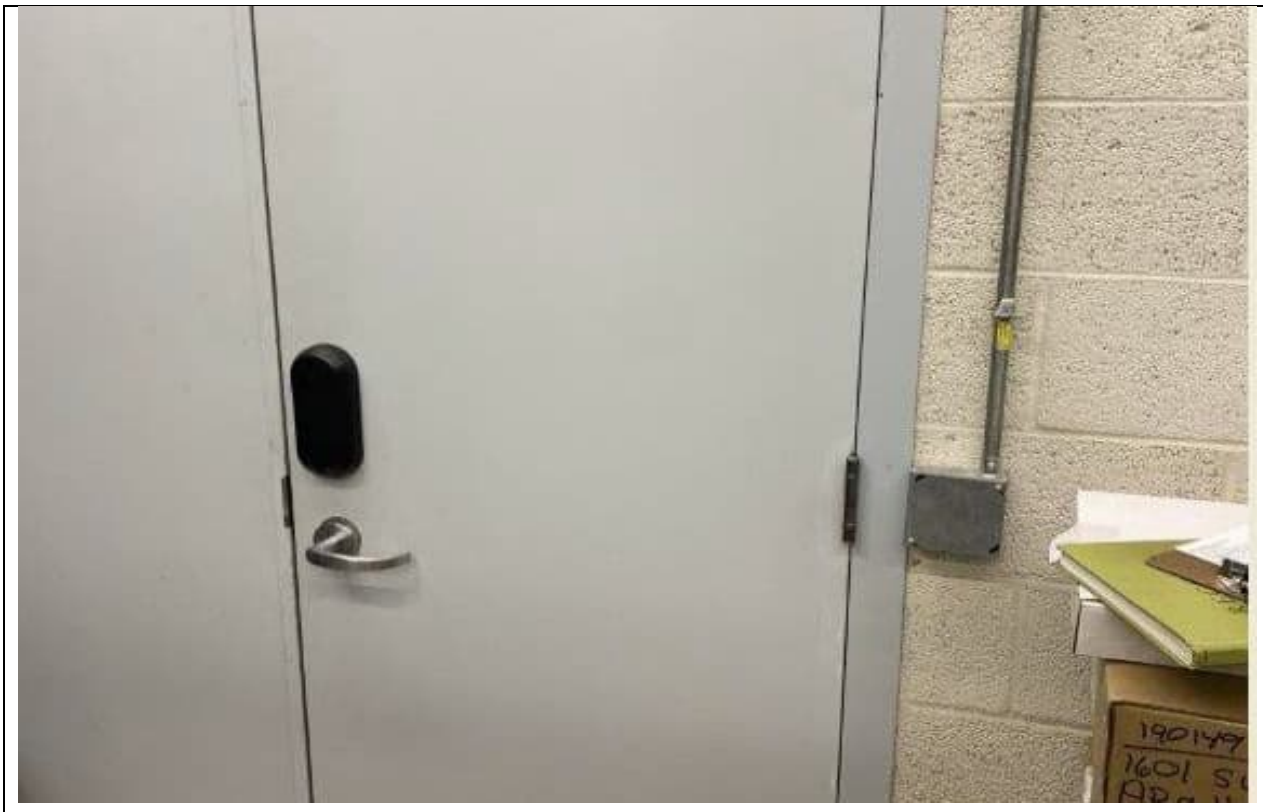
NO PHOTOGRAPH PROVIDED

50 Black Mastic Wall

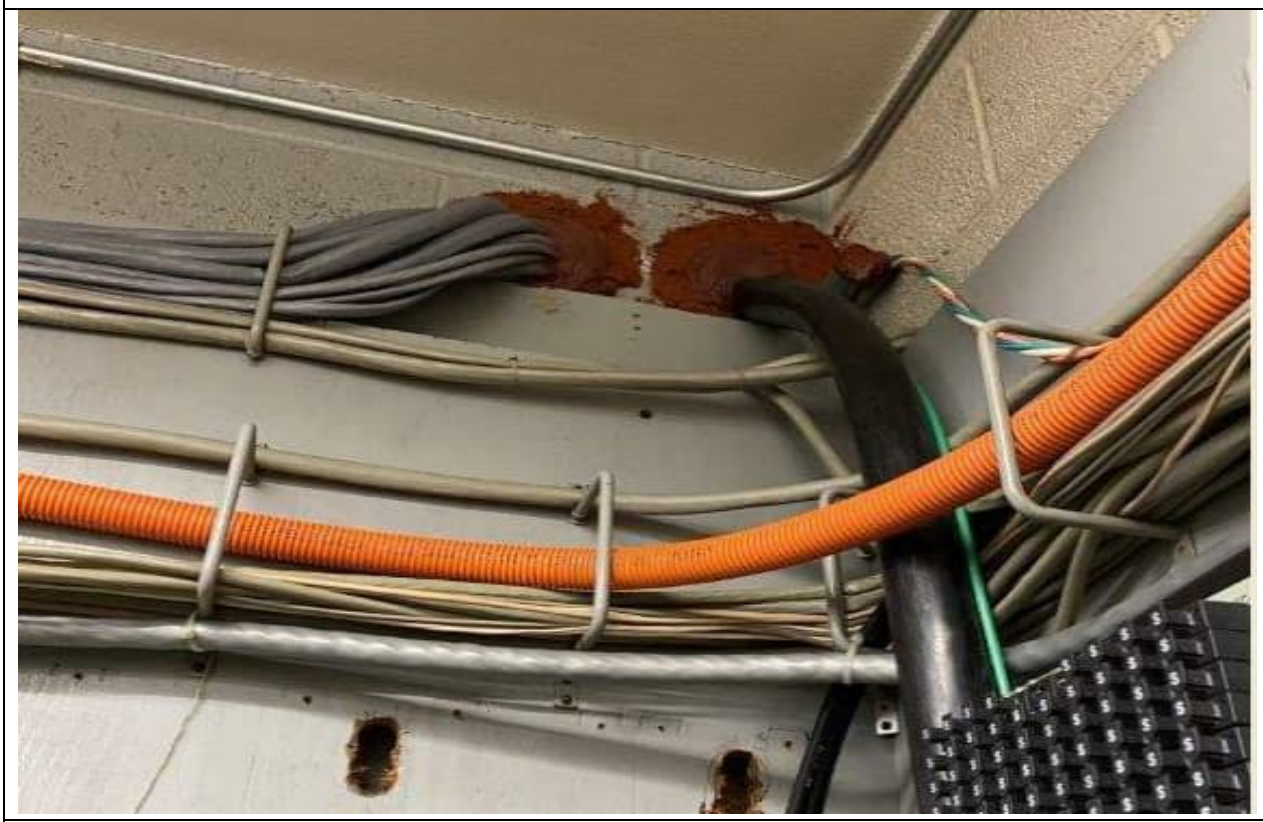


51 White Mastic Fiberglass Duct Insulation

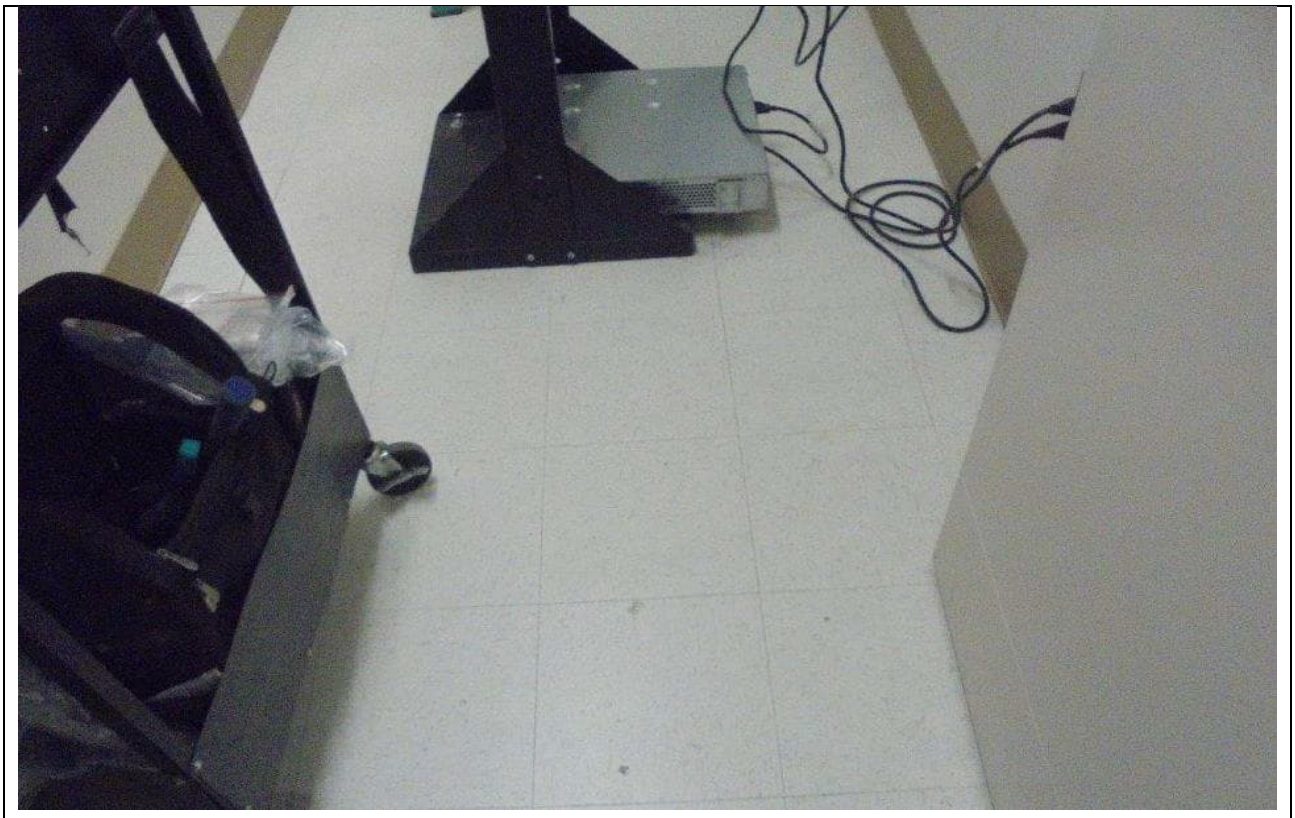
60 White Mastic Fiberglass Duct Insulation



Paint: 1 Light Gray Metal Basement Door Frame



Paint: 7 Gray Wood Basement Wall

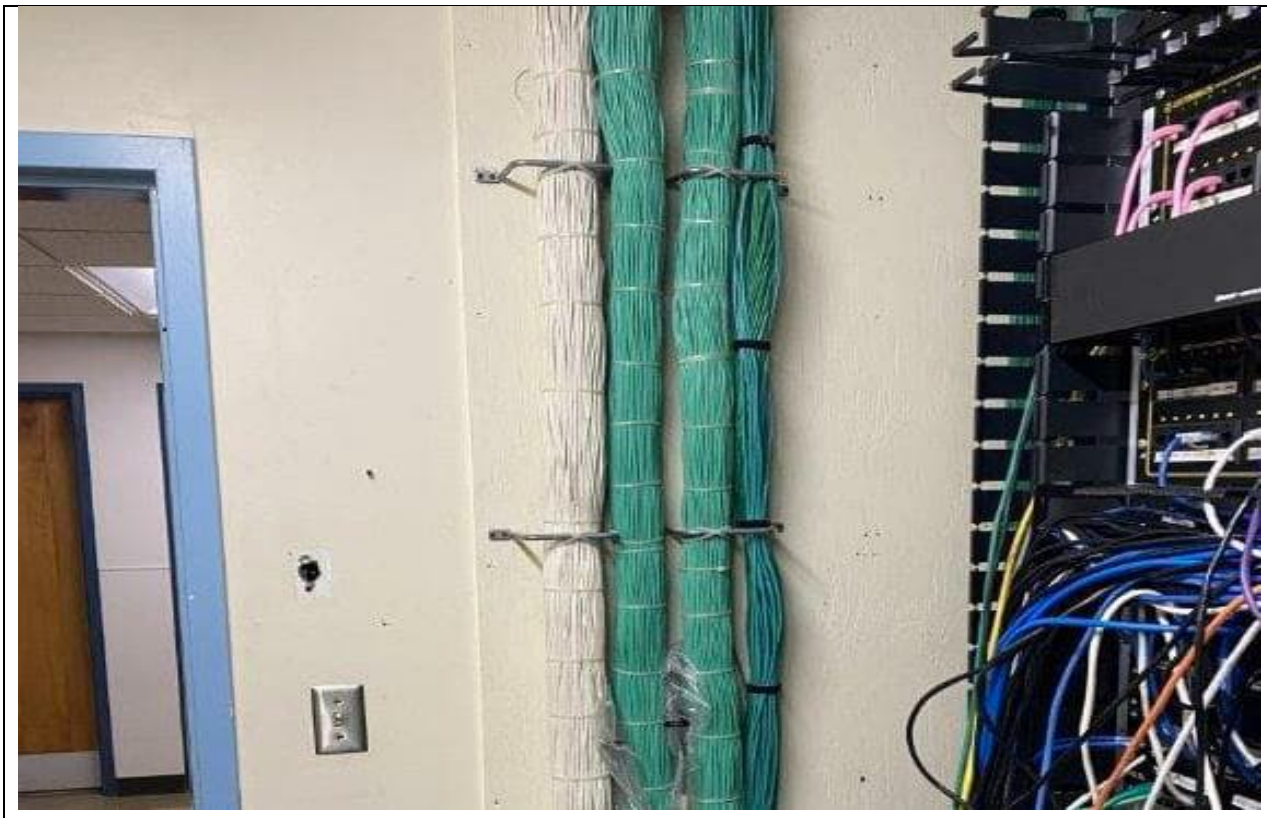


Paint: 21 Off White Wood Floor 1 Door

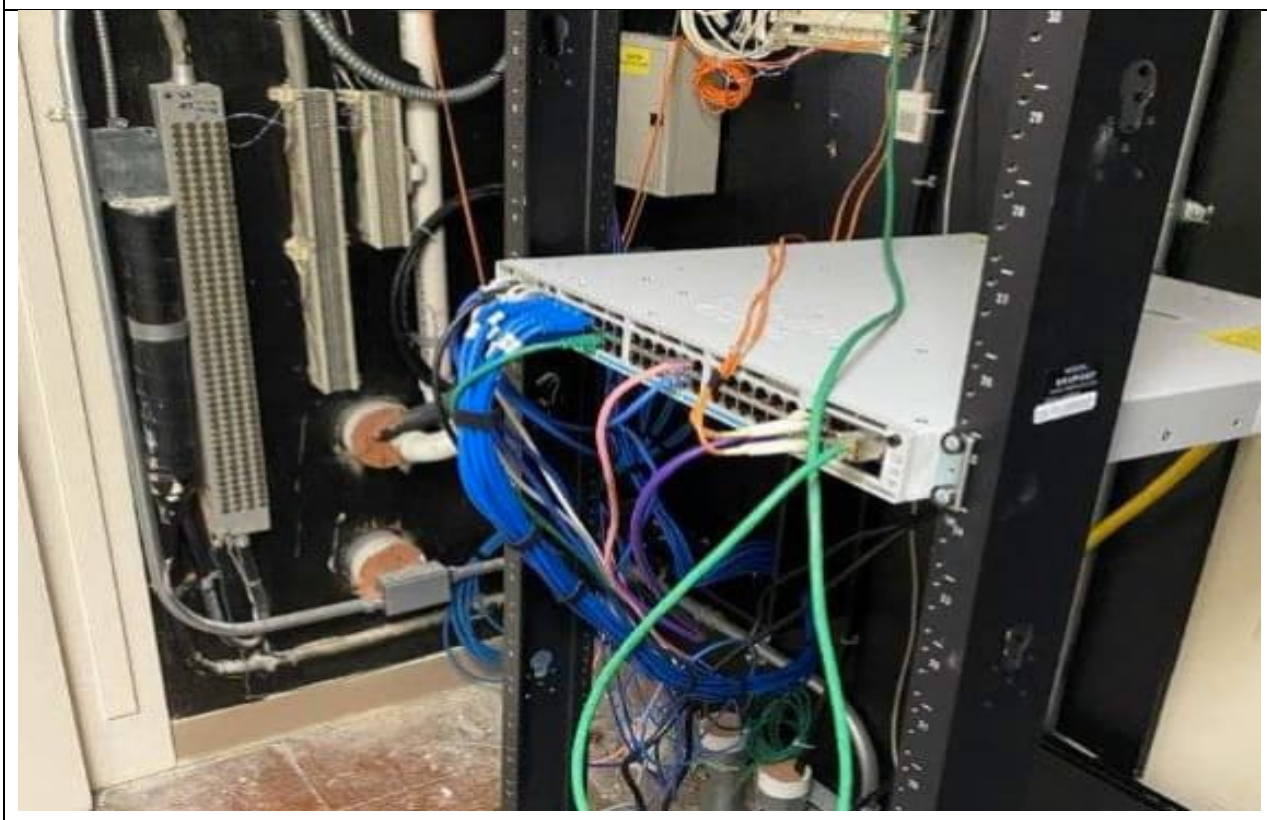
Paint: 31 Green Metal Floor 2 Door Frame

Paint: 34 **Light Gray Wood Floor 2 Door**
Paint: 35 **Light Gray Metal Floor 2 Door Frame**

Paint: 45 **Off White Metal Door Frame**
Paint: 46 **Off White Metal Door**



Paint: 52 Light Blue Metal Door Frame



Paint: 54 Off White Metal Door Frame

Paint: 62 Brown Metal Door Frame

APPENDIX D

INSPECTOR CERTIFICATION

UF | TREEO Center
UNIVERSITY of FLORIDA

Center for Training, Research and Education for Environmental Occupations

certifies

Pete Thompson

8001 Baymeadows Way Jacksonville, FL 32256

Having passed a 25-question exam with a score of 70% or higher has successfully met training requirements for

Asbestos Refresher: Inspector Online

FDBPR Asbestos Licensing Unit: Provider #0000995; Course #FL49-0006389 (½ Day; 3.40 Contact Hours)

(Reaccreditation for Inspector under TSCA Title II/AHERA)

Conducted

1/2/2024

Certificate #: 0091 - 002-394
Exam Date: **1/2/2024**
EPA accreditation expires: **1/2/2025**
Principal Instructor: Brian Duchene, PE, LAC
CEUs: 0.4
FBPR LAC: #0000995; Course ## 0006389
FBPE CEHs: #0004021; Course #0009083/Educational Institutions: 4 CEHs

Andrew Campbell, Director

University of Florida TREEO Center · 3900 SW 63 Blvd Gainesville FL 32608-3800 · 352.392.9570 · train@treeo.ufl.edu · www.treeo.ufl.edu

Vern Roberts Environmental Training, Inc.
13987 94th Avenue N Seminole, FL 33776
727-239-1445

Certifies that

RONALD D COOPERWOOD

Has satisfactorily completed the requisite training for asbestos accreditation under TSCA TITLE II, EPA Model Accreditation Plan (40CFR763 E) for the 4-hour Inspector (Survey & Mechanical) Refresher Course on 1/2/2023, and in testimony whereof, we do confer this certificate at Seminole, Florida on 1/2/2023.

Date of Course: 1/2/2023 Expiration Date 1/2/2024
Certificate # 0022301AM
Course # FL49-0006322 Provider # FL49-0003810

INSTRUCTOR

United States Department of Commerce
National Institute of Standards and Technology

Certificate of Accreditation to ISO/IEC 17025:2017

NVLAP LAB CODE: 200569-0

Cates Laboratories, Inc.

Dallas, TX

is accredited by the National Voluntary Laboratory Accreditation Program for specific services, listed on the Scope of Accreditation, for:

Asbestos Fiber Analysis

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communique dated January 2009).

2023-04-01 through 2024-03-31

Effective Dates

For the National Voluntary Laboratory Accreditation Program

National Voluntary Laboratory Accreditation Program

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

Cates Laboratories, Inc.
1339 Motor Circle
Dallas, TX 75207
Mr. John R. Cates
Phone: 214-920-5006 Fax: 1-972-767-0167
Email: jrcates@cateslab.com
http://www.cateslab.com

ASBESTOS FIBER ANALYSIS — NVLAP LAB CODE 200569-0

Bulk Asbestos Analysis

Code	*Description*
18/A01	EPA -- 40 CFR Appendix E to Subpart E of Part 763, Interim Method of the Determination of Asbestos in Bulk Insulation Samples
18/A03	EPA 600/R-93/116: Method for the Determination of Asbestos in Bulk Building Materials

For the National Voluntary Laboratory Accreditation Program

Ron DeSantis, Governor

Melanie S. Griffin, Secretary

STATE OF FLORIDA
DEPARTMENT OF BUSINESS AND PROFESSIONAL REGULATION

ASBESTOS LICENSING UNIT

THE ASBESTOS CONSULTANT HEREIN IS LICENSED UNDER THE
PROVISIONS OF CHAPTER 469, FLORIDA STATUTES

FRICKE, MARK J

INDIVIDUAL
210 N TUBB ST #1235
OAKLAND FL 34760

LICENSE NUMBER: AX132

EXPIRATION DATE: NOVEMBER 30, 2024

Always verify licenses online at MyFloridaLicense.com

Do not alter this document in any form.

This is your license. It is unlawful for anyone other than the licensee to use this document.

Ron DeSantis, Governor

Melanie S. Griffin, Secretary

STATE OF FLORIDA
DEPARTMENT OF BUSINESS AND PROFESSIONAL REGULATION

ASBESTOS LICENSING UNIT

THE ASBESTOS BUSINESS ORGANIZATION HEREIN IS LICENSED UNDER THE PROVISIONS OF CHAPTER 469, FLORIDA STATUTES

TERRACON CONSULTANTS INC

MICHAEL W SCHRUM
1675 LEE ROAD
WINTER PARK FL 32789

LICENSE NUMBER: ZA337

EXPIRATION DATE: NOVEMBER 30, 2025

Always verify licenses online at MyFloridaLicense.com

ISSUED: 10/25/2023

Do not alter this document in any form.

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8001 Baymeadows Way Suite 1
Jacksonville, Florida 32256
P 904-900-6494
TERRACON.COM

June 10, 2024

RDC/John Poe Architects
116 E. 3rd Street
Dayton, Ohio 45402-2130

Attn: Mr. Ken Raiteri
Project Manager
Cell: 800-362-1523
Email: KRAITERI@RDCJOHNPOE.COM

RE: Asbestos and Lead Paint Survey Report
Trailer 11, Building 13
Malcolm Randall VA Hospital
1601 SW Archer Rd
Gainesville, Florida 32608
Terracon Project EQ247199

Dear Mr. Raiteri:

Terracon Consultants, Inc. (Terracon) is pleased to provide RDC/John Poe Architects (client) with this report regarding asbestos and lead surveys conducted at the above-referenced adjacent sites. The survey activities were limited to the interiors and exteriors including the roof of Trailer 11, and the interiors and exteriors including the roof of Building 13. A description of survey activities and other project-related documents are contained in the attached report and appendices.

Asbestos was not identified in samples collected from either structure. Lead paint was identified in samples collected from Building 13.

We appreciate the opportunity to be of service to you on this project. If there are any questions concerning the report, or if we may be of further assistance, please contact Pete Thompson at 904-330-4405 or Pete.Thompson@Terracon.Com.

Sincerely,
Terracon Consultants, Inc.
Asbestos Business License ZA337

P. Thompson

Peter Thompson
AHERA Certified Building Inspector
Certificate # 240081-1896

Michael Schrum PE
Florida Licensed Asbestos Consultant
License AX78

Asbestos and Lead Survey Report

Malcom Randall VA Hospital
Trailer 11, Building 13
1601 SW Archer Road,
Gainesville, Florida 32608
June 10, 2024
Terracon Project EQ247199

Prepared for:

RDC/John Poe Architects
Dayton, Ohio

Prepared by:

Terracon Consultants, Inc
Jacksonville, Florida

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APPENDIX B ASBESTOS AND LEAD ANALYTICAL LABORATORY DATA

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LIMITED ASBESTOS AND LEAD PAINT SURVEY
TRAILER 11, BUILDING 13
MALCOM RANDALL VA HOSPITAL
GAINESVILLE, FLORIDA
Terracon Project EQ247199
June 10, 2024

1.0 INTRODUCTION

Terracon Consultants, Inc. (Terracon) conducted a pre-renovation asbestos survey and a limited paint inspection for lead paint in the designated areas. Terracon concluded the surveys on May 15.

The limited asbestos survey was conducted by Mr. Peter Thompson, an Asbestos Hazard Emergency Response Act (AHERA)-accredited building inspector. A copy of Mr. Thompson's asbestos inspector certificates is attached as Appendix D.

The limited inspection of paint for lead was conducted by Mr. Peter Thompson. Mr. Thompson is an EPA-certified lead paint inspector. A copy of Mr. Thompson's lead paint inspector certificate is attached as Appendix D.

The limited surveys were performed based on information and drawings provided by the client The interior and exterior building components from the designated areas were surveyed and homogeneous areas of suspect asbestos-containing materials (ACM) and applicable painted surfaces were visually identified and documented.

Although reasonable effort was made to survey accessible suspect materials, additional suspect but un-sampled materials could be located in walls, in voids or in other concealed areas.

1.1 Project Objective

Terracon understands the purpose of these surveys was to provide information to the client regarding asbestos and lead content in materials prior to demolition of the structures. EPA regulation 40 CFR 61, Subpart M, NESHAP, prohibits the release of asbestos fibers to the atmosphere during renovation or demolition activities. The asbestos NESHAP requires that potentially regulated asbestos-containing building materials be identified, classified and quantified prior to planned disturbances or demolition activities. Suspect ACM samples were collected in general accordance with the sampling protocols outlined in EPA AHERA regulation, 40 CFR 763.86. Samples were delivered to an accredited laboratory for analysis Polarized Light Microscopy (PLM). The OSHA Lead in Construction standard 29 CFR 1926.62 regulates lead paints or coatings that are disturbed during construction or renovation activities. Paint and coatings with the potential to contain lead were identified visually by surface color and sampled by scraping to the substrate. Samples were delivered to an accredited laboratory for analysis by Flame Atomic Absorption.

2.0 BUILDING DESCRIPTION

The designated area consists of two adjacent structures. Building 13 is a generator building approximately 450 square feet (SF) in size constructed primarily of concrete masonry blocks and poured concrete. Trailer 11 is a semipermanent mobile office structure approximately 5,000 SF in size. Typical interior components include of drywall panels, drop-in ceiling tiles and vinyl floor tiles, cove

base and associated adhesives and caulks. Terracon has been unable to obtain reliable construction dates for the two structures.

3.0 FIELD ACTIVITIES

The surveys were conducted on May 15, 2024. A summary of survey activities is provided below.

3.1 Asbestos Survey Activities

The survey was conducted in general accordance with the sample collection protocols established in EPA regulation AHERA, 40 CFR 763.86. Our survey activities began with visual observation of the building components from the designated areas to identify apparent homogeneous areas of suspect ACM. A homogeneous area consists of building materials that appear similar throughout in terms of color, texture and date of application. The assessment was conducted throughout visually accessible areas of the designated work area. Building materials identified as glass, wood, metal or rubber are not considered suspect ACM.

Terracon lifted floor coverings in selected locations and did not observe additional floor coverings/layers except as noted in the report. However, as Terracon could not assess beneath all flooring areas, there may be isolated areas of additional suspect material present beneath floor coverings.

3.2 Physical Assessment

A physical assessment of each homogeneous area of suspect ACM was conducted to assess the friability and condition of the materials. A friable material is defined by the EPA as a material which can be crumbled, pulverized, or reduced to powder by hand pressure when dry. Friability was assessed by physically touching suspect materials.

3.3 Sample Collection

Based on results of the visual observation, bulk samples of suspect ACM were collected in general accordance with AHERA sampling protocols. Random samples of suspect materials were collected in each homogeneous area. Samples were collected using wet methods as applicable to reduce the potential for fiber release. Samples were placed in sealable containers and labeled with unique sample numbers using an indelible marker.

A total of 66 bulk samples from the designated areas were collected from 22 homogeneous areas (HAs) of suspect ACM from the designated areas. A listing of suspect ACM observed and sampled from the designated areas during the survey can be found in Appendix A.

3.4 Sample Analysis

Bulk samples were submitted under chain of custody to Cates Labs (Cates) in Dallas, Texas, for analysis by Polarized Light Microscopy per EPA methodology EPA/600/R-93/116. The percentage of asbestos, where applicable, was determined by microscopic visual estimation or point counting. Cates is accredited by the National Institute for Science and Technology (NIST) under the National Voluntary Laboratory Accreditation Program (NVLAP) for bulk-asbestos sample analysis.

3.5 Paint Containing Lead Survey Activities

Terracon performed a visual assessment to identify suspect lead-containing paint (LCP) and document the general location of the materials and the condition of the materials, including noting areas of damaged, peeling, or flaking paint. Terracon collected representative paint chip samples of applicable

suspect coatings identified on surfaces in the designated area. A summary of LCP sampling activities is provided below.

3.6 Sample Collection

Terracon collected ten suspect LCP chip samples from the two structures. Samples were placed in sealable containers and labeled with unique sample numbers using an indelible marker. Sample locations were chosen to include unique color/substrate combinations

3.7 Sample Analysis

Paint sampling included visual observations of applicable coated surfaces (i.e., paints, varnishes) to identify potential LCP-coated components and to collect paint chip samples. Samples were submitted to EMSL Analytical of Orlando, Florida for analysis by EPA Methods SW-846 3050B Acid Digestion of Sediments, Sludges, and Soils and 7000B Flame Atomic Absorption Spectrophotometry. EMSL is accredited by the AIHA® Laboratory Accreditation Programs, LLC under the Environmental Lead Laboratory Accreditation Program (ELLAP).

4.0 Regulatory Review

The asbestos NESHAP (40 CFR Part 61, Subpart M) regulates asbestos fiber emissions and asbestos waste disposal practices. It also requires the identification and classification of existing building materials prior to demolition or renovation activity. Under NESHAP, asbestos-containing building materials are classified as either friable, Category I non-friable or Category II non-friable ACM. Friable materials are those that, when dry, may be crumbled, pulverized or reduced to powder by hand pressure. Category I non-friable ACM includes packings, gaskets, resilient floor coverings and asphalt roofing products containing more than 1% asbestos. Category II non-friable ACM are any materials other than Category I materials that contain more than 1% asbestos.

Friable ACM, Category I and Category II non-friable ACM which is in poor condition and has become friable or which will be subjected to drilling, sanding, grinding, cutting or abrading and which could be crushed or pulverized during anticipated renovation or demolition activities is considered regulated ACM (RACM).

In the State of Florida, asbestos activities are regulated by the Florida Department of Environmental Protection (FDEP). RACM must be removed prior to renovation or demolition activities which will disturb the materials. The owner or operator must provide the FDEP with written notification of asbestos abatement activities and/or planned demolition activities at least 10 working days prior to the commencement of such activities.

The U.S. Occupational Safety and Health Administration (OSHA) Asbestos standard for construction (29 CFR 1926.1101) regulates workplace exposure to asbestos. The OSHA standard requires that employee exposure to airborne asbestos fibers be maintained at or below 0.1 asbestos fibers per cubic centimeter of air (0.1 f/cc) as an eight-hour time weighted average (TWA) and not exceed 1.0 fibers per cubic centimeter of air (1.0 f/cc) over a 30-minute time period known as an excursion limit (EL). The TWA and EL are known as OSHA's permissible exposure limits (PELs). The OSHA standard classifies construction and maintenance activities which could disturb ACM and specifies work practices and precautions which employers must follow when engaging in each class of regulated work. States which administer their own federally-approved state OSHA programs may require additional precautions.

OSHA regulations governing exposure to airborne lead can be found in 29 CFR 1910.1925 and 29 CFR 1926.62. This regulation establishes a permissible exposure limit (PEL) of 50 µg/m^3 of lead over an eight-hour time-weighted-average for all employees covered. The standard also sets an action level of

30 µg/m^3, at which an employer must begin specific compliance activities. The OSHA standard prescribes worker protection requirements and precautions which employers must follow when engaging in lead activities.

5.0 FINDINGS AND RECOMMENDATIONS

5.1 Asbestos

Asbestos was not detected in samples of materials collected from the 22 homogeneous areas identified in Trailer 11 or Building 13. The asbestos laboratory analytical report and chain-of-custody are provided in Appendix B. The Inspector Certification is provided in Appendix D.

It should be noted that suspect materials, other than those identified during the interior NESHAP survey, may exist within the designated areas of the building. If suspect materials other than those which were identified during this survey are discovered prior to or during the renovation process, those materials should be assumed to be asbestos-containing until sampling and analysis can establish the presence or absence of asbestos.

5.2 Lead Containing Paint

Detectable levels of lead were identified in two samples collected from Building 13. Paints in Trailer 11 were of the type normally preinstalled on components and generally referred to as *Factory Paint*. It is difficult to obtain sufficient sampling media from Factory Paints and the analysis of one sample– Sample 3 is therefore inconclusive due to the inability to collect sufficient paint for a thorough analysis. Terracon recommends this paint is assumed to be lead containing. The laboratory analytical report and chain of custody are provided in Appendix B. The Inspector Certification is provided in Appendix D.

6.0 GENERAL COMMENTS

This asbestos survey was conducted in a manner consistent with the level of care and skill ordinarily exercised by members of the profession currently practicing under similar conditions in the same locale. The results, findings, conclusions, and recommendations expressed in this report are based on conditions observed during our survey of the building. The information contained in this report is relevant to the date on which this survey was performed and should not be relied upon to represent conditions at a later date. This report has been prepared on behalf of and exclusively for use by the client for specific application to their project as discussed. This report is not a bidding document. Contractors or consultants reviewing this report must draw their own conclusions regarding further investigation or remediation deemed necessary. Terracon does not warrant the work of regulatory agencies, laboratories or other third parties supplying information which may have been used in the preparation of this report. No warranty, express or implied is made.

APPENDIX A

ASBESTOS SAMPLE SUMMARY

LEAD PAINT SAMPLE SUMMARY

ASBESTOS SAMPLING RESULTS

Table 1
Building 13

HA ID	Material	Location	Asbestos Type and Concentration	Category / Class	Quantity	Condition
1	Gray concrete	Floor slab	NAD	-	-	-
2	Gray concrete	Deck	NAD	-	-	-
3	Gray concrete	Walls	NAD	-	-	-
4	Gray concrete	Curb	NAD	-	-	-
5	Light gray packing material	Floor perimeter	NAD	-	-	-
6	Gray door sealing caulk	Doorway	NAD	-	-	-
7	Gray concrete block and mortar	Fuel room	NAD	-	-	-
8	Red fire stop	Exterior wall penetration	NAD	-	-	-
9	Gray hard plaster on concrete block	Exterior wall east side	NAD	-	-	-
10	Light gray wall, sealing caulk	East wall	NAD	-	-	-
11	Gray built-up roofing on concrete	Generator room roof	NAD	-	-	-
12	Black mastic	Generator room roof	NAD	-	-	-

ASBESTOS SAMPLING RESULTS
Table 2
Trailer 11

HA ID	Material	Location	Asbestos Type and Concentration	Category / Class	Quantity	Condition
1	Cream EPDM membrane on wood	Roof	NAD	-	-	-
2	Light gray EPDM membrane on wood	Roof patch	NAD	-	-	-
3	Brown, dark brown vinyl plank flooring on wood base	Floor throughout	NAD	-	-	-
4	Off-white Vinyl floor tile	Under vinyl plank	NAD	-	-	-
5	Black 6 inch vinyl cove base	Throughout	NAD	-	-	-
6	Off-white wallpaper	Throughout	NAD	-	-	-
7	White 2 x 2 drop-in ceiling tiles with perforations, pinholes	Throughout	NAD	-	-	-
8	Gray drywall system	Throughout	NAD	-	-	-
9	Off-white, light gray 12 inch vinyl floor tile on wood base	PIV office	NAD	-	-	-
10	Sand 4 inch vinyl cove base	PIV office	NAD	-	-	-

LEAD SAMPLING RESULTS
Table 3
Building 13

Sampled Paint Combinations				
Sample #	Color	Substrate	Locations	Lead content % wt.
1	**Yellow**	**Concrete**	**Curb**	**0.011 % wt.**
2	Cream	Metal	Frame	<0.008% wt.
3	**Red**	**Wood**	**Fire extinguisher panel**	**0.042 % wt.**
4	Brown	Metal	Interior door surface	<0.008% wt.
5	Brown	Metal	Exterior door surface	<0.008% wt.
6	White	Metal	Ladders	<0.008% wt.
7	White	Concrete	Exterior walls	<0.008% wt.

Table 4
Trailer 11

Sampled Paint Combinations				
Sample #	Color	Substrate	Locations	Lead content % wt.
1	Cream	Wood	Fire door	<0.015 % wt.
2	Beige	Wood	Interior door	<0.008% wt.
*3**	*White*	*Metal*	*Interior door frames*	*<0.149 % wt.*

*Terracon recommends this paint is assumed to contain lead due to the inability to obtain sufficient media for a usable limit of detection

APPENDIX B

ASBESTOS AND LEAD ANALYTICAL LABORATORY DATA

CATES LABORATORIES

CHAIN OF CUSTODY

CL Project No. PLM37241 (Set 53485)
(Lab Only)

Company: Terracon Consultants Inc.

Contact/Results to: Pete Thompson **Verbal** **Email X** **Fax**

Email(s): pete.thompson@terracon.com

Telephone #: 904-330-4405 **Fax #:**

Project Information

Project: Limited Asbestos Inspection **Project #:** EQ247199

Address: 1601 SW Archer Rd / Trailer 11 **P.O.#**

Turnaround (check one)

CLEARANCE (PCM) **ASAP (SAME DAY) (IMMEDIATE)** **RUSH (1-DAY)** **STANDARD (2-DAY)** **3-4 DAY** **5-DAY X**

Testing Services (check all that apply. use separate COC's for Asbestos & IAQ)

Asbestos		IAQ - Mold (Non-Viable)
PLM-BULK EPA 600/R-93/116 X	**PCM-AIR** NIOSH 7400	**AIR (spore trap)** - Standard Profile (count/genus identification)
Point Count (400)	OSHA: TWA	**AIR (spore trap)** - Expanded Profile (w/insect parts/pollen/skin)
		BULK (tape lift, swab) - Standard Profile (genus identification)

Cates Lab No. Range (Lab Only):	Sample Date			
1260883 - 1260912	2024-05-20	Number of Samples: 30	Positive Stop: Yes	No X

Sample No.	Sample Description/Location	Volume (air only)
	Stop on positive: No	
	Turnaround: 5 Days	
	Office: Jacksonville FL	
	PM: Pete Thompson	

Relinquished By:	Date/Time:	Received By:	Date/Time:
P. Thompson	2024/05/22		5/23/24 0950

AF72017-10 - *issued 1/7/2020* Walk-In☐ D-Drop☐ F-Drop☐ FedEx☑ UPS☐ Lonestar ☐ USPS☐

PLM37241
(set 53485)

Terracon

CHAIN OF CUSTODY

Printed on
May 22, 2024

Project Number: EQ247199	Inspection Date: 2024-05-20
Project Name: Limited Asbestos Survey, 1601 SW Archer Rd / Trailer 11	
Inspector: Pete Thompson #0091-002-394	HAs: 10: Number of samples: 30

HA ID	Material	Sample Location	CAT
1A	Cream EPDM membrane on wood	Northwest corner	CAT II NF
1B	Cream EPDM membrane on wood	Southeast corner	CAT II NF
1C	Cream EPDM membrane on wood	East edge	CAT II NF
2A	Light gray EPDM membrane on wood	SW corner	CAT II NF
2B	Light gray EPDM membrane on wood	SE corner	CAT II NF
2C	Light gray EPDM membrane on wood	North edge	CAT II NF
3A	Brown, dark brown vinyl plank flooring on wood base	Kitchen	CAT I NF
3B	Brown, dark brown vinyl plank flooring on wood base	Storage room	CAT I NF
3C	Brown, dark brown vinyl plank flooring on wood base	Conference room	CAT I NF
4A	Off-white vinyl floor tile	Kitchen	CAT II NF
4B	Off-white vinyl floor tile	Kitchen	CAT II NF
4C	Off-white vinyl floor tile	Kitchen	CAT II NF
5A	Black 6 inch vinyl cove base	Kitchen	CAT II NF
5B	Black 6 inch vinyl cove base	Storage room	CAT II NF
5C	Black 6 inch vinyl cove base	Kitchen	CAT II NF

Terracon

CHAIN OF CUSTODY

PLM 3-7241 (set 53485)

HA ID	Material	Sample Location	CAT
6A	Off-white wallpaper	Kitchen	CAT II NF
6B	Off-white wallpaper	South hallway	CAT II NF
6C	Off-white wallpaper	Conference room	CAT II NF
7A	White 2 x 2 drop-in ceiling tiles with perforations, pinholes	Kitchen	Friable
7B	White 2 x 2 drop-in ceiling tiles with perforations, pinholes	SW corner hallway	Friable
7C	White 2 x 2 drop-in ceiling tiles with perforations, pinholes	Conference room	Friable
8A	Gray drywall system	Kitchen	Friable
8B	Gray drywall system	East hallway	Friable
8C	Gray drywall system	North hallway	Friable
9A	Off-white, light gray 12 inch vinyl floor tile on wood base	Behind desk	CAT I NF
9B	Off-white, light gray 12 inch vinyl floor tile on wood base	Behind desk	CAT I NF
9C	Off-white, light gray 12 inch vinyl floor tile on wood base	Behind desk	CAT I NF
10A	Sand 4 inch vinyl cove base	Doorway	CAT II NF
10B	Sand 4 inch vinyl cove base	Doorway	CAT II NF
10C	Sand 4 inch vinyl cove base	Doorway	CAT II NF

PLM REPORT SUMMARY

Cates Laboratories
1339 Motor Circle
Dallas, Texas 75207 (214) 920-5006

NVLAP Lab No. 200569-0
TDSHS License No. 30-0287

Client: Terracon
Project (Line 1): 1601 SW Archer Rd., Trailer 11
Project (Line 2):
Project No: EQ247199
Identification: Asbestos, Bulk Sample Analysis
Test Method: Polarized Light Microscopy/Dispersion Staining (PLM/DS)
EPA Method 600/R-93/116

Lab Job No.: PLM-37241
Set No.: 53485
Report Date: 5/30/2024
Sample Date: 5/20/2024

On 5/23/2024, thirty (30) bulk samples were submitted by Mr. Pete Thompson of Terracon for asbestos analysis by PLM/DS. Copies of the lab data sheets are attached; additional information may be found therein. The results are summarized below:

Lab Sample No.	Client Field I.D.	Sample Description/Location	Asbestos Content
CL1260883	1A	Cream EPDM Membrane on Wood - Northwest Corner	None Detected - Roof Membrane None Detected - Glass Fiber Backing None Detected - Gypsum Material
CL1260884	1B	Cream EPDM Membrane on Wood - Southeast Corner	None Detected - Roof Membrane None Detected - Glass Fiber Backing None Detected - Gypsum Material
CL1260885	1C	Cream EPDM Membrane on Wood - East Edge	None Detected - Roof Membrane None Detected - Glass Fiber Backing None Detected - Gypsum Material
CL1260886	2A	Light Grey EPDM Membrane on Wood - Southwest Corner	None Detected - Roof Membrane None Detected - Glass Fiber Backing None Detected - Gypsum Material
CL1260887	2B	Light Grey EPDM Membrane on Wood - Southeast Corner	None Detected - Roof Membrane None Detected - Glass Fiber Backing None Detected - Gypsum Material
CL1260888	2C	Light Grey EPDM Membrane on Wood - North Edge	None Detected - Roof Membrane None Detected - Glass Fiber Backing None Detected - Gypsum Material
CL1260889	3A	Brown, Dark Brown Vinyl Plank Flooring on Wood Base - Kitchen	None Detected
CL1260890	3B	Brown, Dark Brown Vinyl Plank Flooring on Wood Base - Storage Room	None Detected
CL1260891	3C	Brown, Dark Brown Vinyl Plank Flooring on Wood Base - Conference Room	None Detected
CL1260892	4A	Off-white Vinyl Floor Tile - Kitchen	None Detected - Floor Tile None Detected - Green Mastic
CL1260893	4B	Off-white Vinyl Floor Tile - Kitchen	None Detected - Floor Tile None Detected - Green Mastic
CL1260894	4C	Off-white Vinyl Floor Tile - Kitchen	None Detected - Floor Tile None Detected - Green Mastic

These samples were analyzed by layers. The overall percent asbestos for the sample is reported when relevant. The EPA considers a material to be asbestos containing only if it contains greater than one percent asbestos by Calibrated Visual Area Estimation (CVAE). EPA regulations also indicate that Regulated Asbestos Containing Materials (RACM) – materials that are friable or may become friable – be further analyzed by point counting when the results indicate less than ten percent asbestos by CVAE. CatesLab utilizes CVAE on a routine basis and does not include point counting unless specifically requested by the client. The results may not be reproduced except in full.

PLM REPORT SUMMARY

Cates Laboratories
1339 Motor Circle
Dallas, Texas 75207 (214) 920-5006

NVLAP Lab No. 200569-0
TDSHS License No. 30-0287

Client: Terracon
Project (Line 1): 1601 SW Archer Rd., Trailer 11
Project (Line 2):
Project No: EQ247199
Identification: Asbestos, Bulk Sample Analysis
Test Method: Polarized Light Microscopy/Dispersion Staining (PLM/DS)
EPA Method 600/R-93/116

Lab Job No.: PLM-37241
Set No.: 53485
Report Date: 5/30/2024
Sample Date: 5/20/2024

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Lab Sample No.	Client Field I.D.	Sample Description/Location	Asbestos Content
CL1260895	5A	Black 6" Vinyl Cove Base - Kitchen	None Detected - Cove Base None Detected - White Mastic
CL1260896	5B	Black 6" Vinyl Cove Base - Storage Room	None Detected - Cove Base None Detected - White Mastic
CL1260897	5C	Black 6" Vinyl Cove Base - Kitchen	None Detected - Cove Base None Detected - White Mastic
CL1260898	6A	Off-white Wallpaper - Kitchen	None Detected
CL1260899	6B	Off-white Wallpaper - South Hallway	None Detected
CL1260900	6C	Off-white Wallpaper - Conference Room	None Detected
CL1260901	7A	White 2' X 2' Drop-in Ceiling Tiles w/Perforations, Pinholes - Kitchen	None Detected
CL1260902	7B	White 2' X 2' Drop-in Ceiling Tiles w/Perforations, Pinholes - Southwest Corner Hallway	None Detected
CL1260903	7C	White 2' X 2' Drop-in Ceiling Tiles w/Perforations, Pinholes - Conference Room	None Detected
CL1260904	8A	Grey Drywall System - Kitchen	None Detected - Wall Covering None Detected - Paper None Detected - Wallboard Material
CL1260905	8B	Grey Drywall System - East Hallway	None Detected - Wall Covering None Detected - Paper None Detected - Wallboard Material
CL1260906	8C	Grey Drywall System - North Hallway	None Detected - Wall Covering None Detected - Paper None Detected - Wallboard Material
CL1260907	9A	Off-white, Light Grey 12" Vinyl Floor Tile on Wood Base - Behind Desk	None Detected - Floor Tile None Detected - Green Mastic
CL1260908	9B	Off-white, Light Grey 12" Vinyl Floor Tile on Wood Base - Behind Desk	None Detected - Floor Tile None Detected - Green Mastic

These samples were analyzed by layers. The overall percent asbestos for the sample is reported when relevant. The EPA considers a material to be asbestos containing only if it contains greater than one percent asbestos by Calibrated Visual Area Estimation (CVAE). EPA regulations also indicate that Regulated Asbestos Containing Materials (RACM) – materials that are friable or may become friable – be further analyzed by point counting when the results indicate less than ten percent asbestos by CVAE. CatesLab utilizes CVAE on a routine basis and does not include point counting unless specifically requested by the client. The results may not be reproduced except in full.

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Cates Laboratories
1339 Motor Circle
Dallas, Texas 75207 (214) 920-5006

NVLAP Lab No. 200569-0
TDSHS License No. 30-0287

Client: Terracon
Project (Line 1): 1601 SW Archer Rd., Trailer 11
Project (Line 2):
Project No: EQ247199
Identification: Asbestos, Bulk Sample Analysis
Test Method: Polarized Light Microscopy/Dispersion Staining (PLM/DS)
EPA Method 600/R-93/116

Lab Job No.: PLM-37241
Set No.: 53485
Report Date: 5/30/2024
Sample Date: 5/20/2024

On 5/23/2024, thirty (30) bulk samples were submitted by Mr. Pete Thompson of Terracon for asbestos analysis by PLM/DS. Copies of the lab data sheets are attached; additional information may be found therein. The results are summarized below:

Lab Sample No.	Client Field I.D.	Sample Description/Location	Asbestos Content
CL1260909	9C	Off-white, Light Grey 12" Vinyl Floor Tile on Wood Base - Behind Desk	None Detected - Floor Tile None Detected - Green Mastic
CL1260910	10A	Sand 4" Vinyl Cove Base - Doorway	None Detected - Cove Base None Detected - Yellow Mastic
CL1260911	10B	Sand 4" Vinyl Cove Base - Doorway	None Detected - Cove Base None Detected - Yellow Mastic
CL1260912	10C	Sand 4" Vinyl Cove Base - Doorway	None Detected - Cove Base None Detected - Yellow Mastic

These samples were analyzed by layers. The overall percent asbestos for the sample is reported when relevant. The EPA considers a material to be asbestos containing only if it contains greater than one percent asbestos by Calibrated Visual Area Estimation (CVAE). EPA regulations also indicate that Regulated Asbestos Containing Materials (RACM) – materials that are friable or may become friable – be further analyzed by point counting when the results indicate less than ten percent asbestos by CVAE. CatesLab utilizes CVAE on a routine basis and does not include point counting unless specifically requested by the client. The results may not be reproduced except in full.

PLM REPORT SUMMARY

Cates Laboratories
1339 Motor Circle
Dallas, Texas 75207 (214) 920-5006

NVLAP Lab No. 200569-0
TDSHS License No. 30-0287

Client:	Terracon	Lab Job No.:	PLM-37241
Project (Line 1):	1601 SW Archer Rd., Trailer 11	Set No.:	53485
Project (Line 2):		Report Date:	5/30/2024
Project No:	EQ247199	Sample Date:	5/20/2024
Identification:	Asbestos, Bulk Sample Analysis		
Test Method:	Polarized Light Microscopy/Dispersion Staining (PLM/DS) EPA Method 600/R-93/116		

On 5/23/2024, thirty (30) bulk samples were submitted by Mr. Pete Thompson of Terracon for asbestos analysis by PLM/DS.
Copies of the lab data sheets are attached; additional information may be found therein.

STATEMENT OF LABORATORY ACCREDITATION

The samples were analyzed in general accordance with the procedures outlined in the U.S. EPA Interim Method for the Determination of Asbestos in Bulk Insulation Samples as found in 40 CFR, Part 763, Subpart E, Appendix E (formerly Subpart F, Appendix A), or the current U.S. EPA method (EPA Method 600/R-93/116) for the analysis of asbestos in building materials, by polarized light microscopy. The results of each bulk sample relate only to the material tested and the results shall not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

Specific questions concerning bulk sample results shall be directed to the Laboratory Director.

Analyst: Darlene Dao

Laboratory Director: John R. Cates, P.G.

Approved Signatory:

NVLAP®

TESTING
NVLAP LAB CODE 200569-0

CATES LABORATORIES

CHAIN OF CUSTODY

CL Project No (Lab Only) PLM37241 (set 53486)

Company: Terracon Consultants Inc.

Contact/Results to: Pete Thompson **Verbal** **Email X** **Fax**

Email(s): pete.thompson@terracon.com

Telephone #: 904-330-4405 **Fax #:**

Project Information

Project: Limited Asbestos Inspection **Project #:** EQ247199

Address: 1601 SW Archer Rd Gainesville / Building 13 **P.O.#**

Turnaround (check one)

CLEARANCE (PCM) **ASAP (SAME DAY) (IMMEDIATE)** **RUSH (1-DAY)** **STANDARD (2-DAY)** **3-4 DAY** **5-DAY X**

Testing Services (check all that apply. use separate COC's for Asbestos & IAQ)

Asbestos		IAQ - Mold (Non-Viable)
PLM-BULK	**PCM-AIR**	**AIR (spore trap)** - Standard Profile (count/genus identification)
EPA 600/R-93/116 X	NIOSH 7400	**AIR (spore trap)** - Expanded Profile (w/insect parts/pollen/skin)
Point Count (400)	OSHA: TWA	**BULK (tape lift, swab)** - Standard Profile (genus identification)

Cates Lab No. Range (Lab Only):	Sample Date	Number of Samples: 36	Positive Stop: Yes	No X
1260913 - 1260948	2024-05-15			

Sample No.	Sample Description/Location	Volume (air only)
	Stop on positive: No	
	Turnaround: 5 Days	
	Office: Jacksonville FL	
	PM: Pete Thompson	

Relinquished By:	Date/Time:	Received By:	Date/Time:
P. Thompson	2024/05/22		5/23/24 0950

AF72017-10 - *issued 1/7/2020* Walk-In☐ D-Drop☐ F-Drop☐ FedEx☑ UPS☐ Lonestar ☐ USPS☐

PLM 37241
(Set 53486)

Terracon

CHAIN OF CUSTODY

Printed on
May 22, 2024

Project Number: EQ247199	Inspection Date: 2024-05-15
Project Name: Limited Asbestos Survey, 1601 SW Archer Rd Gainesville / B 8/13	
Inspector: Pete Thompson #0091-002-394	HAs: 12: Number of samples: 36

HA ID	Material	Sample Location	CAT
1A	Gray concrete	Doorway	CAT II NF
1B	Gray concrete	Tank	CAT II NF
1C	Gray concrete	Louver	CAT II NF
2A	Gray concrete	Above door	CAT II NF
2B	Gray concrete	Fan	CAT II NF
2C	Gray concrete	Conduits	CAT II NF
3A	Gray concrete	Doorway	CAT II NF
3B	Gray concrete	Tank	CAT II NF
3C	Gray concrete	Louver	CAT II NF
4A	Gray concrete	Curb	CAT II NF
4B	Gray concrete	Curb	CAT II NF
4C	Gray concrete	Curb	CAT II NF
5A	Light gray packing material	East wall	CAT II NF
5B	Light gray packing material	West wall	CAT II NF
5C	Light gray packing material	West wall	CAT II NF

Terracon

CHAIN OF CUSTODY PLM37241 (set 53486)

HA ID	Material	Sample Location	CAT
6A	Gray door, sealing caulk	Doorway L	CAT II NF
6B	Gray door, sealing caulk	Doorway R	CAT II NF
6C	Gray door, sealing caulk	Doorway L	CAT II NF
7A	Gray concrete block and mortar	Fuel room wall	CAT II NF
7B	Gray concrete block and mortar	Fuel room wall	CAT II NF
7C	Gray concrete block and mortar	Fuel room wall	CAT II NF
8A	Red fire stop	Exterior wall penetration	CAT II NF
8B	Red fire stop	Exterior wall penetration	CAT II NF
8C	Red fire stop	Exterior wall penetration	CAT II NF
9A	Gray hard plaster on concrete block	East wall	CAT II NF
9B	Gray hard plaster on concrete block	East wall	CAT II NF
9C	Gray hard plaster on concrete block	East wall	CAT II NF
10A	Light gray wall, sealing caulk	East wall penetration	CAT II NF
10B	Light gray wall, sealing caulk	East wall penetration	CAT II NF
10C	Light gray wall, sealing caulk	East wall penetration	CAT II NF
11A	Gray built-up roofing on concrete	L angle	CAT I NF
11B	Gray built-up roofing on concrete	North leg	CAT I NF

Terracon

CHAIN OF CUSTODY

PLM 37241 (set 53486)

HA ID	Material	Sample Location	CAT
11C	Gray built-up roofing on concrete	East leg	CAT I NF
12A	Black mastic	East leg	CAT I NF
12B	Black mastic	SW corner	CAT I NF
12C	Black mastic	North edge	CAT I NF

PLM REPORT SUMMARY

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1339 Motor Circle
Dallas, Texas 75207 (214) 920-5006

NVLAP Lab No. 200569-0
TDSHS License No. 30-0287

Client: Terracon
Project (Line 1): 1601 SW Archer Rd., Gainesville, Building 13
Project (Line 2):
Project No: EQ247199
Identification: Asbestos, Bulk Sample Analysis
Test Method: Polarized Light Microscopy/Dispersion Staining (PLM/DS)
EPA Method 600/R-93/116

Lab Job No.: PLM-37241
Set No.: 53486
Report Date: 5/30/2024
Sample Date: 5/15/2024

On 5/23/2024, thirty-six (36) bulk samples were submitted by Mr. Pete Thompson of Terracon for asbestos analysis by PLM/DS. Copies of the lab data sheets are attached; additional information may be found therein. The results are summarized below:

Lab Sample No.	Client Field I.D.	Sample Description/Location	Asbestos Content
CL1260913	1A	Grey Concrete - Doorway	None Detected - Paint Layer None Detected - Concrete
CL1260914	1B	Grey Concrete - Tank	None Detected - Paint Layer None Detected - Concrete
CL1260915	1C	Grey Concrete - Louver	None Detected - Paint Layer None Detected - Concrete
CL1260916	2A	Grey Concrete - Above Door	None Detected
CL1260917	2B	Grey Concrete - Fan	None Detected
CL1260918	2C	Grey Concrete - Conduits	None Detected
CL1260919	3A	Grey Concrete - Doorway	None Detected
CL1260920	3B	Grey Concrete - Tank	None Detected
CL1260921	3C	Grey Concrete - Louver	None Detected
CL1260922	4A	Grey Concrete - Curb	None Detected - Paint Layer None Detected - Concrete
CL1260923	4B	Grey Concrete - Curb	None Detected - Paint Layer None Detected - Concrete
CL1260924	4C	Grey Concrete - Curb	None Detected - Paint Layer None Detected - Concrete
CL1260925	5A	Light Grey Packing Material - East Wall	None Detected
CL1260926	5B	Light Grey Packing Material - West Wall	None Detected
CL1260927	5C	Light Grey Packing Material - West Wall	None Detected
CL1260928	6A	Grey Door, Sealing Caulk - Doorway L	None Detected
CL1260929	6B	Grey Door, Sealing Caulk - Doorway R	None Detected
CL1260930	6C	Grey Door, Sealing Caulk - Doorway L	None Detected

These samples were analyzed by layers. The overall percent asbestos for the sample is reported when relevant. The EPA considers a material to be asbestos containing only if it contains greater than one percent asbestos by Calibrated Visual Area Estimation (CVAE). EPA regulations also indicate that Regulated Asbestos Containing Materials (RACM) – materials that are friable or may become friable – be further analyzed by point counting when the results indicate less than ten percent asbestos by CVAE. CatesLab utilizes CVAE on a routine basis and does not include point counting unless specifically requested by the client. The results may not be reproduced except in full.

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Lab Sample No.	Client Field I.D.	Sample Description/Location	Asbestos Content
CL1260931	7A	Grey Concrete Block & Mortar - Fuel Room Wall	None Detected - CMU Block None Detected - Mortar
CL1260932	7B	Grey Concrete Block & Mortar - Fuel Room Wall	None Detected - CMU Block None Detected - Mortar
CL1260933	7C	Grey Concrete Block & Mortar - Fuel Room Wall	None Detected - CMU Block None Detected - Mortar
CL1260934	8A	Red Firestop - Exterior Wall Penetration	None Detected
CL1260935	8B	Red Firestop - Exterior Wall Penetration	None Detected
CL1260936	8C	Red Firestop - Exterior Wall Penetration	None Detected
CL1260937	9A	Grey Hard Plaster on Concrete Block - East Wall	None Detected - Paint Layer None Detected - Plaster
CL1260938	9B	Grey Hard Plaster on Concrete Block - East Wall	None Detected - Paint Layer None Detected - Plaster
CL1260939	9C	Grey Hard Plaster on Concrete Block - East Wall	None Detected - Paint Layer None Detected - Plaster None Detected - CMU Block
CL1260940	10A	Light Grey Wall, Sealing Caulk - East Wall Penetration	None Detected
CL1260941	10B	Light Grey Wall, Sealing Caulk - East Wall Penetration	None Detected
CL1260942	10C	Light Grey Wall, Sealing Caulk - East Wall Penetration	None Detected
CL1260943	11A	Grey Built-up Roofing on Concrete - L Angle	None Detected - Roofing Membrane None Detected - Roofing Insulation
CL1260944	11B	Grey Built-up Roofing on Concrete - North Leg	None Detected - Roofing Membrane None Detected - Roofing Insulation
CL1260945	11C	Grey Built-up Roofing on Concrete - East Leg	None Detected - Roofing Membrane None Detected - Roofing Insulation None Detected - Roofing Foam

These samples were analyzed by layers. The overall percent asbestos for the sample is reported when relevant. The EPA considers a material to be asbestos containing only if it contains greater than one percent asbestos by Calibrated Visual Area Estimation (CVAE). EPA regulations also indicate that Regulated Asbestos Containing Materials (RACM) – materials that are friable or may become friable – be further analyzed by point counting when the results indicate less than ten percent asbestos by CVAE. CatesLab utilizes CVAE on a routine basis and does not include point counting unless specifically requested by the client. The results may not be reproduced except in full.

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Client: Terracon
Project (Line 1): 1601 SW Archer Rd., Gainesville, Building 13
Project (Line 2):
Project No: EQ247199
Identification: Asbestos, Bulk Sample Analysis
Test Method: Polarized Light Microscopy/Dispersion Staining (PLM/DS)
EPA Method 600/R-93/116

Lab Job No.: PLM-37241
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Sample Date: 5/15/2024

On 5/23/2024, thirty-six (36) bulk samples were submitted by Mr. Pete Thompson of Terracon for asbestos analysis by PLM/DS. Copies of the lab data sheets are attached; additional information may be found therein. The results are summarized below:

Lab Sample No.	Client Field I.D.	Sample Description/Location	Asbestos Content
CL1260946	12A	Black Mastic - East Leg	None Detected
CL1260947	12B	Black Mastic - Southwest Corner	None Detected
CL1260948	12C	Black Mastic - North Edge	None Detected

These samples were analyzed by layers. The overall percent asbestos for the sample is reported when relevant. The EPA considers a material to be asbestos containing only if it contains greater than one percent asbestos by Calibrated Visual Area Estimation (CVAE). EPA regulations also indicate that Regulated Asbestos Containing Materials (RACM) – materials that are friable or may become friable – be further analyzed by point counting when the results indicate less than ten percent asbestos by CVAE. CatesLab utilizes CVAE on a routine basis and does not include point counting unless specifically requested by the client. The results may not be reproduced except in full.

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NVLAP Lab No. 200569-0
TDSHS License No. 30-0287

Client:	Terracon	Lab Job No.:	PLM-37241
Project (Line 1):	1601 SW Archer Rd., Gainesville, Building 13	Set No.:	53486
Project (Line 2):		Report Date:	5/30/2024
Project No:	EQ247199	Sample Date:	5/15/2024
Identification:	Asbestos, Bulk Sample Analysis		
Test Method:	Polarized Light Microscopy/Dispersion Staining (PLM/DS) EPA Method 600/R-93/116		

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Specific questions concerning bulk sample results shall be directed to the Laboratory Director.

Analyst: Kathy Schosek

Laboratory Director: John R. Cates, P.G.

Approved Signatory:

NVLAP®

TESTING
NVLAP LAB CODE 200569-0

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Lead Chain of Custody

EMSL Use Only

JC50156

EMSL Analytical, Inc.
3303 Parkway Center Court
Orlando, FL 32808
PHONE: (407) 599-5887
EMAIL: orlandolab@emsl.com

Customer Information

Customer ID:	TRCF34
Company Name:	Terracon
Contact Name:	Peter Thompson
Street Address:	8001 Baymeadows Way #1
City, State, Zip:	Jacksonville FL 32256 Country: US
Phone:	904-330-4405
Email(s) for Report:	pthompson@terracon.com

Billing Information

Billing ID:	
Company Name:	Terracon
Billing Contact:	Peter Thompson
Street Address:	8001 Baymeadows Way #1
City, State, Zip:	Jacksonville FL 32256 Country: US
Phone:	904-900-6468
Email(s) for Invoice:	

Project Information

Project Name/No:	EQ247199 TRAILER
Purchase Order:	
EMSL LIMS Project ID: (If applicable, EMSL will provide)	
US State where samples collected:	FL
State of Connecticut (CT) must select project location:	☐ Commercial (Taxable) ☐ Residential (Non-Taxable)
Sampled By Name:	Pete Thompson
Sampled By Signature:	PThompson
No. of Samples in Shipment	

Turn-Around-Time (TAT)

☐ 3 Hour ☐ 6 Hour ☐ 24 Hour ☐ 32 Hour ☐ 48 Hour ☑ 72 Hour ☐ 96 Hour ☐ 1 Week ☐ 2 Week

Please call ahead for large projects and/or turnaround times 6 Hours or Less. *32 Hour TAT available for select tests only, samples must be submitted by 11:30am.

MATRIX	METHOD	INSTRUMENT	REPORTING LIMIT	SELECTION
CHIPS ☑ % by wt. ☐ ppm (mg/kg) ☐ mg/cm*	SW 846-7000B	Flame Atomic Absorption	0.008% (80ppm)	☑
*Reporting Limit based on a minimum 0.25g sample weight	SW 846-6010D*	ICP-OES	0.0004% (4ppm)	☐
AIR	NIOSH 7082	Flame Atomic Absorption	4µg/filter	☐
	NIOSH 7300M / NIOSH 7303M	ICP-OES	0.5µg/filter	☐
	NIOSH 7300M / NIOSH 7303M	ICP-MS	0.05µg/filter	☐
WIPE ☐ ASTM ☐ NON-ASTM	SW 846-7000B	Flame Atomic Absorption	10µg/wipe	☐
*If no box is checked, non-ASTM Wipe is assumed	SW 846-6010D*	ICP-OES	1.0µg/wipe	☐
TCLP	SW 846-1311 / 7000B / SM 3111B	Flame Atomic Absorption	0.4 mg/L (ppm)	☐
	SW 846-1311 / SW 846-6010D*	ICP-OES	0.1 mg/L (ppm)	☐
SPLP	SW 846-1312 / 7000B / SM 3111B	Flame Atomic Absorption	0.4 mg/L (ppm)	☐
	SW 846-1312 / SW 846-6010D*	ICP-OES	0.1 mg/L (ppm)	☐
TTLC	22 CCR App. II, 7000B	Flame Atomic Absorption	40mg/kg (ppm)	☐
	22 CCR App. II, SW 846-6010D*	ICP-OES	2mg/kg (ppm)	☐
STLC	22 CCR App. II, 7000B	Flame Atomic Absorption	0.4 mg/L (ppm)	☐
	22 CCR App. II, SW 846-6010D*	ICP-OES	0.1 mg/L (ppm)	☐
Soil	SW 846-7000B	Flame Atomic Absorption	40mg/kg (ppm)	☐
	SW 846-6010D*	ICP-OES	2mg/kg (ppm)	☐
Wastewater	SM 3111B / SW 846-7000B	Flame Atomic Absorption	0.4 mg/L (ppm)	☐
Unpreserved ☐ / Preserved with HNO3 ☐ PH<2	EPA 200.7	ICP-OES	0.020 mg/L (ppm)	☐
Drinking Water	EPA 200.5	ICP-OES	0.003 mg/L (ppm)	☐
Unpreserved ☐ / Preserved with HNO3 ☐ PH<2	EPA 200.8	ICP-MS	0.001 mg/L (ppm)	☐
TSP/SPM Filter	40 CFR Part 50	ICP-OES	12 µg/filter	☐
Other:				☐

Sample Number	Sample Location	Volume / Area	Date / Time Sampled

Method of Shipment:		Sample Condition Upon Receipt:	
Relinquished by: Pete Thompson	Date/Time: 2024/5/24: 1700	Received by: CA 9:37	Date/Time: MAY 28 2024
Relinquished by:	Date/Time:	Received by:	Date/Time

Controlled Document - COC-25 Lead R16 4/19/2021

*6010C Available Upon Request

☐ AGREE TO ELECTRONIC SIGNATURE (By checking, I consent to signing this Chain of Custody document by electronic signature.)

EMSL Analytical, Inc.'s Laboratory Terms and Conditions are incorporated into this Chain of Custody by reference in their entirety. Submission of samples to EMSL Analy... acceptance and acknowledgment of all terms and conditions by Customer.

Terracon

8001 Baymeadows Way Suite 1
Jacksonville Florida 32256

JC50156

2024/5/24

Project #	Site contact: Ken Raiteri 800-362-1523	Date
EQ247199	Address: 1601 SW Archer Rd Gainesville trailer	

#	Color	Substrate	Sample location	Locations	Quantity
1	CRM	WOOD	FIRE DOOR		
2	BGE	WOOD	INTERNAL DOOR		
3	WHT	METAL	DOOR FRAMES		
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					

MAY 2 8 2024 9:37

EMSL Analytical, Inc.

3303 Parkway Center Court, Orlando, FL, 32808
Telephone: (407)-599-5887 Fax:(407)-599-9063
EMSL-OR-34

EMSL Order ID: 342450156
LIMS Reference ID: JC50156
EMSL Customer ID: TRCF34

Attention: Peter Thompson
Terracon Consultants, Inc. [TRCF34]
8001 Baymeadows Way, Suite 1
Jacksonville, FL 32256
(904) 330-4405
pthompson@terracon.com

Project Name: EQ247199 Trailer
Customer PO: EQ247199
EMSL Sales Rep: Jason McDonald
Received: 05/28/2024 09:37
Reported: 05/30/2024 17:12

Analytical Results

Analyte	Results	RL	Weight(g)	Prep Date & Tech	Prep Method	Analysis Date & Analyst	Analytical Method	Q	DF
Client Sample ID: 1/Crm, Wood, Fire Door									**Date Sampled: 05/24/24**
Matrix: Chips									**LIMS Reference ID: JC50156-01**
Lead	<0.015 % wt	0.015 % wt	0.13	05/29/24 JS3	SW-846 3050B	05/29/24 SM	SW 846-7000B		1
	Sample Comments:								
Client Sample ID: 2/Bge, Wood, Internal Door									**Date Sampled: 05/24/24**
Matrix: Chips									**LIMS Reference ID: JC50156-02**
Lead	<0.008 % wt	0.008 % wt	0.2844	05/29/24 JS3	SW-846 3050B	05/29/24 SM	SW 846-7000B		1
	Sample Comments:								
Client Sample ID: 3/Wht, Metal, Door Frames									**Date Sampled: 05/24/24**
Matrix: Chips									**LIMS Reference ID: JC50156-03**
Lead	<0.149 % wt	0.149 % wt	0.0134	05/29/24 JS3	SW-846 3050B	05/29/24 SM	SW 846-7000B		1
	Sample Comments:								

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Work Order Case Narrative

Data reported may not reach applicable analytical sensitivity due to insufficient sample weights submitted .
Suggested weight for analysis is 0.25 g.

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Certified Analyses included in this Report

Analyte	Certifications
SW 846-7000B in Chips	
Lead	34-AIHA ELLAP,34-LA,34-OH

List of Certifications

Code	Description	Number	Expires
34-LA	LA - Asbestos (PCM, PLM and TEM), Fungi and Bacteria, Lead and Metals	0519	06/30/2024
34-AIHA ELLAP	American Industrial Hygiene Association (AIHA-LAP) - ELLAP	163563	03/01/2026
34-AIHA EMLAP	American Industrial Hygiene Association (AIHA-LAP) - EMLAP	163563	03/01/2026
34-AIHA IHLAP	American Industrial Hygiene Association (AIHA-LAP) - IHLAP	163563	03/01/2026
34-A2LA Food	A2LA Food Microbiology Certificate	2845.49	03/31/2026
34-OH	OH - Lead in Paint Chips, Wipes, Soil and Air	E10057	11/22/2024

Please see the specific Field of Testing (FOT) on www.emsl.com <http://www.emsl.com> for a complete listing of parameters for which EMSL is certified.

Notes and Definitions

Item	Definition
(Dig)	For metals analysis, sample was digested.
[2C]	Reported from the second channel in dual column analysis.
DF	Dilution Factor
MDL	Method Detection Limit.
ND	Analyte was NOT DETECTED at or above the detection limit.
Q	Qualifier
RL	Reporting Limit
Wet	Sample is not dry weight corrected.

Measurement of uncertainty and any applicable definitions of method modifications are available upon request. Per EPA NLLAP policy, sample results are not blank corrected.

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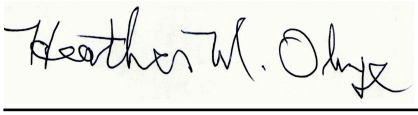

Heather Ohye Laboratory Manager or other approved signatory

EMSL maintains liability limited to coast of analysis. Interpretation and use of test results are the responsibility of the client. This report relates only to the samples reported above and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. The report reflects the samples as received. Results are generated from the field sampling data (sampling volumes and areas, locations, etc.) provided by the client on the Chain of Custody. QC sample results are within quality control criteria and met method specifications unless otherwise noted. All results for soil samples are reported on a dry weight basis, unless otherwise noted.

Analysis following EMSL SOP for the Determination of Environmental Lead by FLAA. The laboratory has a reporting limit of 0.008% by wt., based upon a minimum sample weight of 0.25g submitted to the lab, and is not responsible for any result or reporting limit provided in mg/cm2 since it is dependent upon an area value provided by non-lab personnel. A "<" (less than) result signifies that the analyte was not detected at or above the reporting limit. Measurement of uncertainty and definitions of modifications are available upon request. Results in this report are not blank corrected unless specified.

EMSL ANALYTICAL, INC.
LABORATORY • PRODUCTS • TRAINING

Lead Chain of Custody

EMSL Order Number / Lab Use Only

JC50157

EMSL Analytical, Inc.
3303 Parkway Center Court
Orlando, FL 32808
PHONE: (407) 599-5887
EMAIL: orlandolab@emsl.com

Customer Information		Billing Information	
Customer ID:	TRCF34	Billing ID:	
Company Name:	Terracon	Company Name:	Terracon
Contact Name:	Peter Thompson	Billing Contact:	Peter Thompson
Street Address:	8001 Baymeadows Way #1	Street Address:	8001 Baymeadows Way #1
City, State, Zip:	Jacksonville FL 32256	City, State, Zip:	Jacksonville FL 32256
Country:	US	Country:	US
Phone:	904-330-4405	Phone:	904-900-6468
Email(s) for Report:	pthompson@terracon.com	Email(s) for Invoice:	

Project Information

Project Name/No: EQ247199 GENERATOR BUILDING

Purchase Order:

EMSL LIMS Project ID: (If applicable, EMSL will provide)

US State where samples collected: FL

State of Connecticut (CT) must select project location: ☐ Commercial (Taxable) ☐ Residential (Non-Taxable)

Sampled By Name: Pete Thompson

Sampled By Signature: PThompson

No. of Samples in Shipment

Turn-Around-Time (TAT)

☐ 3 Hour ☐ 6 Hour ☐ 24 Hour ☐ 32 Hour ☐ 48 Hour ☑ 72 Hour ☐ 96 Hour ☐ 1 Week ☐ 2 Week

Please call ahead for large projects and/or turnaround times 6 Hours or Less. *32 Hour TAT available for select tests only; samples must be submitted by 11:30am.

MATRIX	METHOD	INSTRUMENT	REPORTING LIMIT	SELECTION
CHIPS ☑ % by wt. ☐ ppm (mg/kg) ☐ mg/cm²	SW 846-7000B	Flame Atomic Absorption	0.008% (80ppm)	☑
*Reporting Limit based on a minimum 0.25g sample weight	SW 846-6010D*	ICP-OES	0.0004% (4ppm)	☐
AIR	NIOSH 7082	Flame Atomic Absorption	4µg/filter	☐
	NIOSH 7300M / NIOSH 7303M	ICP-OES	0.5µg/filter	☐
	NIOSH 7300M / NIOSH 7303M	ICP-MS	0.05µg/filter	☐
WIPE ☐ ASTM ☐ NON-ASTM	SW 846-7000B	Flame Atomic Absorption	10µg/wipe	☐
*If no box is checked, non-ASTM Wipe is assumed	SW 846-6010D*	ICP-OES	1.0µg/wipe	☐
TCLP	SW 846-1311 / 7000B / SM 3111B	Flame Atomic Absorption	0.4 mg/L (ppm)	☐
	SW 846-1311 / SW 846-6010D*	ICP-OES	0.1 mg/L (ppm)	☐
SPLP	SW 846-1312 / 7000B / SM 3111B	Flame Atomic Absorption	0.4 mg/L (ppm)	☐
	SW 846-1312 / SW 846-6010D*	ICP-OES	0.1 mg/L (ppm)	☐
TTLC	22 CCR App. II, 7000B	Flame Atomic Absorption	40mg/kg (ppm)	☐
	22 CCR App. II, SW 846-6010D*	ICP-OES	2mg/kg (ppm)	☐
STLC	22 CCR App. II, 7000B	Flame Atomic Absorption	0.4 mg/L (ppm)	☐
	22 CCR App. II, SW 846-6010D*	ICP-OES	0.1 mg/L (ppm)	☐
Soil	SW 846-7000B	Flame Atomic Absorption	40mg/kg (ppm)	☐
	SW 846-6010D*	ICP-OES	2mg/kg (ppm)	☐
Wastewater	SM 3111B / SW 846-7000B	Flame Atomic Absorption	0.4 mg/L (ppm)	☐
Unpreserved ☐ / Preserved with HNO3 ☐ PH<2	EPA 200.7	ICP-OES	0.020 mg/L (ppm)	☐
Drinking Water	EPA 200.5	ICP-OES	0.003 mg/L (ppm)	☐
Unpreserved ☐ / Preserved with HNO3 ☐ PH<2	EPA 200.8	ICP-MS	0.001 mg/L (ppm)	☐
TSP/SPM Filter	40 CFR Part 50	ICP-OES	12 µg/filter	☐
Other:				☐

Sample Number	Sample Location	Volume / Area	Date / Time Sampled
	SEE NEXT PAGE		

Method of Shipment:

Sample Condition Upon Receipt:

Relinquished by:	Date/Time:	Received by:	Date/Time
Pete Thompson	2024/5/24: 1700	9:37	MAY 28 2024

Controlled Document - COC-25 Lead R16 4/19/2021

*6010C Available Upon Request

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Terracon

8001 Baymeadows Way Suite 1
Jacksonville Florida 32256

JC50157

2024/5/24

Project #	Site contact: Ken Raiteri 800-362-1523	Date ~~2023/10/05~~
EQ247199	**Address: 1601 SW Archer Rd Gainesville generator bldg**	

#	Color	Substrate	Sample location	Locations	Quantity
1	YEL	CONCRETE	CURB		
2	CRM	METAL	FRAME		
3	RED	WOOD	FIRE EXT. PANEL		
4	BRN	METAL	INSIDE DOOR		
5	BRN	METAL	EXTERIOR DOOR		
6	WHT	METAL	LADDERS		
7	WHT	CONCRETE	EXT WALLS		
8					
9					
10					
11					
12					
13					
14					
15					
16					

MAY 28 2024 9:37

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Jacksonville, FL 32256
(904) 330-4405
pthompson@terracon.com

Project Name: EQ247199 Generator Building

Customer PO: EQ247199
EMSL Sales Rep: Jason McDonald
Received: 05/28/2024 09:37
Reported: 05/30/2024 17:37

Analytical Results

Analyte	Results	RL	Weight(g)	Prep Date & Tech	Prep Method	Analysis Date & Analyst	Analytical Method	Q	DF
Client Sample ID: 1/Yel, Concrete, Curb								**Date Sampled: 05/24/24**	
Matrix: Chips								**LIMS Reference ID: JC50157-01**	
Lead	0.011 % wt	0.008 % wt	0.2687	05/29/24 JS3	SW-846 3050B	05/29/24 SM	SW 846-7000B		1
	Sample Comments:								
Client Sample ID: 2/Crm, Metal, Frame								**Date Sampled: 05/24/24**	
Matrix: Chips								**LIMS Reference ID: JC50157-02**	
Lead	<0.008 % wt	0.008 % wt	0.2809	05/29/24 JS3	SW-846 3050B	05/29/24 SM	SW 846-7000B		1
	Sample Comments:								
Client Sample ID: 3/Red, Wood, Fire Ext. Panel								**Date Sampled: 05/24/24**	
Matrix: Chips								**LIMS Reference ID: JC50157-03**	
Lead	0.042 % wt	0.010 % wt	0.1911	05/29/24 JS3	SW-846 3050B	05/29/24 SM	SW 846-7000B		1
	Sample Comments:								
Client Sample ID: 4/Brn, Metal, Inside Door								**Date Sampled: 05/24/24**	
Matrix: Chips								**LIMS Reference ID: JC50157-04**	
Lead	<0.008 % wt	0.008 % wt	0.2831	05/29/24 JS3	SW-846 3050B	05/29/24 SM	SW 846-7000B		1
	Sample Comments:								
Client Sample ID: 5/Brn, Metal, Exterior Door								**Date Sampled: 05/24/24**	
Matrix: Chips								**LIMS Reference ID: JC50157-05**	
Lead	<0.008 % wt	0.008 % wt	0.272	05/29/24 JS3	SW-846 3050B	05/29/24 SM	SW 846-7000B		1
	Sample Comments:								
Client Sample ID: 6/Wht, Metal, Ladders								**Date Sampled: 05/24/24**	
Matrix: Chips								**LIMS Reference ID: JC50157-06**	
Lead	<0.008 % wt	0.008 % wt	0.2851	05/29/24 JS3	SW-846 3050B	05/29/24 SM	SW 846-7000B		1
	Sample Comments:								
Client Sample ID: 7/Wht, Concrete, Ext Walls								**Date Sampled: 05/24/24**	
Matrix: Chips								**LIMS Reference ID: JC50157-07**	
Lead	<0.008 % wt	0.008 % wt	0.2693	05/29/24 JS3	SW-846 3050B	05/29/24 SM	SW 846-7000B		1
	Sample Comments:								

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34-AIHA ELLAP	American Industrial Hygiene Association (AIHA-LAP) - ELLAP	163563	03/01/2026
34-AIHA EMLAP	American Industrial Hygiene Association (AIHA-LAP) - EMLAP	163563	03/01/2026
34-AIHA IHLAP	American Industrial Hygiene Association (AIHA-LAP) - IHLAP	163563	03/01/2026
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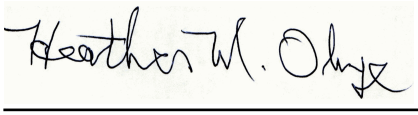

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APPENDIX C

PHOTOGRAPHS

Paint sample #1 Building 13, Concrete curb

Paint sample #3 Building 13, Fire extinguisher panel

Paint sample #3 Trailer 11, Internal door frames

APPENDIX D

CERTIFICATIONS

UF | TREEO Center
UNIVERSITY of FLORIDA

Center for Training, Research and Education for Environmental Occupations

certifies

Pete Thompson

8001 Baymeadows Way Jacksonville, FL 32256

Having passed a 25-question exam with a score of 70% or higher has successfully met training requirements for

Asbestos Refresher: Inspector Online

FDBPR Asbestos Licensing Unit: Provider #0000995; Course #FL49-0006389 (½ Day; 3.40 Contact Hours)

(Reaccreditation for Inspector under TSCA Title II/AHERA)

Conducted

1/16/2024

Certificate #: 0091 - 002-394
Exam Date: **1/16/2024**
EPA accreditation expires: **1/16/2025**
Principal Instructor: Brian Duchene, PE, LAC
CEUs: 0.4
FBPR LAC: #0000995; Course ## 0006389
FBPE CEHs: #0004021; Course #0009083/Educational Institutions: 4 CEHs

Andrew Campbell, Director

University of Florida TREEO Center · 3900 SW 63 Blvd Gainesville FL 32608-3800 · 352.392.9570 · train@treeo.ufl.edu · www.treeo.ufl.edu

United States Environmental Protection Agency

This is to certify that

Peter Thompson

has fulfilled the requirements of the Toxic Substances Control Act (TSCA) Section 402, and has received certification to conduct lead-based paint activities pursuant to 40 CFR Part 745.226 as:

Inspector

In the Jurisdiction of:

All EPA Administered Lead-based Paint Activities Program States, Tribes and Territories

This certification is valid from the date of issuance and expires October 17, 2025

LBP-I-17089-3
Certification #

September 20, 2022
Issued On

Adrienne Priselac, Manager, Toxics Office
Land Division

Ron DeSantis, Governor

Melanie S. Griffin, Secretary

STATE OF FLORIDA
DEPARTMENT OF BUSINESS AND PROFESSIONAL REGULATION

ASBESTOS LICENSING UNIT

THE ASBESTOS CONSULTANT HEREIN IS LICENSED UNDER THE
PROVISIONS OF CHAPTER 469, FLORIDA STATUTES

SCHRUM, MICHAEL W

TERRACON CONSULTANTS INC
1675 LEE ROAD
WINTER PARK FL 32789

LICENSE NUMBER: AX78

EXPIRATION DATE: NOVEMBER 30, 2024

Always verify licenses online at MyFloridaLicense.com

Do not alter this document in any form.

This is your license. It is unlawful for anyone other than the licensee to use this document.

Ron DeSantis, Governor

Melanie S. Griffin, Secretary

STATE OF FLORIDA
DEPARTMENT OF BUSINESS AND PROFESSIONAL REGULATION

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TERRACON CONSULTANTS INC

MICHAEL W SCHRUM
1675 LEE ROAD
WINTER PARK FL 32789

LICENSE NUMBER: ZA337

EXPIRATION DATE: NOVEMBER 30, 2025

Always verify licenses online at MyFloridaLicense.com

ISSUED: 10/25/2023

Do not alter this document in any form.

This is your license. It is unlawful for anyone other than the licensee to use this document.

United States Department of Commerce
National Institute of Standards and Technology

Certificate of Accreditation to ISO/IEC 17025:2017

NVLAP LAB CODE: 200569-0

Cates Laboratories, Inc.

Dallas, TX

is accredited by the National Voluntary Laboratory Accreditation Program for specific services, listed on the Scope of Accreditation, for:

Asbestos Fiber Analysis

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communique dated January 2009).

2024-04-01 through 2025-03-31

Effective Dates

For the National Voluntary Laboratory Accreditation Program

National Voluntary Laboratory Accreditation Program

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

Cates Laboratories, Inc.
1339 Motor Circle
Dallas, TX 75207
Mr. John R. Cates
Phone: 214-920-5006 Fax: 1-972-767-0167
Email: jrcates@cateslab.com
http://www.cateslab.com

ASBESTOS FIBER ANALYSIS **NVLAP LAB CODE 200569-0**

Bulk Asbestos Analysis

Code	*Description*
18/A01	EPA -- 40 CFR Appendix E to Subpart E of Part 763, Interim Method of the Determination of Asbestos in Bulk Insulation Samples
18/A03	EPA 600/R-93/116: Method for the Determination of Asbestos in Bulk Building Materials

For the National Voluntary Laboratory Accreditation Program

Effective 2024-04-01 through 2025-03-31

AIHA Laboratory Accreditation Programs, LLC

acknowledges that

EMSL Analytical, Inc.

3303 Parkway Center Ct Orlando, FL 32808-1040

Laboratory ID: LAP-163563

along with all premises from which key activities are performed, as listed above, has fulfilled the requirements of the AIHA Laboratory Accreditation Programs, LLC (AIHA LAP) accreditation to the ISO/IEC 17025:2017 international standard, General Requirements for the Competence of Testing and Calibration Laboratories in the following:

LABORATORY ACCREDITATION PROGRAMS

☑	**INDUSTRIAL HYGIENE**	Accreditation Expires: March 01, 2026
☑	**ENVIRONMENTAL LEAD**	Accreditation Expires: March 01, 2026
☑	**ENVIRONMENTAL MICROBIOLOGY**	Accreditation Expires: March 01, 2026
☐	**FOOD**	Accreditation Expires:
☐	**UNIQUE SCOPES**	Accreditation Expires:
☐	**BE FIELD/MOBILE**	Accreditation Expires:

Specific Field(s) of Testing/Method(s) within each Accreditation Program for which the above named laboratory maintains accreditation is outlined on the attached Scope of Accreditation. Continued accreditation is contingent upon successful on-going compliance with ISO/IEC 17025:2017 and AIHA LAP requirements. This certificate is not valid without the attached Scope of Accreditation. Please review the AIHA LAP website (www.aihaaccreditedlabs.org) for the most current Scope.

Cheryl O. Morton

Cheryl O Morton
Managing Director, AIHA Laboratory Accreditation Programs, LLC

Revision21: 10/24/2023

Date Issued: 03/01/2024

AIHA Laboratory Accreditation Programs, LLC

SCOPE OF ACCREDITATION

EMSL Analytical, Inc.

3303 Parkway Center Ct Orlando, FL 32808-1040

Laboratory ID: LAP-163563

Issue Date: 03/01/2024
Expire Date: 03/01/2026

The laboratory is approved for those specific field(s) of testing/methods listed in the table below. Clients are urged to verify the laboratory's current accreditation status for the particular field(s) of testing/Methods, since these can change due to proficiency status, suspension and/or withdrawal of accreditation.

The EPA recognizes the AIHA LAP, LLC ELLAP program as meeting the requirements of the National Lead Laboratory Accreditation Program (NLLAP) established under Title X of the Residential Lead-Based Paint Hazard Reduction Act of 1992 and includes paint, soil and dust wipe analysis. Air and composited wipes analyses are not included as part of the NLLAP.

Environmental Lead Laboratory Accreditation Program (ELLAP)

Initial Accreditation Date: 09/01/2007

Component, parameter, characteristic, material, or product tested	Technology sub-type/Detector	Method	Method Description *(for internal methods only)*
Airborne Dust	AA	NIOSH 7082	N/A
Paint	AA	EPA SW-846 3050B	N/A
		EPA SW-846 3051A	N/A
		EPA SW-846 7000B	N/A
Settled Dust by Wipe	AA	EPA SW-846 3050B	N/A
		EPA SW-846 3051A	N/A
		EPA SW-846 7000B	N/A
Soil	AA	EPA SW-846 3050B	N/A
		EPA SW-846 3051A	N/A
		EPA SW-846 7000B	N/A

A complete listing of currently accredited ELLAP laboratories is available on the AIHA LAP, LLC website at: http://www.aihaaccreditedlabs.org

SECTION 03 30 53
(SHORT FORM) CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Cast-in-place structural concrete.
   2. Equipment pads.
   3. Preparation of existing surfaces to receive concrete.

1.2 RELATED WORK

A. Section 01 45 29, TESTING LABORATORY SERVICES: Materials Testing and Inspection During Construction.

1.3 APPLICABLE PUBLICATIONS

A. Comply with references to extent specified in this Section.

B. American Concrete Institute (ACI):

117-10(R2015)	Specification for Tolerances for Concrete Construction and Materials and Commentary
301/301M-16	Specifications for Structural Concrete.
305.1-14 -	Hot Weather Concreting.
306.1-90(R2002)	Cold Weather Concreting.
318/318M-19	Building Code Requirements for Structural Concrete and Commentary
347R-14 -	Guide to Formwork for Concrete.
SP-66-04-.....	ACI Detailing Manual.

C. ASTM International(ASTM):

A615/A615M-20	Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement
A1064/A1064M-18a.....	Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
C33/C33M-18	Standard Specification for Concrete Aggregates.
C39/C39M-20	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
C94/C94M-20	Standard Specification for Ready-Mixed Concrete.

C150/C150M-20 ..... Standard Specification for Portland Cement.
C618-19 ..... Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
C989/C989M-18a ..... Standard Specification for Slag Cement for Use in Concrete and Mortars.
C1240-20 ..... Standard Specification for Silica Fume Used in Cementitious Mixtures.
D1751-18 ..... Standard Specification for Preformed Expansion Joint Fillers for Structural Construction (Non-extruding and Resilient Bituminous Types).

D. International Concrete Repair Institute:
310.2R-2013 - ..... Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair.

1.4 SUBMITTALS

A. Submittal Procedures: Refer to Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. All items indicated below are required submittals requiring Contracting Officer’s Representative (COR) review and approval.
B. Submittal Drawings:
   1. Submit large scale drawings of reinforcing steel, including all reinforcing bend diagrams and reinforcing details, to the COR for review and approval.
C. Manufacturer's Literature and Data:
   1. Concrete Mix Design.
   2. Air-entraining admixture, chemical admixtures, and curing compounds.
   3. Indicate manufacturer's recommendation for each application.
D. Sustainable Construction Submittals:

   1. Recycled Content: Identify post-consumer and pre-consumer recycled content percentage by weight.
E. Certificates: Certify products comply with specifications.
   1. Each ready mix concrete batch delivered to site.

1.5 DELIVERY

A. Deliver each ready-mixed concrete batch with mix certification in duplicate according to ASTM International(ASTM) C94/C94M.

1.6 WARRANTY

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

PART 2 - PRODUCTS

2.1 MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or II.

B. Pozzolans:

1. Fly Ash: ASTM International(ASTM) C618, Class C or F including supplementary optional physical requirements. Pozzolans shall not exceed 25 percent of total cementitious materials by weight.
2. Slag: ASTM International(ASTM) C989/C989M; Grade 80
3. Silica Fume: ASTM International(ASTM) C1240.

C. Coarse Aggregate: ASTM International(ASTM) C33/C33M.

1. Size 67 for other applications.

D. Fine Aggregate: ASTM International(ASTM) C33/C33M.

E. Mixing Water: Fresh, clean, and potable.

F. Air-Entraining Admixture: ASTM International(ASTM) C260/C260M.

G. Chemical Admixtures: ASTM International(ASTM) C494/C494M.

H. Reinforcing Steel: ASTM International(ASTM) A615/A615M or ASTM International(ASTM) A996/A996M, deformed. See Structural Drawings for grade.

I. Forms: Wood, plywood, metal, or other materials, approved by Contracting Officer, of grade or type suitable to obtain type of finish specified.

1. Plywood: Exterior grade, free of defects and patches on contact surface.
2. Lumber: Sound, grade-marked, S4S stress graded softwood.
3. Form coating: As recommended by Contractor.

J. Welded Wire Fabric: ASTM International(ASTM) A1064/A1064M, plain; sized as indicated.

K. Expansion Joint Filler: ASTM International(ASTM) D1751.

L. Sheet Materials for Curing Concrete: ASTM International(ASTM) C171.

M. Abrasive Aggregates: Aluminum oxide grains or emery grits.

N. Liquid Densifier/Sealer: 100 percent active colorless aqueous siliconate solution.

O. Grout, Non-Shrinking: Premixed ferrous or non-ferrous. Grout to show no settlement or vertical drying shrinkage at 3 days. Compressive strength for grout, at least 18 MPa (2500 psi) at 3 days and 35 MPa (5000 psi) at 28 days.

2.2 ACCESSORIES

A. Bonding Agent: ASTM International (ASTM) C 1059/C 1059M, Type II.

B. Structural Adhesive: ASTM International (ASTM) C881, 2-component material suitable for use on dry or damp surfaces. Provide material Type, Grade, and Class to suit Project requirements.

2.3 CONCRETE MIXES

A. Design concrete mixes according to ASTM International (ASTM) C94/C94M, Option C.

B. Compressive strength at 28 days: minimum 25 MPa (3,000 psi) for footings; and 30 MPa (4,000psi) for beams and columns.

C. Submit mix design and results of compression tests to the Contracting Officer for his evaluation. Identify all materials, including admixtures, making-up the concrete.

D. Maximum Slump for Vibrated Concrete: 100 mm (4 inches) tested according to ASTM International (ASTM) C143.

E. Cement and Water Factor (See Table I):

TABLE I - CEMENT AND WATER FACTORS FOR CONCRETE

Concrete: Strength	Non-Air-Entrained		Air-Entrained	
Min. 28 Day Comp. Str. MPa (psi)	Min. Cement kg/cu. m (lbs./cu. yd.)	Max. Water Cement Ratio	Min. Cement kg/cu. m (lbs./cu. yd.)	Max. Water Cement Ratio
30 (4000)1,3	325 (550)	0.55	340 (750)	0.50
25 (3000)1,3	280 (470)	0.65	290 (490)	0.55
25 (3000)1,2	300 (500)	See 4 Below	310 (520)	See 4 Below

Notes:

1. If trial mixes are used, achieve a compressive strength 8.3 MPa (1 200 psi) in excess of f'c. For concrete strengths greater than 35 MPa (5,000 psi), achieve a compressive strength 9.7 MPa (1,400 psi) in excess of f'c.
2. Lightweight Structural Concrete: Pump mixes may require higher cement values as specified in ACI 318/318M.
3. For Concrete Exposed to High Sulfate Content Soils: Maximum water cement ratio is 0.44.
4. Laboratory Determined according to ACI 211.1 for normal weight concrete or ACI 211.2 for lightweight structural concrete.

F. Air-entrainment as specified, and conform with the following for air content table:

TABLE II - TOTAL AIR CONTENT FOR VARIOUS SIZES OF COARSE AGGREGATES	
Nominal Maximum Size of Coarse Aggregate	Total Air Content, percent
10 mm (3/8 inches)	6 Moderate exposure; 7.5 severe exposure
13 mm (1/2 inches)	5.5 Moderate exposure; 7 severe exposure
19 mm (3/4 inches)	5 Moderate exposure; 6 severe exposure
25 mm (1 inches)	4.5 Moderate exposure; 6 severe exposure
40 mm (1 1/2 inches)	4.5 Moderate exposure; 5.5 severe exposure

2.4 BATCHING AND MIXING

A. Store, batch, and mix materials according to ASTM C94/C94M.
   1. Job-Mixed: Batch mix concrete in stationary mixers as specified in ASTM International(ASTM) C94/C94M.
   2. Ready-Mixed Concrete: Comply with ASTM International(ASTM) C94/C94M, except use of non-agitating equipment for transporting concrete to Site is not acceptable.
   3. EXECUTION Mixing Structural Lightweight Concrete: Charge mixer with 2/3 of total mixing water and total aggregate for each batch. Mix ingredients minimum 30 seconds in stationary mixer or minimum 10 revolutions at mixing speed in truck mixer. Add remaining mixing water and other ingredients and continue mixing. Above procedure may be modified as recommended by aggregate producer.
   4. When aggregate producer's instructions deviate from specifications, submit proposed resolution for Contracting Officer's Representative consideration.

PART 3 - EXECUTION

3.1 FORMWORK

A. Installation: Conform to ACI 347. Construct forms to obtain concrete of the shapes, dimensions and profiles indicated, with tight joints.
B. Design and construct forms to prevent bowing-out of forms between supports and to be removable without prying against or otherwise damaging fresh concrete.
C. When patching formed concrete, seal form edges against existing surface to prevent leakage; set forms so that patch is flush with adjacent surfaces.
D. Treating and Wetting: Treat or wet concrete contact surfaces:
   1. Coat plywood and lumber forms with non-staining form sealer.
   2. Wet wood forms thoroughly when they are not treated with form release agent.

3. Prevent water from accumulating and remaining within forms.
4. Clean and coat removable metal forms with light form oil before reinforcement is placed.
5. In hot weather, cool metal forms by thoroughly wetting with water just before placing concrete.
6. Prevent water from accumulating and remaining within forms.

E. Inserts, Sleeves, and Similar Items: Install flashing reglets, masonry ties, anchors, inserts, wires, hangers, sleeves, boxes for floor hinges, and other cast-in items specified in other Sections. Place where indicated, square, flush and secured to formwork.

F. Construction Tolerances - General: Install and maintain concrete formwork to assure completion of work within specified tolerances.

G. Adjust or replace completed work exceeding specified tolerances before placing concrete.

3.2 REINFORCEMENT

A. Install concrete reinforcement according to ACI 318 and ACI SP-66.

B. Support and securely tie reinforcing steel to prevent displacement during placing of concrete.

C. Drilling for Dowels in Existing Concrete: Use sharp bits, drill hole slightly oversize, fill with epoxy grout, inset the dowel, and remove excess epoxy.

3.3 PLACING CONCRETE

A. Remove water from excavations before concrete is placed. Remove hardened concrete, debris and other foreign materials from interior of forms, and from inside of mixing and conveying equipment. Obtain approval from Contracting Officer's Representative before placing concrete.

B. Install screeds at required elevations for concrete slabs.

C. Roughen and clean free from laitance, foreign matter, and loose particles before placing new concrete on existing concrete.

1. Blow-out areas with compressed air and immediately coat contact areas with adhesive in compliance with manufacturer's instructions.

D. Place structural concrete according to ACI 301 and ACI 318.

E. Convey concrete from mixer to final place of deposit by method that will prevent segregation or loss of ingredients. Do not deposit, in Work, concrete that has attained its initial set or has contained its water or cement more than 1 1/2 hours. Do not allow

concrete to drop freely more than 1500 mm (5 feet) in unexposed work nor more than 900 mm (3 feet) in exposed work.

F. Place and consolidate concrete in horizontal layers not exceeding 300 mm (12 inches) in thickness. Consolidate concrete by spading, rodding, and mechanical vibrator. Do not secure vibrator to forms or reinforcement. Continuously vibrate during placement of concrete.

G. Hot Weather Concrete Placement: As recommended by ACI 305.1 to prevent adversely affecting properties and serviceability of hardened concrete.

H. Cold Weather Concrete Placement: As recommended by ACI 306.1, to prevent freezing of thin sections less than 300 mm (12 inches) and to permit concrete to gain strength properly.

1. Do not use calcium chloride without written approval from Contracting Officer's Representative.

3.4 PROTECTION AND CURING

A. Protect exposed surfaces of concrete from premature drying, wash by rain or running water, wind, mechanical damage, and excessive hot or cold temperatures.

B. Curing Methods: Cure concrete with curing compound using wet method with sheets.

C. Formed Concrete Curing: Wet the tops and exposed portions of formed concrete and keep moist until forms are removed.

1. If forms are removed before 14 days after concrete is cast, install sheet curing materials as specified above.

D. Concrete Flatwork Curing:

1. Install sheet materials according to the manufacturer's instructions.

a. When manufacturer's instructions deviate from specifications, submit proposed resolution for Contracting Officer's Representative consideration.

3.5 FORM REMOVAL

A. Maintain forms in place until concrete is self-supporting, with construction operation loads.

B. Remove fins, laitance and loose material from concrete surfaces when forms are removed. Repair honeycombs, rock pockets, sand runs, spalls, or otherwise damaged surfaces by patching with the same mix as concrete minus the coarse aggregates.

C. Finish to match adjacent surfaces.

3.6 FINISHES

A. Slab Finishes:
   1. Allow bleed water to evaporate before surface is finished. Do not sprinkle dry cement on surface to absorb water.
   2. Scratch Finish: Rake or wire broom after partial setting slab surfaces to received bonded applied cementitious application, within 2 hours after placing, to roughen surface and provide permanent bond between base slab and applied cementitious materials.
   3. Float Finish: Interior and exterior ramps, interior stair treads, and platforms, both equipment pads, and slabs to receive non-cementitious materials, except as specified.
      a. Screen and float to smooth dense finish.
      b. After first floating, while surface is still soft, check surfaces for alignment using straightedge or template. Correct high spots by cutting down with trowel or similar tool. Correct low spots by filling in with material same composition as floor finish. Remove any surface projections on floated finish by rubbing or dry grinding. Refloat slab to uniform sandy texture.
   4. Steel Trowel Finish: Applied toppings, concrete surfaces to receive resilient floor covering or carpet, future floor roof and other monolithic concrete floor slabs exposed to view without other finish indicated or specified.
      a. Delay final steel troweling to secure smooth, dense surface, usually when surface can no longer be dented by fingers. During final troweling, tilt steel trowel at slight angle and exert heavy pressure on trowel to compact cement paste and form dense, smooth surface.
      b. Finished surface: Free from trowel marks. Uniform in texture and appearance.
   5. Broom Finish: Finish exterior slabs, ramps, and stair treads with bristle brush moistened with clear water after surfaces have been floated.

3.7 SURFACE TREATMENTS

A. Mix and apply the following surface treatments according to manufacturer's instructions.
   1. When manufacturer's instructions deviate from specifications, submit proposed resolution for Contracting Officer's Representative consideration.
B. Liquid Densifier/Sealer: Use for exposed concrete floors and concrete floors to receive carpeting except those specified to receive non-slip finish .

C. Slip Resistant Finish:
   1. Except where safety nosing and tread coverings are shown, apply abrasive aggregate to treads and platforms of concrete steps and stairs, and to surfaces of exterior concrete ramps and platforms.
      a. Broadcast aggregate uniformly over concrete surface. Trowel concrete surface to smooth dense finish. After curing, rub treated surface with abrasive brick and water sufficiently to slightly expose abrasive aggregate.

- - E N D - -

SECTION 04 20 00
UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 RELATED REQUIREMENTS

A. Sealants and Sealant Installation: Section 07 92 00, JOINT SEALANTS.
B. Color and Texture of Masonry Units: Section 09 06 00, SCHEDULE FOR FINISHES.

1.3 APPLICABLE PUBLICATIONS

A. Comply with references to extent specified in this section.
B. American Concrete Institute (ACI):
   1. 315-99 - Details and Detailing of Concrete Reinforcement.
   2. 530.1/ASCE 6/TMS 602-13 - Specification for Masonry Structures.
C. ASTM International (ASTM):
   1. A615/A615M-15ae1 - Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
   2. A951/A951M-14 - Steel Wire for Masonry Joint Reinforcement.
   3. C62-13a - Building Brick (Solid Masonry Units Made from Clay or Shale).
   4. C90-14 - Load-Bearing Concrete Masonry Units.
   5. C216-15 - Facing Brick (Solid Masonry Units Made From Clay or Shale).
   6. C612-14 - Mineral Fiber Block and Board Thermal Insulation.
   7. D1056-14 - Flexible Cellular Materials - Sponge or Expanded Rubber.
   8. D2240-05(2010) - Rubber Property-Durometer Hardness.
D. American Welding Society (AWS):
   1. D1.4/D1.4M-11 - Structural Welding Code - Reinforcing Steel.
E. Brick Industry Association (BIA):
   1. TN 11B-88 - Guide Specifications for Brick Masonry, Part 3.

1.4 SUBMITTALS

A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
B. Submittal Drawings:
   1. Fabrication, bending, and placement of reinforcing bars. Comply with ACI 315. Show bar schedules, diagrams of bent bars, stirrup spacing, lateral ties and other arrangements and assemblies.
   2. Special masonry shapes, profiles, and placement.

3. Masonry units for typical window and door openings, and, for special conditions as affected by structural conditions.

C. Manufacturer's Literature and Data:
   1. Description of each product.
   2. Installation instructions.

D. Samples:
   1. Face brick: Sample panel, 200 mm by 400 mm (8 inches by 16 inches,) showing full color range and texture of bricks, bond, and proposed mortar joints.
   2. Concrete masonry units, when exposed in finish work.
   3. Anchors and Ties: Each type.
   4. Joint Reinforcing: 1200 mm (48 inches) long each type.

E. Sustainable Construction Submittals:
   1. Recycled Content: Identify post-consumer and pre-consumer recycled content percentage by weight.

F. Certificates: Certify products comply with specifications.
   1. Face brick.
   2. Solid and load-bearing concrete masonry units, including fire-resistant rated units.

G. Delegated Design Drawings and Calculations: Signed and sealed by responsible design professional.

1.5 QUALITY ASSURANCE

A. Welders and Welding Procedures Qualifications: AWS D1.4/D1.4M.

1.6 DELIVERY

A. Deliver products in manufacturer's original sealed packaging.

B. Mark packaging, legibly. Indicate manufacturer's name or brand, type, production run number, and manufacture date.

C. Before installation, return or dispose of products within distorted, damaged, or opened packaging.

1.7 STORAGE AND HANDLING

A. Store products above grade, protected from contamination.

B. Protect products from damage during handling and construction operations.

1.8 FIELD CONDITIONS

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

1.9 WARRANTY

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

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

A. Delegated Design: Prepare submittal documents including design calculations and drawings signed and sealed by registered design professional, licensed in state where work is located.

2.2 PRODUCTS - GENERAL

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. Brick or Concrete Masonry Unit Recycled Content: Select products with recycled content to achieve overall Project recycled content requirement.
2. Steel Recycled Content: 30 percent total recycled content, minimum.

2.3 UNIT MASONRY PRODUCTS

A. Brick:

1. Face Brick:
   a. ASTM C216, Grade SW, Type FBS.
   b. Brick when tested according to ASTM C67: Classified slightly efflorescent or better.
   c. Size:
      1) Modular.
      2) Thin Brick: 13 mm (1/2 inch) thick with angle shapes for corners.
2. Building Brick: ASTM C62, Grade MW for backup and interior work; Grade SW where in contact with earth.
3. One Face Exposed: Grade S, Type I.

B. Concrete Masonry Units (CMU):

1. Hollow and Solid Load-Bearing Concrete Masonry Units: ASTM C90.
   a. Unit Weight: Normal weight.
   b. Fire rated units for fire rated partitions.
2. Sizes: Modular, 200 mm by 400 mm (8 inches by 16 inches) nominal face dimension; thickness as indicated on drawings.
3. For molded faces used as a finished surface, use concrete masonry units with uniform fine to medium surface texture unless specified otherwise.
4. Use bullnose concrete masonry units at corners exposed in finished work with 25 mm (1 inch) minimum radius rounded vertical exterior corners (bullnose units).

2.4 ANCHORS, TIES, AND REINFORCEMENT

A. Steel Reinforcing Bars: ASTM A615/A615M; Grade 60, deformed bars.

B. Joint Reinforcement:

1. Form from wire complying with ASTM A951/A951M.
2. Hot dipped galvanized after fabrication.
3. Width of joint reinforcement 40 mm (1.6 inches) less than nominal thickness of masonry wall or partition.
4. Cross wires welded to longitudinal wires.
5. Joint reinforcement minimum 3000 mm (10 feet) long, factory cut.
6. Joint reinforcement with crimp formed drip is not acceptable.
7. Maximum spacing of cross wires 400 mm (16 inch) to longitudinal wires.
8. Ladder Design:
    a. Longitudinal wires deformed 4 mm (0.16 inch).
    b. Cross wires4 mm (0.16 inch) diameter.
9. Trussed Design:
    a. Longitudinal and cross wires minimum 4 mm (0.16 inch nominal) diameter.
    b. Longitudinal wires deformed.
10. Multiple Wythes and Cavity Wall Ties:
    a. Longitudinal wires 4 mm (0.16 inch), two in each wythe with ladder truss wires 4 mm (0.16 inch) overlay, welded to each longitudinal wire.
    b. Longitudinal wires 4 mm (0.16 inch) with U shape 4 mm (0.16 inch) rectangular ties extending into other wythe minimum 75 mm (3 inches) spaced 400 mm on center (16 inches). Adjustable type with U shape tie designed to receive 4 mm (0.16 inch) pintle projecting into other wythe 75 mm (3 inches min.).
11. Angle Type:
    a. Anchor: Minimum 2 mm (16 gage) thick galvanized steel angle shaped anchor strap. Provide hole in vertical leg for fastener. Provide hole near end of outstanding leg to suit upstanding portion of tie.
    b. Tie: Fabricate from 5 mm (0.20 inch) diameter galvanized cold drawn steel wire. Form "L" shape to be embedded minimum 50 mm (2 inches) into the bed joint of masonry veneer and provide upstanding leg to fit through hole in anchor and be long enough to allow 50 mm (2 inches) of vertical adjustment.

C. Dovetail Anchors:
1. Corrugated steel dovetail anchors formed of 1.5 mm (0.06 inch) thick by 25 mm (1 inch) wide galvanized steel, 90 mm (3-1/2 inches) long where used to anchor 100 mm (4 inch) nominal thick masonry units, 140 mm (5-1/2 inches) long for masonry units more than 100 mm (4 inches) thick.
2. Triangular wire dovetail anchor 100 mm (4 inch) wide formed of 4 mm (9 gage) steel wire with galvanized steel dovetail insert. Anchor length to extend minimum 75 mm (3 inches) into masonry, 25 mm (1 inch) into 40 mm (1-1/2 inch) thick units.

3. Form dovetail anchor slots from 0.6 mm (0.02 inch) thick galvanized steel (with felt or fiber filler).

D. Individual Ties:
1. Rectangular ties: Form from 5 mm (3/16 inch) diameter galvanized steel rod to rectangular shape minimum 50 mm (2 inches) wide by sufficient length for ends of ties to extend within 25 mm (1 inch) of each face of wall. Ties that are crimped to form drip are not acceptable.
2. Adjustable Cavity Wall Ties:
a. Adjustable wall ties may be furnished at Contractor's option.
b. Two piece type permitting up to 40 mm (1-1/2 inch) adjustment.
c. Form ties from 5 mm (3/16 inch) diameter galvanized steel wire.
d. Form one piece to rectangular shape 105 mm (4-1/8 inches) wide by length required to extend into bed joint 50 mm (2 inches).
e. Form other piece to 75 mm (3 inch) long by 75 mm (3 inch) wide shape, having 75 mm (3 inch) long bent section for engaging 105 mm (4-1/8 inch) wide piece to form adjustable connection.

E. Wall Ties, (Mesh or Wire):
1. Mesh wall ties formed of ASTM A1064/A1064M, W0.5, 2 mm, (0.08 inch) galvanized steel wire 13 mm by 13 mm (1/2 inch by 1/2 inch) mesh, 75 mm (3 inches) wide by 200 mm (8 inches) long.
2. Rectangular wire wall ties formed of W1.4, 3 mm, (0.12 inch) galvanized steel wire 50 mm (2 inches) wide by 200 mm (8 inches) long.

F. Adjustable Steel Column Anchor:
1. Two piece anchor consisting of a 6 mm (1/4 inch) diameter steel rod to be welded to steel with offset ends, rod to permit 100 mm (4 inch) vertical adjustment of wire anchor.
2. Triangular shaped wire anchor 100 mm (4 inches) wide formed from 5 (3/16 inch) diameter galvanized wire, to extend minimum 75 mm (3 inches) into joints of masonry.

G. Adjustable Steel Beam Anchor:
1. Z or C type steel strap, 30 mm (1 1/4 inches) wide, 3 mm (1/8 inch) thick.
2. Flange hook minimum 38 mm (1 1/2 inches) long.
3. Length to embed in masonry minimum 50 mm (2 inches) in 100 mm (4 inch) nominal thick masonry and 100 mm (4 inches) in thicker masonry.
4. Bend masonry end minimum 40 mm (1 1/2 inches).

2.5 ACCESSORIES

A. Shear Keys:

1. Solid extruded cross-shaped section of rubber, neoprene, or polyvinyl chloride, with durometer hardness of approximately 80 when tested according to ASTM D2240, and minimum shear strength of 3.5 MPa (500 psi).
2. Shear Key Dimensions: Nominal 70 mm by 8 mm for long flange and 38 mm by 16 mm for short flange (2-3/4 inches by 5/16 inch for long flange, and 1-1/2 inches by 5/8 inch for short flange).

B. Weeps:
1. Weep Hole Wicks: Glass fiber ropes, 10 mm (3/8 inch) minimum diameter, 300 mm (12 inches) long.
2. Weep Tubing: Round, polyethylene, 9 mm (3/8 inch) diameter, 100 mm (4 inches) long.
3. Weep Hole: Flexible PVC louvered configuration with rectangular closure strip at top.

C. Cavity Drain Material: Open mesh polyester sheets or strips to prevent mortar droppings from clogging the cavity.

D. Preformed Compressible Joint Filler:
1. Thickness and depth to fill joint.
2. Closed Cell Neoprene: ASTM D1056, Type 2, Class A, Grade 1, B2F1.
3. Non-Combustible Type: ASTM C612, Type 5, Max. Temp.1800 degrees F.

E. Box Board:
1. Mineral Fiber Board: ASTM C612, Type 1.
2. 25 mm (1 inch) thickness.
3. Other spacing material having similar characteristics is acceptable subject to Contracting Officer's Representative's approval.

F. Masonry Cleaner:
1. Detergent type cleaner selected for each type masonry.
2. Acid cleaners are not acceptable.
3. Use soapless type specially prepared for cleaning brick or concrete masonry as appropriate.

G. Fasteners:
1. Concrete Nails: ASTM F1667, Type I, Style 11, 19 mm (3/4 inch) minimum length.
2. Masonry Nails: ASTM F1667, Type I, Style 17, 19 mm (3/4 inch) minimum length.
3. Screws: FS-FF-S-107, Type A, AB, SF thread forming or cutting.

H. Welding Materials: AWS D1.4/D1.4M, type to suit application.

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL

A. Install products according to manufacturer's instructions and approved submittal drawings.
1. When manufacturer's instructions deviate from specifications, submit proposed resolution for Contracting Officer's Representative consideration.

B. Keep finish work free from mortar smears or spatters, and leave neat and clean.

C. Wall Openings:
   1. Fill hollow metal frames built into masonry walls and partitions solid with mortar as laying of masonry progresses.
   2. When items are not available when walls are built, prepare openings for subsequent installation.

D. Tooling Joints:
   1. Do not tool until mortar has stiffened enough to retain thumb print when thumb is pressed against mortar.
   2. Tool while mortar is soft enough to be compressed into joints and not raked out.
   3. Finish joints in exterior face masonry work with jointing tool, and provide smooth, water-tight concave joint unless specified otherwise.
   4. Tool Exposed interior joints in finish work concave unless specified otherwise.

E. Partition Height:
   1. Extend partitions minimum 100 mm (4 inches) above suspended ceiling or to overhead construction where no ceiling occurs.
   2. Extend following partitions to overhead construction.
      a. Full height partitions, and fire partitions and smoke partitions indicated on drawings.
      b. Both walls at expansion joints.
      c. Corridor walls.
      d. Walls at stairway and stair halls, elevators, dumbwaiters, trash and laundry chute shafts, and other vertical shafts.
      e. Walls at refrigerator space.
      f. Reinforced masonry partitions.
   3. Extend finished masonry partitions minimum 100 mm (4 inches) above suspended ceiling and continue with concrete masonry units or structural clay tile to overhead construction:

F. Lintels:
   1. Lintels are not required for openings less than 1000 mm (40 inches) wide that have hollow metal frames.
   2. Openings 1025 mm (41 inches) wide to 1600 m (63 inches) wide without structural steel lintel or frames, require lintel formed of concrete masonry lintel or bond beam units filled with grout and reinforced with one No. 16 (No. 5) rod top and bottom for each 100 mm (4 inches) of nominal thickness unless shown otherwise.
   3. Precast concrete lintels of 25 MPa (3,000 psi) concrete, same thickness as partition, and with one No. 16 (No. 5) deformed bar top and bottom for each 100 mm (4 inches) of nominal thickness, is acceptable in lieu of reinforced CMU masonry lintels.

4. Use steel lintels, for openings greater than 1600 m (63 inches) wide, brick masonry openings, and elevator openings unless shown otherwise.
5. Doors having overhead concealed door closers require steel lintel, and pocket for closer box.
6. Lintel Bearing Length: Minimum 100 mm (4 inches) at both ends.
7. Build masonry openings or arches over wood or metal centering and supports when steel lintels are not used.

G. Wall, Furring, and Partition Units:
1. Lay out field units to provide one-half running bond, unless indicated otherwise.
2. Align head joints of alternate vertical courses.
3. At sides of openings, balance head joints in each course on vertical center lines of openings.
4. Minimum Masonry Unit Length: 100 mm (4 inches).

H. Before connecting new masonry with previously laid masonry, remove loosened masonry or mortar, and clean and wet work in place as specified under wetting.

I. When new masonry partitions start on existing floors, machine cut existing floor finish material down to concrete surface.

J. Chases:
1. Do not install chases in masonry walls and partitions exposed to view in finished work, including painted or coated finishes on masonry.
2. Masonry 100 mm (4 inch) nominal thick may have electrical conduits 25 mm (1 inch) or less in diameter when covered with soaps, or other finishes.
3. Fill recess chases after installation of conduit, with mortar and finish flush.
4. When pipes or conduits, or both occur in hollow masonry unit partitions retain minimum one web of hollow masonry units.

K. Wetting and Wetting Test:
1. Test and wet brick and clay tile according to BIA TN 11B.
2. Do not wet concrete masonry units or glazed structural facing tile before laying.

L. Temporary Formwork: Provide formwork and shores as required for temporary support of reinforced masonry elements.

M. Construct formwork to conform to shape, line and dimensions indicated on drawings. Make sufficiently tight to prevent mortar, grout, or concrete leakage. Brace, tie and support formwork as required to maintain position and shape during construction and curing of reinforced masonry.

N. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other reasonable temporary construction loads.

3.2 INSTALLATION - ANCHORAGE

A. Masonry Facing to Backup and Cavity Wall Ties:
1. Use individual ties for new work.

2. Stagger ties in alternate courses, and space at 400 mm (16 inches) maximum vertically, and 400 mm (16 inches) horizontally.
3. At openings, provide additional ties spaced maximum 900 mm (36 inches) apart vertically around perimeter of opening, and within 300 mm (12 inches) from edge of opening.
4. Anchor new masonry facing to existing masonry with adjustable cavity wall ties spaced at 400 mm (16 inch) maximum vertical intervals and at every second masonry unit horizontally. Fasten ties to masonry with masonry nails.
5. Option: Install joint reinforcing for multiple wythes and cavity wall ties spaced maximum 400 mm (16 inches) vertically.
6. Tie interior and exterior wythes of reinforced masonry walls together with individual ties. Provide ties at intervals maximum 400 mm (16 inches) on center horizontally, and 400 mm (16 inches) on center vertically. Lay ties in the same line vertically in order to facilitate vibrating of the grout pours.

B. Masonry Furring:
1. Anchor masonry furring less than 100 mm (4 inches) nominal thick to masonry walls or to concrete with adjustable wall ties or dovetail anchors.
2. Space at maximum 400 mm (16 inches) on center in both directions.

C. Anchorage to Steel Beams or Columns:
1. Use adjustable beam anchors on each flange.
2. At columns weld steel rod to steel columns at 300 mm (12 inch) intervals, and place wire ties in masonry courses at 400 mm (16 inches) maximum vertically.

3.3 INSTALLATION - REINFORCEMENT

A. Joint Reinforcement:
1. Install joint reinforcement in CMU wythe of combination brick and CMU, cavity walls, and single wythe concrete masonry unit walls or partitions.
2. Reinforcing is acceptable in lieu of individual ties for anchoring brick facing to CMU backup in exterior masonry walls.
3. Locate joint reinforcement in mortar joints at 400 mm (16 inch) maximum vertical intervals.
4. Additional joint reinforcement is required in mortar joints at both 200 mm (8 inches) and 400 (16 inches) above and below windows, doors, louvers and similar openings in masonry.

B. Steel Reinforcing Bars:
1. Install reinforcing bars in cells of hollow masonry units where required for vertical reinforcement and in bond beam units for horizontal reinforcement. Install in wall cavities of reinforced masonry walls where indicated on drawings.
2. Bond Beams:

a. Form Bond beams of load-bearing concrete masonry units filled with grout and reinforced with two No. 15m (No. 5) reinforcing bars unless shown otherwise. Do not cut reinforcement.
b. Brake bond beams only at expansion joints and at control joints, if shown.

3. Stack Bond:
a. Locate additional joint reinforcement in vertical and horizontal joints as indicated on drawings.
b. Anchor vertical reinforcement into foundation or wall or bond beam below.
c. Provide temporary bracing for walls over 8 feet tall until permanent horizontal bracing is completed.

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

3.4 INSTALLATION - BRICK EXPANSION AND CMU CONTROL JOINTS

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

3.5 INSTALLATION - ISOLATION JOINT

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

3.6 INSTALLATION - BRICKWORK

A. Lay clay brick according to BIA TN 11B.

B. Laying:

1. Lay brick in one-half running bond with bonded corners, unless indicated otherwise.
2. Maintain bond pattern throughout.
3. Do not use brick smaller than half-brick at any angle, corner, break, and jamb.
4. Where length of cut brick is greater than one half length, maintain vertical joint location.
5. Lay exposed brickwork joints symmetrical about center lines of openings.
6. Do not structurally bond multi-wythe brick walls, unless indicated on drawings.
7. Before starting work, lay facing brick on foundation wall and adjust bond to openings, angles, and corners.
8. Lay brick for sills with wash and drip.
9. Build solid brickwork as required for anchorage of items.

C. Joints:

1. Exterior And Interior Joint Widths: Lay for three equal joints in 200 mm (8 inches) vertically, unless shown otherwise.
2. Rake joints for pointing with colored mortar when colored mortar is not full depth.
3. Arches:
   a. Flat arches (jack arches) lay with camber of 1 in 200 (1/16 inch per foot) of span.
   b. Face radial arches with radial brick with center line of joints on radial lines.
   c. Form Radial joints of equal width.
   d. Bond arches into backing with metal ties in every other joint.

D. Weep Holes:

1. Install weep holes at 600 mm (24 inches) on center in bottom of vertical joints of exterior masonry veneer or cavity wall facing over foundations, bond beams, and other water stops in wall.
2. Form weep holes using wicks made of mineral fiber insulation strips turned up 200 mm (8 inches) in cavity. Anchor top of strip to backup to securely hold in place.
3. Install sand or pea gravel in cavity approximately 75 mm (3 inches) high between weep holes.

E. Solid Exterior Walls:

1. Build with 100 mm (4 inches) of nominal thick facing brick, backed up with .
2. Construct solid brick jambs minimum 20 mm (0.81 inches) wide at exterior wall openings and at recesses, except where exposed concrete unit backup is shown.
3. Do not install full bonding headers.
4. Parging:

a. For solid masonry walls, lay backup to height of six brick courses, parge backup with 13 mm (1/2 inch) of mortar troweled smooth; then lay exterior wythe to height of backup.
b. Make parging continuous over backup, and extend 150 mm (6 inches) onto adjacent concrete or masonry.
c. Parge ends and backs for recesses in exterior walls to thickness of 13 mm (1/2 inch).
d. Parge inside surface of exterior walls to produce true even surface to receive insulation.

5. Coordinate with building insulation for thickness of insulation and allowance of air space behind exterior wythe.

F. Cavity Walls:
1. Keep air space clean of mortar accumulations and debris.
2. Lay the interior wythe of the masonry wall full height where air barrier is required on cavity face. Coordinate to install air barrier before laying outer wythe.
3. Insulated Cavity Type Exterior Walls:
a. Install insulation against cavity face of inner masonry wythe.
b. Place insulation between rows of ties or joint reinforcing. Adhere insulation to masonry surface with a bonding agent as recommended by insulation manufacturer.
c. Lay outer masonry wythe up with air space between insulation and masonry units.
4. Veneer Framed Walls:
a. Build with 100 mm (4 inches) of face brick over sheathed stud wall with air space.
b. Keep air space clean of mortar accumulations and debris.

3.7 INSTALLATION - CONCRETE MASONRY UNITS

A. Types and Uses:
1. Provide special concrete masonry shapes as required, including lintel and bond beam units, sash units, and corner units. Provide solid concrete masonry units, where full units cannot be installed, or where needed for anchorage of accessories.
2. Provide solid load-bearing concrete masonry units or grout cell of hollow units at jambs of openings in walls, where structural members impose loads directly on concrete masonry, and where shown.
3. Provide rounded corner (bullnose) shapes at opening jambs in exposed work and at exterior corners.
4. Do not install brick jambs in exposed finish work.
5. Construct fire resistance in fire rated partitions meeting fire ratings indicated on drawings.
6. Where lead-lined concrete masonry unit partitions terminate below underside of overhead floor or roof deck, fill remaining open space between top of partition and underside of

overhead floor or roof deck, with standard concrete masonry units of same thickness as lead lined units.

B. Laying:
   1. Lay concrete masonry units with 9 mm (3/8 inch) joints, with a bond overlap of minimum 1/4 of unit length, except where stack bond is indicated on drawings.
   2. Do not wet concrete masonry units before laying.
   3. Bond external corners of partitions by overlapping alternate courses.
   4. Lay first course in a full mortar bed.
   5. Set anchorage items as work progress.
   6. Where ends of anchors, bolts, and other embedded items, project into voids of units, completely fill voids with mortar or grout.
   7. Lay concrete masonry units with full face shell mortar beds and fill head joint beds for depth equivalent to face shell thickness.
   8. Lay concrete masonry units so cores of units, that are to be filled with grout, are vertically continuous with joints of cross webs of such cores completely filled with mortar. Unobstructed core openings minimum 50 mm (2 inches) by 75 mm (3 inches).
   9. Do not wedge masonry against steel reinforcing. Minimum 13 mm (1/2 inch) clear distance between reinforcing and masonry units.
   10. Install deformed reinforcing bars of sizes indicated on drawings.
   11. At time of placement, ensure steel reinforcement is free of loose rust, mud, oil, and other contamination capable of affecting bond.
   12. Place steel reinforcement at spacing indicated on drawings before grouting.
   13. Minimum clear distance between parallel bars: One bar diameter.
   14. Hold vertical steel reinforcement in place vertically by centering clips, caging devices, tie wire, or other approved methods.
   15. Support vertical bars near each end and at maximum 192 bar diameter on center.
   16. Splice reinforcement or attach reinforcement to dowels by placing in contact and securing with wire ties.
   17. Stagger splices in adjacent horizontal reinforcing bars. Lap reinforcing bars at splices a minimum of 40 bar diameters.
   18. Grout cells of concrete masonry units, containing reinforcing bars, solid as specified.
   19. Install cavity and joint reinforcement as masonry work progresses.
   20. Rake joints 6 to 10 mm (1/4 to 3/8 inch) deep for pointing with colored mortar when colored mortar is not full depth.

C. Waterproofing Parging:
   1. Parge earth side of concrete masonry unit basement walls with mortar applied in two coats, each coat 6 mm (1/4 inch) thick.

2. Clean wall surfaces to receive parging of dirt, oil, or grease, and moisten before application of first coat.
3. Roughen first coat when partially set, permit to hardened for 24 hours, and moisten before application of second coat.
4. Keep second coat damp for minimum 48 hours.
5. Thicken parging and round to form a cove at the junction of outside wall face and footing.

3.8 GROUTING

A. Preparation:
   1. Clean grout space of mortar droppings before placing grout.
   2. Close cleanouts.
   3. Install vertical solid masonry dams across grout space for full height of wall at intervals of maximum 9000 mm (30 feet). Do not bond dam units into wythes as masonry headers.
   4. Verify reinforcing bars are installed as indicated on drawings.

B. Placing:
   1. Place grout in grout space in lifts as specified.
   2. Consolidate each grout lift after free water has disappeared but before plasticity is lost.
   3. Do not slush with mortar or use mortar with grout.
   4. Interruptions:
      a. When grouting must be stopped for more than an hour, top off grout 40 mm (1-1/2 inches) below top of last masonry course.
      b. Grout from dam to dam on high lift method.
      c. Longitudinal run of masonry may be stopped off only by raking back one-half masonry unit length in each course and stopping grout 100 mm (4 inches) back of rake on low lift method.

C. Puddling Method:
   1. Consolidate by puddling with grout stick during and immediately after placing.
   2. Grout cores of concrete masonry units containing reinforcing bars solid as masonry work progresses.

D. Low Lift Method:
   1. Construct masonry to 1.5 m (5 feet) maximum height before grouting.
   2. Grout in one continuous operation and consolidate grout by mechanical vibration and reconsolidate after initial water loss and settlement has occurred.

E. High Lift Method:
   1. Do not pour grout until masonry wall has cured minimum of 4 hours.
   2. Place grout in 1.5 m (5 feet) maximum lifts.
   3. Exception:

a. Where following conditions are met, place grout in 3.86 m (12.67 feet) maximum lifts.
b. Masonry has cured minimum of 4 hours.
c. Grout slump is maintained between 250 and 275 mm (10 and 11 inches).
d. No intermediate reinforced bond beams are placed between top and bottom of grout lift.

4. When vibrating succeeding lifts, extend vibrator 300 to 450 mm (12 to 18 inches) into preceding lift.

3.9 PLACING REINFORCEMENT

A. General: Clean reinforcement of loose rust, mill scale, earth, ice or other materials which will reduce bond to mortar or grout. Do not use reinforcement bars with kinks or bends not shown on drawings or approved submittal drawings, or bars with reduced cross-section due to excessive rusting or other causes.

B. Position reinforcement accurately at spacing indicated on drawings. Support and secure vertical bars against displacement. Install horizontal reinforcement as masonry work progresses. Where vertical bars are shown in close proximity, provide clear distance between bars of minimum one bar diameter or 25 mm (1 inch), whichever is greater..

C. Splice reinforcement bars only where indicated on drawings, unless approved by Contracting Officer's Representative. Provide lapped splices. In splicing vertical bars or attaching to dowels, lap ends, place in contact and wire tie.

D. Provide minimum lap as indicated on approved submittal drawings, or if not indicated, minimum 48 bar diameters.

E. Embed metal ties in mortar joints as work progresses, with minimum mortar cover of 15 mm (5/8 inch) on exterior face of walls and 13 mm (1/2 inch) at other locations.

F. Embed prefabricated horizontal joint reinforcement as work progresses, with minimum cover of 15 mm (5/8 inch) on exterior face of walls and 13 mm (1/2 inch) at other locations. Lap joint reinforcement minimum 150 mm (6 inches) at ends. Use prefabricated “L” and “T” sections to provide continuity at corners and intersections. Cut and bend joint reinforcement for continuity at returns, offsets, column fireproofing, pipe enclosures and other special conditions.

G. Anchoring: Anchor reinforced masonry work to supporting structure as indicated on drawings.

H. Anchor reinforced masonry walls at intersections with non-reinforced masonry.

3.10 INSTALLATION OF REINFORCED CONCRETE UNIT MASONRY

A. Do not wet concrete masonry units (CMU).

B. Lay CMU units with full-face shell mortar beds. Fill vertical head joints (end joints between units) solidly with mortar from face of unit to distance behind face equal to thickness of longitudinal face shells. Solidly bed cross-webs of starting courses in mortar. Maintain head and bed 9 mm (3/8 inch) joint widths.

C. Where solid CMU units are shown, lay with full mortar head and bed joints.

D. Walls:
   1. Pattern Bond: Lay CMU wall units in 1/2-running bond with vertical joints in each course centered on units in courses above and below, unless otherwise indicated. Bond and interlock each course at corners and intersections. Use special-shaped units where shown, and as required for corners, jambs, sash, control joints, lintels, bond beams and other special conditions.
   2. Maintain vertical continuity of core or cell cavities, which are to be reinforced and grouted, to provide minimum clear dimension indicated and to provide minimum clearance and grout coverage for vertical reinforcement bars. Keep cavities free of mortar. Solidly bed webs in mortar where adjacent to reinforced cores or cells.
   3. Where horizontally reinforced beams (bond beams) are indicated on drawings, use special units or modify regular units to allow for placement of continuous horizontal reinforcement bars. Place small mesh expanded metal lath or wire screening in mortar joints under bond beam courses over cores or cells of non-reinforced vertical cells, or provide units with solid bottoms.

E. Grouting:
   1. Use fine grout for filling spaces less than 100 mm (4 inches) in one or both horizontal directions.
   2. Use coarse grout for filling 100 mm (4 inch) spaces or larger in both horizontal directions.
   3. Grouting Technique: At Contractor’s option, use either low-lift or high-lift grouting techniques.

F. Low-Lift Grouting:
   1. Provide minimum clear dimension of 50 mm (2 inches) and clear area of 5160 sq. mm (8 sq. inches) in vertical cores to be grouted.
   2. Place vertical reinforcement before grouting of CMU. Extend above elevation of maximum pour height as required for splicing. Support in position at vertical intervals not exceeding 192 bar diameters nor 3 m (10 feet).
   3. Lay CMU to maximum pour height. Do not exceed 1.5 m (5 feet) height, or if bond beam occurs below 1.5 m (5 feet) height, stop pour 38 mm (1-1/2 inches) below top of bond beam.
   4. Rod or vibrate grout during placing. Place grout continuously; do not interrupt pouring of grout for more than one hour. Terminate grout pours 38 mm (1-1/2 inches) below top course of pour.
   5. Bond Beams: Stop grout in vertical cells 38 mm (1-1/2 inches) below bond beam course. Place horizontal reinforcement in bond beams; lap at corners and intersections as indicated on drawings. Place grout in bond beam course before filling vertical cores above bond beam.

G. High-Lift Grouting:
   1. Do not use high-lift grouting technique for grouting of CMU unless minimum cavity dimension and area is 75 mm (3 inches) and 6450 sq. mm (10 sq. inches), respectively.

2. Provide cleanout holes in first course at vertical cells which are to be filled with grout.
3. Use units with one face shell removed and provide temporary supports for units above, or use header units with concrete brick supports, or cut openings in one face shell.
4. Construct masonry to full height of maximum grout pour before placing grout.
5. Limit grout lifts to maximum height of 1.5 m (5 feet) and grout pour to maximum height of 7.3 m (24 feet), for single wythe hollow concrete masonry walls, unless otherwise indicated.
6. Place vertical reinforcement before grouting. Place before or after laying masonry units, to suit application. Tie vertical reinforcement to dowels at base of masonry where shown and thread CMU over or around reinforcement. Support vertical reinforcement at intervals not exceeding 192 bar diameters nor 3 m (10 feet).
7. Where individual bars are placed after laying masonry, place wire loops extending into cells as masonry is laid and loosen before mortar sets. After insertion of reinforcement bar, pull loops and bar to proper position and tie free ends.
8. Where reinforcement is prefabricated into cage units before placing, fabricate units with vertical reinforcement bars and lateral ties of the size and spacing indicated.
9. Place horizontal beam reinforcement as masonry units are laid.
10. Preparation of Grout Spaces: Before grouting, inspect and clean grout spaces. Remove dust, dirt, mortar droppings, loose pieces of masonry and other foreign materials from grout spaces. Clean reinforcement and adjust to proper position. Clean top surface of structural members supporting masonry to ensure bond. After final cleaning and inspection, close cleanout holes and brace closures to resist grout pressures.
11. Do not place grout until entire height of masonry to be grouted has attained sufficient strength to resist displacement of masonry units and breaking of mortar bond. Install shores and bracing, if required, before starting grouting operations.
12. Limit grout pours to sections which can be completed in one working day with maximum one hour interruption of pouring operation. Place grout in lifts which do not exceed 1.5 m (5 feet). Allow minimum 30 minutes and maximum one hour between lifts. Mechanically consolidate each lift.
13. Place grout in lintels or beams over openings in one continuous pour.
14. Where bond beam occurs more than one course below top of pour, fill bond beam course to within 25 mm (1 inch) of vertically reinforced cavities, during construction of masonry.
15. When more than one pour is required to complete a given section of masonry, extend reinforcement beyond masonry as required for splicing. Pour grout to within 38 mm (1-1/2 inches) of top course of first pour. After grouted masonry is cured, lay masonry units and place reinforcement for second pour section before grouting. Repeat sequence if more pours are required.

3.11 CONSTRUCTION TOLERANCES

A. Lay masonry units plumb, level and true to line within tolerances according to ACI 530.1/ASCE 6/TMS 602 and as follows:

B. Maximum variation from plumb:
   1. In 3000 mm (10 feet) - 6 mm (1/4 inch).
   2. In 6000 mm (20 feet) - 9 mm (3/8 inch).
   3. In 12,000 mm (40 feet) or more - 13 mm (1/2 inch).

C. Maximum variation from level:
   1. In any bay or up to 6000 mm (20 feet) - 6 mm (1/4 inch).
   2. In 12,000 mm (40 feet) or more - 13 mm (1/2 inch).

D. Maximum variation from linear building lines:
   1. In any bay or up to 6000 mm (20 feet) - 13 mm (1/2 inch).
   2. In 12,000 mm (40 feet) or more - 19 mm (3/4 inch).

E. Maximum variation in cross-sectional dimensions of columns and thickness of walls from dimensions shown:
   1. Minus 6 mm (1/4 inch).
   2. Plus 13 mm (1/2 inch).

F. Maximum variation in prepared opening dimensions:
   1. Accurate to minus 0 mm (0 inch).
   2. Plus 6 mm (1/4 inch).

3.12 CLEANING AND REPAIR

A. General:
   1. Clean exposed masonry surfaces on completion.
   2. Protect adjoining construction materials and landscaping during cleaning operations.
   3. Cut out defective exposed new joints to depth of approximately 19 mm (3/4 inch) and repoint.
   4. Remove mortar droppings and other foreign substances from wall surfaces.

B. Brickwork:
   1. First wet surfaces with clean water, then wash down with detergent solution. Do not use muriatic acid.
   2. Brush with stiff fiber brushes while washing, and immediately wash with clean water.
   3. Remove traces of detergent, foreign streaks, or stains of any nature.

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

3.13 FIELD QUALITY CONTROL

A. Water Penetration Testing:

1. Seven days before plastering or painting, in presence of Contracting Officer's Representative, test solid exterior masonry walls for water penetration.
2. Direct water on masonry for a period of one hour when wind velocity is less than five miles per hour.
3. Should moisture appear on inside of walls tested, make additional tests at other areas as directed by Contracting Officer's Representative.
4. Correct areas showing moisture on inside of walls, and repeat test at repaired areas, to ensure moisture penetration has been stopped.
5. Make water test at following locations:
    a. Sixteen places on Building

- - E N D - -

SECTION 05 12 00
STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Structural steel shapes, plates, and bars.
   2. 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 Joist: Section 05 21 00, STEEL JOIST FRAMING.
C. Steel Decking: Section 05 31 00, STEEL DECKING.
D. Fireproofing: Section 07 81 00, APPLIED FIREPROOFING.
E. Steel Finishes: Section 09 06 00, SCHEDULE FOR FINISHES.
F. Steel Support: Section 10 13 00, DIRECTORIES.
G. 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. 303-10 - Code of Structural Steel Buildings and Bridges.
   3. 360-10: Specification for Structural Steel Buildings.
C. The American Society of Mechanical Engineers (ASME):
   1. B18.22.1-09 - Washers: Helical Spring-Lock, Tooth Lock, and Plain Washers.
D. American Welding Society (AWS):
   1. D1.1/D1.1M-15 - Structural Welding Code - Steel.
E. ASTM International (ASTM):
   1. A6/A6M-14 - General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.

2. A36/A36M-14 - Carbon Structural Steel.
3. A53/A53M-12 - Pipe, Steel, Black and Hot-Dip, Zinc-Coated, Welded and Seamless.
4. A123/A123M-15 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
5. A242/A242M-13 - High-Strength Low-Alloy Structural Steel.
6. A283/A283M-13 - Low and Intermediate Tensile Strength Carbon Steel Plates.
7. A307-14 - Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength.
8. 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. Sustainable Construction Submittals:
   1. Recycled Content: Identify post-consumer and pre-consumer recycled content percentage by weight.

D. Test Reports: Certify products comply with specifications.
   1. Welders' qualifying tests.

E. Certificates: Certify each product complies with specifications.
   1. Structural steel.
   2. Steel connections.
   3. Welding materials.
   4. Shop coat primer paint.

F. Qualifications: Substantiate qualifications comply with specifications.
   1. Fabricator with project experience list .
   2. Installer with project experience list .
   3. Welders and welding procedures.

G. Delegated Design Drawings and Calculations: Signed and sealed by responsible Architect/Engineer.
   1. Connection calculations.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: AISC Quality Certification participant designated as AISC Certified Plant, Category STD.
   1. Regularly fabricates specified products.
   2. Fabricated 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: AISC Quality Certification Program participant designated as AISC-Certified Erector, Category ACSE.
   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. Before commencement of Work, ensure steel erector provides written notification required by OSHA 29 CFR 1926.752(e). Submit a copy of the notification to Contracting Officer's Representative.

D. Welders and Welding Procedures Qualifications: AWS D1.1/D1.1M.

1.6 WARRANTY

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

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

A. Delegated Design: Prepare submittal documents including design calculations and drawings signed and sealed by registered design professional, licensed in state where project is located.

B. Design structural steel framing connections complying with specified performance:

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

2.2 MATERIALS

A. W-Shapes:
   1. ASTM A992/A992M.
B. Channel and Angles:
   1. ASTM A36/A36M.
C. Plates and Bars:
   1. ASTM A36/A36M.
D. Hollow Structural Sections:
   1. ASTM A501/A501M.
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.
B. Sustainable Construction Requirements:
   1. Steel Recycled Content: 30 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. Paints and coatings.

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.

3.3 FIELD QUALITY CONTROL

A. Record Survey:
    1. Engage registered land surveyor or registered civil engineer as specified in Section 01 00 00, GENERAL REQUIREMENTS to perform survey.
    2. Measure and record structural steel framing plumbness, level, and alignment after completing bolting and welding and before installation of work supported by structural steel.
    3. Identify deviations from allowable tolerances specified in AISC Manual.

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SECTION 05 36 00
COMPOSITE METAL DECKING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies material and services required for installation of composite steel decking including shear connector studs and miscellaneous closures required to prepare deck for concrete placement as shown and specified.

1.2 RELATED WORK

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

1.3 DESIGN REQUIREMENTS

A. Design steel decking in accordance with AISI S-100, except as otherwise shown or specified.

B. Design steel decking to comply with codes referenced by the Florida Building Code.

1.4 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. All items indicated below are required submittals requiring Contracting Officer’s Representative (COR) review and approval.

B. Sustainable Design Submittals, as described below:

1. Combined recycled content as specified in PART 2 - PRODUCTS.

C. Shop Drawings: Shop and erection drawings showing decking unit layout, connections to supporting members, and information necessary to complete the installation as shown and specified, including supplementary framing, cant strips, cut openings, special jointing or other accessories.

1. Show welding, side lap, closure, deck reinforcing and closure reinforcing details.
2. Show openings required for work of other trades, including openings not shown on structural drawings.
3. Indicate where temporary shoring is required to satisfy design criteria.

D. Manufacturer's Literature and Data: Showing steel decking section properties and specifying required structural characteristics.

E. Manufacturer's written recommendations for:

1. Shape of decking section.
2. Cleaning of steel decking prior to concrete placement.

F. Test Report - Establishing structural characteristics of composite concrete and steel decking system.

G. Test Report - Stud base qualification.

H. Welding power setting recommendation by shear stud manufacturer.

I. Shear Stud Layouts: Submit drawings showing the quantity, pattern, spacing and configuration of shear studs for each beam and girder.

J. Certification: For each type and gauge of metal deck supporting concrete slab or fill, submit certification of specified fire ratings. Certify that units supplied are UL listed as a “Steel Floor and Form Unit”.

K. Manufacturers Certificates for deck units attesting compliance with specified requirements.

L. Submit manufacturer’s catalog data for Welding Equipment and Welding Rods and Accessories intended use.

M. Power Actuated Tool Operator Certificates.

N. Welders qualifications.

1.5 QUALITY ASSURANCE

A. Fire Safety

1. Underwriters’ Label: Provide composite metal floor deck units listed in Underwriters’ Laboratories “Building Materials Directory”, with each deck unit bearing the UL label and marking for specific system detailed.
2. Insurance Certification: Assist the Government in preparation and submittal of roof installation acceptance certification as may be necessary in connection with fire and extended coverage insurance.

B. Certification of Powder-Actuated Tool Operator: Manufacturer’s certificate attesting that the operators are authorized to use the low velocity powder-actuated tool.

C. Qualifications for Welding Work: Submit qualified welder qualifications in accordance with AWS D1.1/D1.1M or under an approved qualification test.

1.6 APPLICABLE PUBLICATIONS:

A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only. Refer to the latest edition of referenced Standards and codes.

B. American Iron and Steel Institute (AISI):

S-100-16 ..... North American Specification for the Design of Cold-Formed Steel Structural Members

C. ASTM International (ASTM):

A36/A36M-19 ..... Standard Specification for Carbon Structural Steel

A108-18..... Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished

A653/A653M-20 ..... Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by the Hot Dip Process

D. American Institute of Steel Construction (AISC):
   1. Specification for Structural Steel Buildings – Allowable Stress Design and Plastic Design (Latest Edition)
   2. Load and Resistance Factor Design Specification for Structural Steel Buildings (Latest Edition)

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. FM Global (FM):
   APP Guide ..... Approval Guide
   DS 1-28-15 ..... Design Wind Loads

G. Military Specifications (Mil. Spec.):
   MIL-P-21035B ..... Paint, High Zinc Dust Content, Galvanizing Repair

H. Underwriters Laboratories (UL):
   Bld Mat Dir(Annually) ..... Building Materials Directory

PART 2 - PRODUCTS

2.1 MATERIALS

A. Steel Decking and Flashings: ASTM A653/A653M, Structural Quality suitable for shear stud weld-through techniques.

B. Recycled Content of Steel Products: Combined recycled content not less than 75 percent.

C. Galvanizing: ASTM A653/A653M,G90. Thickness not less than indicated on drawings.

D. Shear connector studs: ASTM A108, Grades 1015-1020, yield 350 Mpa (50,000 pound/square inch) minimum, tensile strength - 400 Mpa (60,000 pounds/square inch) minimum, reduction of area 50 percent minimum.
   1. Provide studs of uniform diameter, with heads concentric and on same axis to shaft.
   2. Provide studs, after welding, free from substance or defect which would interfere with its function as a shear connector.
   3. Do not paint or galvanize studs.
   4. Provide size of studs as shown on drawings.
   5. Provide studs manufactured by a company normally engaged in the manufacturer of shear studs, and can furnish equipment suitable for weld-through installation of shear studs.

E. Galvanizing Repair Paint: Mil. Spec. MIL-P-21035B.

F. Miscellaneous Steel Shapes: ASTM A36/A36M.

G. Welding Electrode: E60XX minimum.

H. Sheet Metal Accessories: ASTM A653/A653M, galvanized, unless noted otherwise. Provide accessories of every kind required to complete the installation of metal decking in the system shown. Finish sheet metal items to match deck including, but not limited to, the following items:
   1. Metal Cover Plates: For end-abutting deck units, to close gaps at changes in deck direction, columns, walls and openings. Same quality as deck units but not less than 1.3 mm (18 gauge) sheet steel.
   2. Continuous sheet metal edging: at openings and concrete slab edges. Same quality as deck units but not less than 1.3 mm (18 gauge) steel. Side and end closures supporting concrete and their attachment to supporting steel to be designed by the manufacturer to safely support the wet weight of concrete and construction loads. The deflection of cantilever closures to be limited to a total of 3 mm (1/8 inch) maximum.
   3. Metal Closure Strips: For openings between decking and other construction, of not less than 1.3 mm (18 gauge) sheet steel of the same quality as the deck units. Form to the configuration required to provide tight-fitting closures at open ends of flutes and sides of decking.
   4. Seat angles for deck: Where a beam does not frame into a column.

2.2 REQUIREMENTS

A. Steel decking depth, gauge, and section properties to be as shown on contract documents. Provide edges of deck with vertical interlocking male and female lip providing for a positive mechanical connection.

B. Fabricate deck units with integral embossments to provide mechanical bond with concrete slab. Deck units combined with concrete slab to be capable of supporting total design loads.

PART 3 - EXECUTION

3.1 ERECTION

A. Do not start installation of metal decking until corresponding steel framework has been plumbed, aligned and completed, and until temporary shoring, where required, has been installed.
   1. Remove oil, dirt, paint, ice, water and rust from steel surfaces to which metal decking will be welded.

B. Coordinate and cooperate with structural steel erector in locating decking bundles to prevent overloading of structural members.

C. Do not use floor deck units for storage or working platforms until permanently secured.
   1. Do not overload deck units once placed.
   2. Replace deck units that become damaged after erection and prior to casting concrete at no additional cost to the Government.

D. Erect steel deck in accordance with manufacturer's printed instructions.

E. Ship steel deck units in standard widths and fabricated to proper length.

F. Provide steel decking in sufficient lengths to extend over 3 or more spans, except where structural steel layout does not permit.

G. Place steel decking units on supporting steel framework and adjust to final position before being permanently fastened.
   1. Bring each unit to proper bearing on supporting beams.
   2. Place deck units in straight alignment for entire length of run of flutes and with close registration of flutes of one unit with those of abutting unit.
   3. Maximum space between ends of abutting units is 13 mm (1/2 inch). If space exceeds 13 mm (1/2 inch), install closure plates.

H. Ceiling hanger loops, if provided, must be flattened or removed to obtain bearing of units on structural steel.

I. Fastening Deck Units:
   1. Fasten floor deck units to steel supporting members by not less than 16 mm (5/8 inch) diameter puddle welds or elongated welds of equal strength, spaced not more than 305 mm (12 inches) on center with a minimum of two welds per unit at each support. Where two units abut, fasten each unit individually to the supporting steel framework.
   2. Tack weld or use self-tapping No. 8 or larger machine screws at 914 mm (3 feet) on center for fastening end closures. Only use welds to attach longitudinal end closures.
   3. Weld side laps of adjacent floor deck units that span more than 1524 mm (5 feet). Fasten at midspan or 914 mm (3 feet) on center, whichever is smaller.

J. Weld in conformance to AWS D1.3/D1.3M and done by qualified experienced welding mechanics.

K. Clean and touch-up area and welds scarred during erection, and repair with zinc rich galvanizing repair paint.
   1. Paint touch-up is not required for welds or scars that are to be in direct contact with concrete.

L. Provide metal concrete stops at edges of deck.

M. Cutting and Fitting:
   1. Fabricate metal deck units to proper length prior to shipping.
   2. Field cutting by the metal deck erector is restricted to bevel cuts, notching to fit around columns and similar items, and cutting openings that are located and dimensioned on the structural drawings.
   3. Other penetrations shown on the approved metal deck shop drawings but not shown on the structural drawings are to be located, cut and reinforced.
   4. Make cuts and penetrations neat and trim using a metal saw, drill or punchout device; cutting with torches is prohibited.
   5. Do not make cuts in the metal deck that are not shown on the approved metal deck drawings.

6. If an additional opening not shown on the approved shop drawings is required, submit a sketch, to scale, locating the required new opening and other openings and supports in the immediate area. Do not cut the opening until the sketch has been reviewed and accepted by the Contracting Officer Representative (COR). Provide additional reinforcing or framing required for the opening at no additional cost to the Government.
7. Reinforcement at Openings: Provide additional metal reinforcement and closure pieces as required for strength, continuity of decking and support of other work shown.

N. Install shear connector studs through previously installed metal deck in conformance to AWS D1.1/D1.1M, Section 7.

Exception: Install studs with automatically timed welding equipment and as specified below:

1. Do not place welded wire reinforcing or other materials and equipment which will interfere with stud installation on steel deck until shear connector studs are installed.
2. Clean steel deck sheets free of oil, rust, dirt, and paint. Release water in deck’s valley so that it does not become entrapped between deck and beam. Clean and dry surface to which stud is to be welded.
3. Rest metal deck tightly upon top flange of structural member with bottom of deck rib in full contact with top of beam flange.
4. Weld studs only through a single thickness of deck. Place decking so that a butt joint is obtained. Place studs directly over beam web, where one row of studs are required.
5. Provide ferrules specially developed for the weld-through technique, and appropriate for size of studs installed. Remove ferrules after welding.
6. Submit report of successful test program for stud base qualification as required by AWS D1.1/D1.1M, Appendix K.

3.2 CLEANING

A. Clean deck in accordance with manufacturer's recommendation before concrete placement.

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SECTION 05 40 00
COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 DESCRIPTION

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

1.2 RELATED WORK

A. Section 01 81 13 SUSTAINABLE CONSTRUCTION REQUIREMENTS.
B. Section 05 12 00, STRUCTURAL STEEL FRAMING: Structural steel framing.
C. Section 05 21 00, STEEL JOIST FRAMING: Open web steel joists.
D. Section 09 22 16, NON-STRUCTURAL METAL FRAMING: Non-load-bearing metal stud framing assemblies.
E. Section 09 29 00, GYPSUM BOARD: Gypsum board assemblies.

1.3 DESIGN REQUIREMENTS

A. Design steel in accordance with American Iron and Steel Institute Publication "Specification for the Design of Cold-Formed Steel Structural Members", except as otherwise shown or specified.

B. Structural Performance: Engineer, fabricate and erect cold-formed metal framing with the minimum physical and structural properties indicated.
C. Structural Performance: Engineer, fabricate, and erect cold-formed metal framing to withstand design loads within limits and under conditions required.
   1. Design Loads:
      a. Gravity, wind and seismic loading as indicated on the drawings or in this specification.
   2. Design framing systems to withstand design loads without deflections greater than the following:

      a. Exterior Non-load-Bearing wall: Lateral deflection of 1/240 of the wall height.

3. Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change (range) of 67 degrees C (120 degrees F).
4. Design framing system to accommodate deflection of primary building structure and construction tolerances, and to maintain clearances at openings.
5. Design exterior non-load-bearing wall framing to accommodate lateral deflection without regard to contribution of sheathing materials.
6. Engineering Responsibility: Engage a fabricator who assumes undivided responsibility for engineering cold-formed metal framing by employing a qualified professional engineer to prepare design calculations, shop drawings, and other structural data.

1.4 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. All items indicated below are required submittals requiring Contracting Officer’s Representative (COR) review and approval

B. Shop Drawings: Shop and erection drawings showing steel unit layout, connections to supporting members, and information necessary to complete installation as shown and specified.

C. Manufacturer's Literature and Data: Showing steel component sections and specifying structural characteristics.

D. Sustainable Construction Submittals:

1. Recycled Content: Identify post-consumer and pre-consumer recycled content percentage by weight.

1.5 APPLICABLE PUBLICATIONS

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

B. American Iron and Steel Institute (AISI): Specification and Commentary for the Design of Cold-Formed Steel Structural Members (2016)

C. ASTM International (ASTM):
A36/A36M-19 ..... Standard Specification for Carbon Structural Steel

A123/A123M-17 ..... Standard Specifications for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
A153/A153M-16a ..... Standard Specifications for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
A307-14e1..... Standard Specifications for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength
A653/A653M-20 ..... Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by the Hot Dip Process
C955-18e1 ..... Standard Specification for Cold Formed Steel Structural Framing Members
C1107/1107M-20..... Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink)
E488/E488M-18 ..... Standard Test Methods for Strength of Anchors in Concrete Elements
E1190-11(2018) ..... Standard Test Methods for Strength of Power-Actuated Fasteners Installed in Structural Members

D. American Welding Society (AWS):
D1.3/D1.3M-18..... Structural Welding Code-Sheet Steel
E. Military Specifications (Mil. Spec.):
MIL-P-21035B ..... Paint, High Zinc Dust Content, Galvanizing Repair
F. VA Physical Security and Resiliency Design Manual October 1, 2020.

PART 2 - PRODUCTS

2.1 **MATERIALS**

A. Sheet Steel for, studs and accessories 16 gauge and heavier: ASTM A653, structural steel, zinc coated CP60 , with a yield of 340 MPa (50 ksi) minimum.
B. Sheet Steel for joists, studs and accessories 18 gauge and lighter: ASTM A653, structural steel, zinc coated G60 , with a yield of 230 MPa (33 ksi) minimum.
C. Galvanizing Repair Paint: MIL-P-21035B.

D. Nonmetallic, Non-shrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, Portland cement, shrinkage-compensating agents,

plasticizing and water-reducing agents, complying with ASTM C1107, with fluid consistency and a 30 minute working time.

2.2 WALL FRAMING

A. Steel Studs: Complying with ASTM C 955. Manufacturer's standard C-shaped steel studs of web depth indicated, with lipped flanges, and complying with the following:
   1. Minimum Base-Steel Thickness(uncoated): 1.37 mm (0.0538 inch)
   2. Flange Width: 1-5/8 inches
   3. Web: Punched
B. Steel Track: Manufacturer's standard U-shaped steel track, unpunched, of web depths indicated, with straight flanges, and complying with the following:
   1. Design Uncoated-Steel Thickness: Matching steel studs.
   2. Flange Width: Manufacturer's standard deep flange where indicated, standard flange elsewhere.

2.3 FRAMING ACCESSORIES

A. Fabricate steel framing accessories of the same material and finish used for framing members, with a minimum yield strength of 230 MPa (33 ksi).
B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
   1. Supplementary framing.
   2. Bracing, bridging, and solid blocking.
   3. Deflection track and vertical slide clips.

2.4 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A36, zinc coated by the hot-dip process according to ASTM A123.
B. Cast-in-Place Anchor Bolts and Studs: ASTM A307, Grade A, zinc coated by the hot-dip process according to ASTM A153.
C. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times the design load, as determined by testing per ASTM E488 conducted by a qualified independent testing agency.

D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times the design load, as determined by testing per ASTM E1190 conducted by a qualified independent testing agency.
E. Mechanical Fasteners: Corrosion-resistant coated, self-drilling, self-threading steel drill screws. Low-profile head beneath sheathing, manufacturer's standard elsewhere.

2.5 REQUIREMENTS

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

PART 3 - EXECUTION

3.1 FABRICATION

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

3.2 ERECTION

A. Handle and lift prefabricated panels in a manner as to not distort any member.
B. Securely anchor tracks to supports as shown.
C. At butt joints, securely anchor two pieces of track to same supporting member or butt-weld or splice together.
D. Plumb, align, and securely attach studs to flanges or webs of both upper and lower tracks.

E. All axially loaded members shall be aligned vertically to allow for full transfer of the loads down to the foundation. Vertical alignment shall be maintained at floor/wall intersections.
F. Install jack studs above and below openings and as required to furnish support. Securely attach jack studs to supporting members.
G. Install headers in all openings that are larger than the stud spacing in that wall.
H. Attach bridging for studs in a manner to prevent stud rotation. Space bridging rows as shown.
I. Studs in one piece for their entire length, splices will not be permitted.
J. Provide a load distribution member at top track where joist is not located directly over bearing stud.
K. Provide temporary bracing and leave in place until framing is permanently stabilized.
L. Do not bridge building expansion joints with cold-formed metal framing. Independently frame both sides of joints.
M. Fasten reinforcement plate over web penetrations that exceed size of manufacturer's standard punched openings.

3.3 TOLERANCES

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

3.4 FIELD REPAIR

A. Touch-up damaged galvanizing with galvanizing repair paint.

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SECTION 05 50 00
METAL FABRICATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies items and assemblies fabricated from structural steel shapes and other materials as shown and specified.

B. Items specified.

1. Support for Wall and Ceiling Mounted Items: (SD055000-01, SD055000-02, SD102113-01, SD102600-01, SD123100-01 & SD123100-02)
2. Frames.
3. Gratings
6. Loose Lintels
7. Shelf Angles
4. Plate Door Sill
5. Safety Nosings
6. Railings

1.2 RELATED WORK

A. Prime and finish painting: Section 09 91 00, PAINTING.

B. Stainless steel corner guards: Section 10 26 00, WALL AND DOOR PROTECTION.

1.3 SUBMITTALS

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

B. Manufacturer's Literature and Data.

C. Shop Drawings:

1. Each item specified, showing complete detail, location in the project, material and size of components, method of joining various components and assemblies, finish, and location, size and type of anchors.
2. Mark items requiring field assembly for erection identification and furnish erection drawings and instructions.
3. Provide templates and rough-in measurements as required.

D. Manufacturer's Certificates:

1. Anodized finish as specified.
2. Live load designs as specified.

E. Design Calculations for specified live loads including dead loads.

1.4 QUALITY ASSURANCE

A. Each manufactured product shall meet, as a minimum, the requirements specified, and shall be a standard commercial product of a manufacturer regularly presently manufacturing items of type specified.

B. Each product type shall be the same and be made by the same manufacturer.

C. Assembled product to the greatest extent possible before delivery to the site.

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

1.5 APPLICABLE PUBLICATIONS

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

B. American Society of Mechanical Engineers (ASME):

B18.6.1-97.....Wood Screws

B18.2.2-87(R2010).....Square and Hex Nuts

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

A36/A36M-14 .....Structural Steel

A47-99(R2014).....Malleable Iron Castings

A48-03(R2012).....Gray Iron Castings

A53-12.....Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless

A123-15.....Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

A240/A240M-15 .....Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels and for General Applications.

A269-15.....Seamless and Welded Austenitic Stainless Steel Tubing for General Service

A307-14.....Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength

A391/A391M-07(R2015) .....Grade 80 Alloy Steel Chain

A786/A786M-15 .....Rolled Steel Floor Plate

B221-14.....Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes

B456-11.....Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium

B632-08.....Aluminum-Alloy Rolled Tread Plate

C1107-13 .....Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

F436-16.....Hardened Steel Washers

F468-06(R2015).....Nonferrous Bolts, Hex Cap Screws, Socket Head Cap Screws and Studs for General Use
F593-13.....Stainless Steel Bolts, Hex Cap Screws, and Studs
F1667-15.....Driven Fasteners: Nails, Spikes and Staples

D. American Welding Society (AWS):
D1.1-15.....Structural Welding Code Steel
D1.2-14.....Structural Welding Code Aluminum
D1.3-18.....Structural Welding Code Sheet Steel

E. National Association of Architectural Metal Manufacturers (NAAMM)
AMP 500-06 .....Metal Finishes Manual

F. Structural Steel Painting Council (SSPC)/Society of Protective Coatings:
SP 1-15 .....No. 1, Solvent Cleaning
SP 2-04 .....No. 2, Hand Tool Cleaning
SP 3-04 .....No. 3, Power Tool Cleaning

G. Federal Specifications (Fed. Spec):
RR-T-650E .....Treads, Metallic and Nonmetallic, Nonskid

PART 2 - PRODUCTS

2.1 DESIGN CRITERIA

A. In addition to the dead loads, design fabrications to support the following live loads unless otherwise specified.
B. Ladders and Rungs: 120 kg (250 pounds) at any point.
C. Railings and Handrails: 900 N (200 pounds) in any direction at any point.

2.2 MATERIALS

A. Structural Steel: ASTM A36.
B. Stainless Steel: ASTM A240, Type 302 or 304.
F. Cast-Iron: ASTM A48, Class 30, commercial pattern.
H. Primer Paint: As specified in Section 09 91 00, PAINTING.
I. Stainless Steel Tubing: ASTM A269, type 302 or 304.
J. Modular Channel Units:
1. Factory fabricated, channel shaped, cold formed sheet steel shapes, complete with fittings bolts and nuts required for assembly.
2. Form channel within turned pyramid shaped clamping ridges on each side.
3. Provide case hardened steel nuts with serrated grooves in the top edges designed to be inserted in the channel at any point and be given a quarter turn so as to engage the channel clamping ridges. Provide each nut with a spring designed to hold the nut in place.

4. Factory finish channels and parts with oven baked primer when exposed to view. Channels fabricated of ASTM A525, G90 galvanized steel may have primer omitted in concealed locations. Finish screws and nuts with zinc coating.
5. Fabricate snap-in closure plates to fit and close exposed channel openings of not more than 0.3 mm (0.0125 inch) thick stainless steel.

K. Grout: ASTM C1107, pourable type.

2.3 HARDWARE

A. Rough Hardware:
   1. Furnish rough hardware with a standard plating, applied after punching, forming and assembly of parts; galvanized, cadmium plated, or zinc-coated by electro-galvanizing process. Galvanized G-90 where specified.
   2. Use G90 galvanized coating on ferrous metal for exterior work unless non-ferrous metal or stainless is used.

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

2.4 FABRICATION GENERAL

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

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

C. Connections
   1. Except as otherwise specified, connections may be made by welding, riveting or bolting.
   2. Field riveting will not be approved.

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

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

E. Workmanship
1. General:
   a. Fabricate items to design shown.
   b. Furnish members in longest lengths commercially available within the limits shown and specified.
   c. Fabricate straight, true, free from warp and twist, and where applicable square and in same plane.
   d. Provide holes, sinkages and reinforcement shown and required for fasteners and anchorage items.
   e. Provide openings, cut-outs, and tapped holes for attachment and clearances required for work of other trades.
   f. Prepare members for the installation and fitting of hardware.
   g. Cut openings in gratings and floor plates for the passage of ducts, sumps, pipes, conduits and similar items. Provide reinforcement to support cut edges.

h. Fabricate surfaces and edges free from sharp edges, burrs and projections which may cause injury.

2. Welding:
   a. Weld in accordance with AWS.
   b. Welds shall show good fusion, be free from cracks and porosity and accomplish secure and rigid joints in proper alignment.
   c. Where exposed in the finished work, continuous weld for the full length of the members joined and have depressed areas filled and protruding welds finished smooth and flush with adjacent surfaces.
   d. Finish welded joints to match finish of adjacent surface.
3. Joining:
   a. Miter or butt members at corners.
   b. Where frames members are butted at corners, cut leg of frame member perpendicular to surface, as required for clearance.
4. Anchors:
   a. Where metal fabrications are shown to be preset in concrete, weld 32 x 3 mm (1-1/4 by 1/8 inch) steel strap anchors, 150 mm (6 inches) long with 25 mm (one inch) hooked end, to back of member at 600 mm (2 feet) on center, unless otherwise shown.
   b. Where metal fabrications are shown to be built into masonry use 32 x 3 mm (1-1/4 by 1/8 inch) steel strap anchors, 250 mm (10 inches) long with 50 mm (2 inch) hooked end, welded to back of member at 600 mm (2 feet) on center, unless otherwise shown.
5. Cutting and Fitting:
   a. Accurately cut, machine and fit joints, corners, copes, and miters.
   b. Fit removable members to be easily removed.
   c. Design and construct field connections in the most practical place for appearance and ease of installation.
   d. Fit pieces together as required.
   e. Fabricate connections for ease of assembly and disassembly without use of special tools.
   f. Joints firm when assembled.
   g. Conceal joining, fitting and welding on exposed work as far as practical.
   h. Do not show rivets and screws prominently on the exposed face.
   i. The fit of components and the alignment of holes shall eliminate the need to modify component or to use exceptional force in the assembly of item and eliminate the need to use other than common tools.

F. Finish:
   1. Finish exposed surfaces in accordance with NAAMM AMP 500 Metal Finishes Manual.
   2. Aluminum: NAAMM AMP 501.

a. Mill finish, AA-M10, as fabricated, use unless specified otherwise.
b. Clear anodic coating, AA-C22A41, chemically etched medium matte, with Architectural Class 1, 0.7 mils or thicker.
c. Colored anodic coating, AA-C22A42, chemically etched medium matte with Architectural Class 1, 0.7 mils or thicker.
d. Painted: AA-C22R10.

3. Steel and Iron: NAAMM AMP 504.
   a. Zinc coated (Galvanized): ASTM A123, G90 unless noted otherwise.
   b. Surfaces exposed in the finished work:
      1) Finish smooth rough surfaces and remove projections.
      2) Fill holes, dents and similar voids and depressions with epoxy type patching compound.
   c. Shop Prime Painting:
      1) Surfaces of Ferrous metal:
         a) Items not specified to have other coatings.
         b) Galvanized surfaces specified to have prime paint.
         c) Remove all loose mill scale, rust, and paint, by hand or power tool cleaning as defined in SSPC-SP2 and SP3.
         d) Clean of oil, grease, soil and other detrimental matter by use of solvents or cleaning compounds as defined in SSPC-SP1.
         e) After cleaning and finishing apply one coat of primer as specified in Section 09 91 00, PAINTING.
      2) Non ferrous metals: Comply with MAAMM-500 series.
4. Stainless Steel: NAAMM AMP-504 Finish No. 4.

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

2.5 SUPPORTS

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

C. For Wall Mounted Items:

1. For items supported by metal stud partitions.
2. Steel strip or hat channel minimum of 1.5 mm (0.0598 inch) thick.
3. Steel strip minimum of 150 mm (6 inches) wide, length extending one stud space beyond end of item supported.
4. Steel hat channels where shown. Flange cut and flatted for anchorage to stud.
5. Structural steel tube or channel for grab bar at water closets floor to structure above with clip angles or end plates formed for anchors.
6. Use steel angles for thru wall counters. Drill angle for fasteners at ends and not over 100 mm (4 inches) on center between ends.

2.6 RAILINGS

A. In addition to the dead load design railing assembly to support live load specified.

B. Fabrication General:
   1. Provide continuous welded joints, dressed smooth and flush.
   2. Standard flush fittings, designed to be welded, may be used.
   3. Exposed threads will not be approved.
   4. Form handrail brackets to size and design shown.
   5. Exterior Post Anchors.
      a. Fabricate tube or pipe sleeves with closed ends or plates as shown.
      b. Where inserts interfere with reinforcing bars, provide flanged fittings welded or threaded to posts for securing to concrete with expansion bolts.
      c. Provide heavy pattern sliding flange base plate with set screws at base of pipe or tube posts.
   6. Interior Post Anchors:
      a. Provide flanged fittings for securing fixed posts to floor with expansion bolts, unless shown otherwise.
      b. Weld or thread flanged fitting to posts at base.
      c. For securing removable posts to floor, provide close fitting sleeve insert or inverted flange base plate with stud bolts or rivets concrete anchor welded to the base plate.
      d. Provide sliding flange base plate on posts secured with set screws.
      e. Weld flange base plate to removable posts set in sleeves.

C. Handrails:
   1. Close free ends of rail with flush metal caps welded in place except where flanges for securing to walls with bolts are shown.
   2. Make provisions for attaching handrail brackets to wall, posts, and handrail as shown.

D. Steel Pipe Railings:
   1. Fabricate of steel pipe with welded joints.
   2. Number and space of rails as shown.

3. Space posts for railings not over 1800 mm (6 feet) on centers between end posts.
4. Form handrail brackets from malleable iron.
5. Fabricate removable sections with posts at end of section.
6. Removable Rails:
    a. Provide "U" shape brackets at each end to hold removable rail as shown. Use for top and bottom horizontal rail when rails are joined together with vertical members.
    b. Secure rail to brackets with 9 mm (3/8 inch) stainless steel through bolts and nuts at top rail only when rails joined with vertical members.
    c. Continuously weld brackets to post.
    d. Provide slotted bolt holes in rail bracket.
    e. Weld bolt heads flush with top of rail.
    f. Weld flanged fitting to post where posts are installed in sleeves.

2.7 STEEL PIPE BOLLARD

Provide bollard in accordance with ASTM A53 with dimensions as shown in standard detail SD320523-04. Anchor posts in concrete and fill solidly with concrete with a minimum compressive strength of 17 MPa 2500psi.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Set work accurately, in alignment and where shown, plumb, level, free of rack and twist, and set parallel or perpendicular as required to line and plane of surface.
B. Items set into concrete or masonry.
    1. Provide temporary bracing for such items until concrete or masonry is set.
    2. Place in accordance with setting drawings and instructions.
    3. Build strap anchors, into masonry as work progresses.
C. Set frames of gratings, covers, corner guards, trap doors and similar items flush with finish floor or wall surface and, where applicable, flush with side of opening.
D. Field weld in accordance with AWS.
    1. Design and finish as specified for shop welding.
    2. Use continuous weld unless specified otherwise.
E. Install anchoring devices and fasteners as shown and as necessary for securing metal fabrications to building construction as specified. Power actuated drive pins may be used except for removable items and where members would be deformed or substrate damaged by their use.
F. Spot prime all abraded and damaged areas of zinc coating as specified and all abraded and damaged areas of shop prime coat with same kind of paint used for shop priming.
G. Isolate aluminum from dissimilar metals and from contact with concrete and masonry materials as required to prevent electrolysis and corrosion.
H. Secure escutcheon plate with set screw.

3.2 INSTALLATION OF SUPPORTS

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

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

3.3 RAILINGS

A. Steel Posts:
   1. Secure fixed posts to concrete with expansion bolts through flanged fittings except where sleeves are shown with pourable grout.
   2. Install sleeves in concrete formwork.
   3. Set post in sleeve and pour grout to surface. Apply beveled bead of urethane sealant at perimeter of post or under flange fitting as specified in Section 07 92 00, JOINT SEALANTS- on exterior posts.
   4. Secure removable posts to concrete with either machine screws through flanged fittings which are secured to inverted flanges embedded in and set flush with finished floor, or set posts in close fitting pipe sleeves without grout.
   5. Secure sliding flanged fittings to posts at base with set screws.
   6. Secure fixed flanged fittings to concrete with expansion bolts.
   7. Secure posts to steel with welds.

C. Anchor to Walls:
   1. Anchor rails to concrete or solid masonry with machine screws through flanged fitting to steel plate.
      a. Anchor steel plate to concrete or solid masonry with expansion bolts.
      b. Anchor steel plate to hollow masonry with toggle bolts.
   2. Anchor flanged fitting with toggle bolt to steel support in frame walls.

D. Removable Rails:
   1. Rest rails in brackets at each end and secure to bracket with stainless steel bolts and nuts where part of a continuous railing.
   2. Rest rail posts in sleeves where not part of a continuous railing. Do not grout posts.

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

3.4 INSTALLATION OF STEEL PIPE BOLLARD

Set bollards vertically in concrete piers. Compressive strength of concrete piers shall be 21MPa 3000psi. For dimensions of concrete piers See standard detail SD320523-04.

3.5 CLEAN AND ADJUSTING

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

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

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SECTION 06 10 00
ROUGH CARPENTRY

PART 1 - GENERAL

1.1 DESCRIPTION:

A. This section specifies wood blocking, nailers and rough hardware.

1.2 RELATED WORK:

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

1.3 SUBMITTALS:

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

B. 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.

C. 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

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

M. U.S. Department of Commerce Product Standard (PS)

PS 1-95 ..... Construction and Industrial Plywood

PS 20-10 ..... American Softwood Lumber Standard

N. ICC Evaluation Service (ICC ES):

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. Structural Members: Species and grade as listed in the AFPA NDS having design stresses as shown.

C. Lumber Other Than Structural:
   1. Unless otherwise specified, species graded under the grading rules of an inspection agency approved by Board of Review, American Lumber Standards Committee.
   2. Furring, blocking, nailers and similar items 101 mm (4 inches) and narrower Standard Grade; and, members 152 mm (6 inches) and wider, Number 2 Grade.

D. Sizes:
   1. Conforming to PS 20.

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

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

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

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

2.2 PLASTIC LUMBER:

A. General:
1. Allowable loads and spans, as documented in evaluation reports or in information referenced in evaluation reports, are not to be less than design loads and spans indicated on contract documents.
2. Restricted to exterior use only.

B. Composite Plastic Lumber: Shapes made from a mixture of cellulose fiber and polyethylene or polypropylene.
1. Shear Parallel to Length: Maximum 6894 kPa (1,000 psi) in accordance with ASTM D2344/D2344M.
2. Density: ASTM D6111.
3. Compressive Strength:
a. Secant Modulus: Minimum 482,633 kPa (70,000 psi) in accordance with ASTM D6108.
b. Stress at 3 percent strain: Minimum 10,342 kPa (1,500 psi) in accordance with ASTM D6108.

c. Compression Parallel to Grain: Minimum 20,684 kPa (3,000 psi) in accordance with ASTM D6112.

d. Compression Perpendicular to Grain: Minimum 6,894 kPa (1,000 psi) in accordance with ASTM D6112.

4. Flexural Strength: Minimum 13,789 kPa (2,000 psi) in accordance with ASTM D6109.

5. Tensile Strength: Minimum 8618 kPa (1,250 psi) in accordance with ASTM D198.

C. All-Plastic Lumber: Shapes made from high-density polyethylene (HDPE), PVC, polystyrene, or cellular PVC with no cellulose fiber.

1. Shear Parallel to Length: Maximum 6,894 kPa (1,000 psi) in accordance with ASTM D2344/D2344M.

2. Density: ASTM D6111.

3. Compressive Strength:

a. Secant Modulus: Minimum 482,633 kPa (70,000 psi) in accordance with ASTM D6108.

b. Stress at 3 percent strain: Minimum 10,342 kPa (1,500 psi) in accordance with ASTM D6108.

c. Compression Parallel to Grain: Minimum 20,684 kPa (3,000 psi) in accordance with ASTM D6112.

d. Compression Perpendicular to Grain: Minimum 6,894 kPa (1,000 psi) in accordance with ASTM D6112.

4. Flexural Strength: Minimum 13,789 kPa (2,000 psi) in accordance with ASTM D6109.

5. Tensile Strength: Minimum 8618 kPa (1,250 psi) in accordance with ASTM D198.

2.5 ROUGH HARDWARE AND ADHESIVES:

A. Anchor Bolts:

1. ASME B18.2.1 and ASME B18.2.2 galvanized, 13 mm (1/2 inch) unless shown otherwise.
2. Extend at least 203 mm (8 inches) into masonry or concrete with ends bent 50 mm (2 inches).

B. Miscellaneous Bolts: Expansion Bolts: C1D A-A-55615; lag bolt, long enough to extend at least 65 mm (2-1/2 inches) into masonry or concrete. Provide 13 mm (1/2 inch) bolt unless shown otherwise.

C. Washers

1. ASTM F844.
2. Provide zinc or cadmium coated steel or cast iron for washers exposed to weather.

D. Screws:

1. Wood to Wood: ASME B18.6.1 or ASTM C1002.
2. Wood to Steel: ASTM C954, or ASTM C1002.

E. Nails:

1. Size and type best suited for purpose unless noted otherwise. Provide aluminum-alloy nails, plated nails, or zinc-coated nails, for nailing wood work exposed to weather and on roof blocking.
2. ASTM F1667:
   a. Common: Type I, Style 10.
   b. Concrete: Type I, Style 11.
   c. Barbed: Type I, Style 26.
   d. Masonry: Type I, Style 27.
   e. 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 WCD1 for nailing and framing unless specified otherwise.
   2. Space plastic lumber boards to allow for lengthwise expansion and contraction in accordance with manufacturer recommendations.

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:
         1) Joist bearing on sill or girder, toe nail three (3) 8d nails or framing anchor.
         2) Bridging to joist, toe nail each end two (2) 8d nails.
         3) Ledger strip to beam or girder three (3) 16d nails under each joint.

   2. Bolts:
      a. Fit bolt heads and nuts bearing on wood with washers.
      b. Countersink bolt heads flush with the surface of nailers.

c. Embed in concrete and solid masonry or provide expansion bolts. Special bolts or screws designed for anchor to solid masonry or concrete in drilled holes may be used.
d. Provide toggle bolts to hollow masonry or sheet metal.
e. Provide bolts to steel over 2.84 mm (0.112 inch, 11 gage) in thickness. Secure wood nailers to vertical structural steel members with bolts, placed one at ends of nailer and 610 mm (24 inch) intervals between end bolts. Provide clips to beam flanges.

3. Drill Screws to steel less than 2.84 mm (0.112 inch) thick.
   a. ASTM C1002 for steel less than 0.84 mm (0.033 inch) thick.
   b. ASTM C954 for steel over 0.84 mm (0.033 inch) thick.
4. Power actuated drive pins may be provided where practical to anchor to solid masonry, concrete, or steel.
5. Do not anchor to wood plugs or nailing blocks in masonry or concrete. Provide metal plugs, inserts or similar fastening.
6. Screws to Join Wood:
   a. Where shown or option to nails.
   b. ASTM C1002, sized to provide not less than 25 mm (1 inch) penetration into anchorage member.
   c. Spaced same as nails.
7. Install plastic lumber with stainless steel bolts or screws; if nails are used use stainless steel spiral shank or ring shank type.

C. Set sills or plates level in full bed of mortar on masonry or concrete walls.
   1. Space anchor bolts 1219 mm (4 feet) on centers between ends and within 152 mm (6 inches) of end. Stagger bolts from side to side on plates over 178 mm (7 inches) in width.
   2. Provide shims of slate, tile or similar approved material to level wood members resting on concrete or masonry. Do not use wood shims or wedges.
   3. Closely fit, and set to required lines.

D. Cut notch, or bore in accordance with AFPA WCD1 passage of ducts wires, bolts, pipes, conduits and to accommodate other work. Repair or replace miscut, misfit or damaged work.

E. Blocking Nailers, and Furring:
   1. Install furring, blocking, nailers, and grounds where shown.
   2. Provide longest lengths practicable.
   3. Provide fire retardant treated wood blocking where shown at openings and where shown or specified.
   4. Layers of Blocking or Plates:
      a. Stagger end joints between upper and lower pieces.
      b. Nail at ends and not over 610 mm (24 inches) between ends.
      c. Stagger nails from side to side of wood member over 127 mm (5 inches) in width.

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SECTION 07 21 13
THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Thermal insulation.
    a. Board insulation at foundation perimeter.
    b. Batt insulation at framed and furred walls.
    c. Board insulation at masonry cavity walls.
2. Acoustical insulation.
    a. Batt and blanket insulation at interior framed partitions and ceilings.

1.2 RELATED WORK

A. Section 04 20 00, UNIT MASONRY: Insulation for Cavity Face of Masonry.

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.

1.5 DELIVERY

A. Deliver products in manufacturer's original sealed packaging.

B. Mark packaging, legibly. Indicate manufacturer's name or brand, type, production run number, and manufacture date.

C. Before installation, return or dispose of products within distorted, damaged, or opened packaging.

1.6 STORAGE AND HANDLING

A. Store products indoors in dry, weathertight facility.

B. Protect products from damage during handling and construction operations.

C. Protect foam plastic insulation from UV exposure.

1.7 WARRANTY

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

PART 2 - PRODUCTS

2.1 INSULATION - GENERAL

A. Insulation Thickness:

1. Provide thickness required by R-value shown on drawings.
2. Provide thickness indicated when R-value is not shown on drawings.

B. Insulation Types:

1. Provide one insulation type for each application.

2.2 THERMAL INSULATION

A. Perimeter Insulation In Contact with Soil:

1. Polystyrene Board: ASTM C578, Type IV, V, VI, VII, or IX.

B. Exterior Framing or Furring Insulation:

1. Mineral Fiber: ASTM C665, Type II, Class C, Category I where concealed by thermal barrier.
2. Mineral Fiber: ASTM C665, Type III, Class A at other locations.

C. Inside Face of Exterior Wall Insulation:

1. Mineral Fiber Board: ASTM C612, Type IB or II.
2. Perlite Board: ASTM C728.

D. Floor Assemblies Above Unconditioned Spaces:

1. Mineral Fiber Board: ASTM C612, Type IB or Type II.

2. Perlite Board: ASTM C728.
3. Cellular Glass Block: ASTM C552, Type I.

E. Masonry Cavity Wall Insulation:
1. Mineral Fiber Board: ASTM C612, Type II, with vapor retarder facing; maximum permeance 29 ng/Pa/s/sq. m (0.5 perms).
2. Polyurethane or Polyisocyanurate Board: ASTM C591, Type I, with vapor retarder facing; maximum permeance 29 ng/Pa/s/sq. m (0.5 perms).
3. Polystyrene Board: ASTM C578, Type X.
4. Perlite Board: ASTM C728.
5. Cellular Glass Block: ASTM C552, Type I or IV.

2.3 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 unfaced .
a. Density: nominal 4.5 pound.
3. Mineral Fiber Batt or Blankets: ASTM C665 unfaced .
4. Maximum Surface Burning Characteristics: ASTM E84.
a. Flame Spread Rating: 25.
b. Smoke Developed Rating: 450.

2.4 ACCESSORIES

A. Fasteners:
1. Staples or Nails: ASTM F1667, zinc-coated, size and type to suit application.
2. Screws: ASTM C954 or ASTM C1002, size and length to suit application with washer minimum 50 mm (2 inches) diameter.
3. Impaling Pins: Steel pins with head minimum 50 mm (2 inches) diameter.
a. Length: As required to extend beyond insulation and retain cap washer when washer is placed on pin.
b. Adhesive: Type recommended by manufacturer to suit application.

B. Insulation Adhesive: 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 THERMAL INSULATION

A. Perimeter Insulation In Contact with Soil:
   1. Vertical insulation:
      a. Fill joints of insulation with same material used for bonding.
      b. Bond polystyrene board to surfaces with adhesive.
      c. Bond cellular glass insulation to surfaces with hot asphalt or adhesive cement.
   2. Horizontal insulation under concrete floor slab:
      a. Lay insulation boards and blocks horizontally on level, compacted and drained fill.
      b. Extend insulation from foundation walls towards center of building minimum 600 mm (24 inches).
B. Exterior Framing or Furring Insulation:
   1. General:
      a. Open voids are not acceptable.
      b. Pack insulation around door frames and windows, in building expansion joints, door soffits, and other voids.
      c. Pack behind outlets, around pipes, ducts, and services encased in walls.
      d. Hold insulation in place with pressure sensitive tape.
      e. Lap facing flanges together over framing for continuous surface. Seal penetrations through insulation and facings.
   2. Metal Studs: Fasten insulation between metal studs, framing, and furring with pressure sensitive tape continuous along flanged edges.
   3. Wood Studs:
      a. Fasten insulation between wood studs or framing with nails or staples through flanged edges on face of stud.
      b. Space fastenings maximum 150 mm (six inches) apart.
   4. Roof Rafters and Floor Joists: Friction fit insulation between framing to provide minimum 50 mm (2 inch) air space between insulation and roof sheathing and subfloor.

5. Ceilings and Soffits:
    a. Wood Framing:
        1) Fasten blanket insulation between wood framing and joists with nails or staples through flanged edges of insulation.
        2) Space fastenings maximum 150 mm (6 inches) on center.
    b. Metal Framing:
        1) Fasten insulation between metal framing with pressure sensitive tape continuous along flanged edges.
        2) At metal framing and ceilings suspension systems, install insulation above suspended ceilings and metal framing at right angles to main runners and framing.
        3) Tape insulation tightly together without gaps. Cover metal framing members with insulation.
    c. Ceiling Transitions:
        1) In areas where suspended ceilings transition to structural ceiling, install blanket or batt insulation.
        2) Extend insulation from suspended ceiling to underside of structure above.
        3) Secure blanket and batt with continuous cleats to structure above.

C. Inside Face of Exterior Wall Insulation:
1. Location: On interior face of solid masonry and concrete walls, beams, beam soffits, underside of floors, and to face of studs to support interior wall finish where indicated.
2. Bond insulation to solid vertical surfaces with adhesive. Fill joints with adhesive cement.
3. Fasten board insulation to face of studs with screws, nails or staples. Space fastenings maximum 300 mm (12 inches) on center. Stagger fasteners at board joints. Install fasteners at each corner.

D. Masonry Cavity Wall Insulation:
1. Install insulation on exterior faces of concrete and masonry inner wythes of cavity walls.
2. Bond polystyrene board to surfaces with adhesive.
3. Bond polyurethane or polyisocyanurate board, and perlite board to surfaces with adhesive.
4. Bond cellular glass insulation to surfaces with hot asphalt or adhesive cement.
5. Fill insulation joints with same material used for bonding.

3.4 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. 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.

3.5 CLEANING

A. Remove excess adhesive before adhesive sets.

3.6 PROTECTION

A. Protect insulation from construction operations.

B. Repair damage.

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SECTION 07 22 00
ROOF AND DECK INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

B. Roof and deck insulation, substrate board, vapor retarder, and cover board on concrete and metal deck substrates ready to receive roofing or waterproofing membrane.

1.2 RELATED WORK

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

1.3 APPLICABLE PUBLICATIONS

A. Comply with references to extent specified in this section.

B. American Society of Civil Engineers

ASCE 7-16 ..... Minimum Design Loads and Associated Criteria for Buildings and Other Structures

C. American Society of Heating, Refrigeration and Air Conditioning (ASHRAE):

Standard 90.1-13 ..... Energy Standard for Buildings Except Low-Rise Residential Buildings.

D. ASTM International (ASTM):

C208-12(2017)e2 ..... Cellulosic Fiber Insulating Board.

C552-17e1 ..... Cellular Glass Thermal Insulation.

C726-17 ..... Mineral Fiber Roof Insulation Board.

C728-17a ..... Perlite Thermal Insulation Board.

C1177/C1177M-17 ..... Glass Mat Gypsum Substrate for Use as Sheathing.

C1278/C1278M-17 ..... Fiber-Reinforced Gypsum Panel.

C1289-19 ..... Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.

C1396/C1396M-17 ..... Gypsum Board.

D41/D41M-11 (2016) ..... Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.

D312/D312M-16a ..... Asphalt Used in Roofing.

D1970/D1970M-20 ..... Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.

D2178/D2178M-15a ..... Asphalt Glass Felt Used in Roofing and Waterproofing.

D2822/D2822M-05(2011)e1 ..... Asphalt Roof Cement, Asbestos Containing.

D4586/D4586M-07(2018) ..... Asphalt Roof Cement, Asbestos-Free.

E84-20 ..... Surface Burning Characteristics of Building Materials.

F1667-18a ..... Driven Fasteners: Nails, Spikes, and Staples.

E. National Roofing Contractors Association (NRCA):

Manual-15 .....The NRCA Roofing Manual: Membrane Roof Systems-2019.

F. UL LLC (UL):

Listed Online Certifications Directory.

G. U.S. Department of Agriculture (USDA):

USDA BioPreferred Program Catalog.

H. 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 SUBMITTALS

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

B. Submittal Drawings:

1. Show size, configuration, and installation details.
    a. Nailers, cants, and terminations.
    b. Layout of insulation showing slopes, tapers, penetrations, and edge conditions.

C. Manufacturer's Literature and Data:

1. Description of each product.

D. Samples:

1. Roof insulation, each type.
2. Fasteners, each type.

E. Qualifications: Substantiate qualifications meet specifications.

1. Installer.

1.5 QUALITY ASSURANCE

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

1.6 DELIVERY

A. Comply with recommendations of NRCA Manual.

B. Deliver products in manufacturer's original sealed packaging.

C. Mark packaging, legibly. Indicate manufacturer's name or brand, type, and manufacture date.

D. Before installation, return or dispose of products within distorted, damaged, or opened packaging.

1.7 STORAGE AND HANDLING

A. Comply with recommendations of NRCA Manual.

B. Store products indoors in dry, weathertight facility.

C. Protect products from damage during handling and construction operations.

1.8 FIELD CONDITIONS

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

1.9 WARRANTY

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

B. Manufacturer's Warranty: Warrant substrate board, vapor retarder, insulation, and cover board against material and manufacturing defects as part of Division 07 roofing system warranty.

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

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

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

C. Insulation on Metal Decking: UL labeled indicating compliance with one of the following:
   1. UL Listed.
   2. Insulation Surface Burning Characteristics: When tested according to ASTM E84.
      a. Flame Spread Rating: 75 maximum.
      b. Smoke Developed Rating: 150 maximum.

2.2 PRODUCTS - GENERAL

A. Provide each product from one manufacturer.

2.3 ADHESIVES

A. Primer: ASTM D41/D41M.

B. Asphalt: ASTM D312, Type III or IV for vapor retarders and insulation.

C. Modified Asphaltic Insulation Adhesive: Insulation manufacturer's recommended modified asphaltic, asbestos-free, cold-applied adhesive formulated to adhere roof insulation to substrate or to another insulation layer.

D. Bead-Applied Urethane Insulation Adhesive: Insulation manufacturer's recommended bead-applied, low-rise, one- or multicomponent urethane adhesive formulated to adhere roof insulation to substrate or to another insulation layer.

E. Full-Spread Applied Urethane Insulation Adhesive: Insulation manufacturer's recommended spray-applied, low-rise, two-component urethane adhesive formulated to adhere roof insulation to substrate or to another insulation layer.

F. Roof Cement: Asbestos free, ASTM D2822/D2822M, Type I or Type II; or, ASTM D4586/D4586M, Type I or Type II.

2.4 ROOF AND DECK INSULATION

A. Roof and Deck Insulation, General: Preformed roof insulation boards approved by roofing manufacturer.

B. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 1, Grade 2, faced with glass fiber reinforced cellulosic felt facers on both major surfaces of the core foam.

C. Tapered Roof Insulation System:

1. Fabricate of mineral fiberboard, polyisocyanurate, perlite board, or cellular glass. Use only one insulation material for tapered sections. Use only factory-tapered insulation.
2. Cut to provide high and low points with crickets and slopes as shown.
3. Minimum thickness of tapered sections; 38 mm (1-1/2 inch).
4. Minimum slope 1/48 (1/4 inch per 12 inches).

2.5 INSULATION ACCESSORIES

A. Glass (Felt): ASTM D2178/D2178M, Type VI, heavy duty ply sheet.

B. Cants and Tapered Edge Strips:
1. Wood Cant Strips: Refer to Section 06 10 00, ROUGH CARPENTRY.
2. Insulation Cant Strips: ASTM C208, Type II, Grade 1, cellulosic-fiber insulation board.
3. Tapered Edge Strips: 1/12 (1 inch per 12 inches), from 0 mm (0 inches), 300 mm to 450 mm (12 inches to 18 inches) wide.
   a. Cellulosic Fiberboard: ASTM C208.
   b. Mineral Fiberboard: ASTM C726.
   c. Perlite Board: ASTM C728.

C. Vapor Retarder:
1. Self-Adhering Sheet Vapor Retarder: ASTM D1970/D1970M, minimum 1.0 mm (40 mils) thick membrane of HDPE film fully coated with asphalt adhesive, or 0.76 to 1.0 mm (30 to 40 mils) thick membrane of butyl rubber-based adhesive backed by a layer of high density cross-laminated polyethylene; maximum permeance rating of 6 ng/Pa/s/sq. m (0.1 perms).

D. Substrate Board:
1. Glass-Mat, Water-Resistant Gypsum Roof Board: ASTM C1177/C1177M, Type X, 16 mm (5/8 inch) thick, factory primed.

E. Coverboard:
1. Glass-Mat, Water-Resistant Gypsum Roof Board: ASTM C1177/C1177M, 16 mm (5/8 inch) thick, factory primed.

2.6 ACCESSORIES

A. Fasteners: Corrosion-resistant carbon steel fasteners and galvalume-coated steel or plastic round plates for fastening substrate board and insulation to roof deck.

B. Nails: ASTM F1667; type to suit application.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Comply with requirements of Division 07 roofing section.

3.2 PREPARATION

A. Examine and verify substrate suitability for product installation.

B. Protect existing construction and completed work from damage.

3.3 INSTALLATION - GENERAL

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

3.4 SUBSTRATE BOARD INSTALLATION

A. Fasten substrate board to top flanges of steel decking to resist uplift pressures according requirements for specified roofing system.
   1. Locate the long dimension edge joints solidly bearing on top of decking ribs.

3.5 VAPOR RETARDER INSTALLATION

A. Vapor Retarder Installation, General:
   1. Install continuous vapor retarder on roof decks where indicated.
   2. At vertical surfaces, turn up vapor retarder to top of insulation or base flashing.
   3. Seal penetrations through vapor retarder with roof cement to prevent moisture entry from below.

3.6 INSULATION INSTALLATION

A. Insulation Installation, General:
   1. Base Sheet: Where required by roofing system, install one lapped base sheet specified in Division 07 roofing section by mechanically fastening to roofing substrate before installation of insulation.
   2. Cant Strips: Install preformed insulation cant strips or wood cant strips specified in Section 06 10 00 ROUGH CARPENTRY at junctures of roofing system with vertical construction.
B. Insulation Thickness:
   1. Thickness of roof insulation shown on drawings is nominal. Provide thickness required to comply with specified thermal performance.
   2. Insulation on Metal Decks: Provide insulation in minimum thickness recommended by insulation manufacturer to span deck flutes. Support edges of insulation on metal deck ribs.
   3. When actual insulation thickness differs from drawings, coordinate alignment and location of roof drains, flashing, gravel stops, fascias and similar items.
   4. Where tapered insulation is used, maintain insulation thickness at high points and roof edges shown on drawings.
      a. Low Point Thickness: Minimum 38 mm (1-1/2 inches).
   5. Use minimum two layers of insulation when required thickness is 68 mm (2.7 inch) or greater.
C. Lay insulating units with close joints, in regular courses and with end joints staggered.
   1. Stagger joints between layers minimum 150 mm (6 inches).
D. Lay units with long dimension perpendicular to the rolled (longitudinal) direction of the roofing felt.

E. Seal cut edges at penetrations and at edges against blocking with bitumen or roof cement.

F. Cut to fit tightly against blocking or penetrations.

G. Cover all insulation installed on the same day; comply with temporary protection requirements of Division 07 roofing section.

H. Installation Method:

1. Adhered Insulation:
    a. Prime substrate as required.
    b. Set each layer of insulation firmly in solid mopping of hot asphalt.
    c. Set each layer of insulation firmly in ribbons of bead-applied insulation adhesive.
    d. Set each layer of insulation firmly in uniform application of full-spread insulation adhesive.
2. Mechanically Fastened Insulation:
    a. Fasten insulation according to requirements in Division 07 roofing section.
    b. Fasten insulation to resist uplift pressures specified in Division 07 roofing section and ASCE-7.
3. Mechanically Fastened and Adhered Insulation:
    a. Fasten first layer of insulation according to "Mechanically Fastened Insulation" requirements.
    b. Fasten each subsequent layer of insulation according to "Adhered Insulation" requirements.

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SECTION 07 27 27
FLUID-APPLIED MEMBRANE AIR BARRIERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Fluid-applied vapor-retarding air barrier at exterior above grade wall assemblies.
   2. Window and door flashing, air and water-resistive barriers membrane systems.
   3. Connection to adjacent air barrier components providing a durable, continuous, full building air barrier.

1.2 RELATED REQUIREMENTS

A. General Sustainable Construction Requirements: Section 01 81 13 SUSTAINABLE CONSTRUCTION REQUIREMENTS.
B. Commissioning of Building Envelope Components: Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.
C. Masonry Unit Air Barrier Substrates: Section 04 20 00 UNIT MASONRY.
D. Flashing Components of Factory Finished Roofing and Wall Systems Air Barriers Requiring Air Barrier Transitions: Division 07 roofing and wall system sections.
E. Metal Flashing Requiring Air Barrier Transitions: Section 07 60 00 FLASHING AND SHEET METAL.
F. Joint Sealants: Section 07 92 00 JOINT SEALANTS.
G. Exterior Wall Openings Requiring Air Barrier Transitions: Division 08 sections for aluminum-framed entrances and storefronts, glazed aluminum curtain walls, and louvers and vents.
H. Wall Sheathings Air Barrier Substrates: Section 09 29 00 GYPSUM BOARD.

1.3 APPLICABLE PUBLICATIONS

A. Comply with references to extent specified in this section.
B. Air Barrier Association of America (ABAA):
   Quality Assurance Program.
C. ASTM International (ASTM):
   C920-18 ..... Elastomeric Joint Sealants.
   C1193-16 ..... Use of Joint Sealants.
   D412-16 ..... Vulcanized Rubber and Thermoplastic Elastomers-Tension.
   E84-20 ..... Surface Burning Characteristics of Building Materials.
   E96/E96M-16 ..... Water Vapor Transmission of Materials.
   E162-16 ..... Surface Flammability of Materials Using a Radiant Heat Energy Source.
   E783-02(2018) ..... Field Measurement of Air Leakage Through Installed Exterior Windows and Doors.

E1186-17.....Air Leakage Site Detection in Building Envelopes and Air Barrier Systems.

E2178-13.....Air Permanence of Building Materials.

E2357-18.....Determining Air Leakage of Air Barrier Assemblies.

D. U.S. Environmental Protection Agency (EPA):

40 CFR 59, Subpart D National Volatile Organic Compound Emission Standards for Consumer and Commercial Products.

1.4 SUBMITTALS

A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
   1. Indicate size, configuration, and fabrication and installation details.
B. Manufacturer's Literature and Data:
   1. Description of each product.
   2. Installation instructions.
C. Sustainable Construction Submittals:
   1. Low Pollutant-Emitting Materials:
      a. Show volatile organic compound types and quantities.
D. Test reports:
   1. Submit field inspection and test reports.
E. Certificates: 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.
      a. Certify installer approval by air barrier manufacturer.
G. Installation Audit:
   1. Submit audit report.

1.5 QUALITY ASSURANCE

A. Coordinate work with adjacent and related work to provide continuous, unbroken, durable air barrier system.
B. Manufacturer Qualifications:
   1. Regularly and presently manufactures specified products.
   2. Manufactured specified products with satisfactory service on five similar installations for minimum five years.
   3. Accreditation by ABAA.
C. Installer Qualifications:
   1. Regularly and presently installs specified products.
   2. Approved by manufacturer.
   3. Accredited by ABAA.

4. Applicators trained and certified by manufacturer of air barrier system.
5. Full time on-site field supervisor has completed three projects of similar scope within last year.
6. Field Supervisor: Holds Sealant, Waterproofing, and Restoration Institute (SWRI) Wall Coating Validation Program Certificate, or similar qualification acceptable to Contracting Officer's Representative.

D. Testing Agency Qualifications:
1. Accredited by International Accreditation Service, Inc. or American Association for Laboratory Accreditation.
2. Verification of installer's completed SWR Institute's Validated Air Barrier Training and approved to perform work as herein specified by air and water-resistive barrier system manufacturer.
3. Staff experienced in installation of specified system and qualified to perform observation and inspection specified and determine compliance with project requirements.

E. Sole Source:
1. Obtain materials within the scope of this specification from a single manufacturer.
2. Verify materials within this scope of specifications, and adjoining products on the Project, comply with one another and do not restrict the performance of either product.

1.6 DELIVERY

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

1.7 STORAGE AND HANDLING

A. Store products indoors in dry, weathertight, conditioned facility.
B. Protect products from damage during handling and construction operations.

1.8 FIELD CONDITIONS

A. Environment:
1. Work Area Ambient Temperature Range: 4 to 32 degrees C (40 to 90 degrees F) continuously, beginning 48 hours before installation.
2. Perform work only when existing an forecasted weather conditions are within the limits established by the manufacturer of the materials used.

B. Surface Requirements:
1. Visibly dry and complying with manufacturer's instructions.
2. Comply with manufacturer's written instructions for substrate temperature and moisture content and other conditions affecting performance requirements.

C. Ultra-Violet Exposure:

1. Do not expose air barrier materials to sunlight and weather longer than as recommended by the material manufacturer.

1.9 WARRANTY

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

B. Manufacturer's Warranty Requirements:

1. Submit manufacturer's 5-year limited warranty stating:
   a. The products have been tested in accordance with national standards for air and water-resistive barriers and passed those tests with effectiveness and durability indicating their suitability for performance as an air and water-resistive barrier system when properly applied.
   b. The products shall be free from defects in material for a period of five years after the substantial completion of the material application.
   c. That the products will not disintegrate and will maintain their integrity over the life of the warranty.
2. Warranty period: Five (5) years from Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

A. Air-Barrier Assembly Air Leakage: Maximum 0.2 L/s/square meter (0.04 cfm/square feet) of surface area at 75 Pa (1.57 psf) differential pressure when tested according to ASTM E2357.

B. Full Building Air Leakage: Refer to Section 01 45 29 TESTING LABORATORY SERVICES.

C. Provide full system of compatible materials under conditions of service and application required. Compatibility based on testing by material manufacturer.

D. Perform as continuous vapor retarding air barrier and moisture drainage plane.

E. Transition to adjacent flashings and discharge water to building exterior.

F. Accommodate substrate movement and seal expansion and control joints, construction material transitions, opening transitions, penetrations, and perimeter conditions without moisture deterioration and air leakage exceeding performance requirements.

2.2 PRODUCTS - GENERAL

A. Provide air barrier system components from one manufacturer.

B. Sustainable Construction Requirements:

1. Low Pollutant-Emitting Materials: Comply with VOC limits specified in Section 01 81 13 SUSTAINABLE CERTIFICATION REQUIREMENTS for the following products:
   a. Non-Flooring Adhesives and Sealants.

2.3 AIR BARRIER

A. Fluid-Applied, Vapor-Retarding Membrane Air Barrier:

1. Basis of Design, or equivalent: PROSOCO R-Guard Cat 5, Manufactured by PROSOCO, Inc., Lawrence KS, (800) 255-4255, www.prosoco.com

2. Use: Continuous fluid-applied air and water membrane barrier for above-grade use in Exterior Wall and Soffit assemblies.
3. Single Component, Silyl-Terminated-Polymer (STP), fluid applied, waterproofing, air and water barrier membrane of silicone and polyurethane properties. Either sprayed or roller applied to exterior sheathing to produce high durability, seamless, elastomeric waterproofing membrane capable of preventing water and air penetration of building envelope in conditions ranging from every day weather to drenching rains and Category 5 hurricane winds up to 155 mph.
4. Performance Criteria:
    a. Will not shrink, stain, or yellow.
    b. Will not support mold growth.
    c. Hardness, Shore A: 20-25
    d. Tensile Strength: >100 psi
    e. Elongation at Break: >400% (ASTM D412)
    f. Transfer Free Time: 1-2 hours at 73° (23° C), 50% Relative Humidity
    g. Air Permeance: ASTM E2178: 0.02 L/s/square meter (0.004 cfm/square feet) of surface area at 75 Pa (1.57 psf) differential pressure.
    h. Vapor Permeance: ASTM E96/E96M: Maximum 5.8 ng/Pa/s/square meter (0.1 perms).
5. Technical Data:
    a. Air Barrier Association of America (ABAA) Approved.
    b. Form: Viscous Liquid, mild oder; light brown in color.
    c. Specific Gravity, 1.26 to 1.33.
    d. pH: N/A
    e. Weight/Gallon: 10.75 pounds per gallon.
    f. Total Solids: 99%
    g. Flash Point: >200°F (>93° C)
    h. VOC Content: <30 grams/liter. Complies with all known national, state and district AIM VOC regulations.
6. Surface Burning Characteristics: When tested according to ASTM E84S.
    a. Flame Spread Rating: 25 maximum.
    b. Smoke Developed Rating: 450 maximum.

B. Fluid-Applied Air and Water-Resistive Barrier for Stucco.
1. Basis of Design, or equivalent: PROSOCO R-Guard Cat 5, manufactured by PROSOCO INC., Lawrence, KS, (800) 255-4255, www.prosoco.com
2. Use: Continuous fluid-applied air and water membrane barrier in Stucco wall and soffit assemblies.

3. Single component, Silyl-Terminated-Polymer (STP), fluid-applied, waterproofing, air and water barrier membrane of silicone and polyurethane properties. Either sprayed or roller applied to exterior sheathing to produce high durability, seamless, elastomeric waterproofing membrane capable of preventing water and air penetration of building envelope in conditions ranging from everyday weather to drenching rains and Category 5 hurricane winds up to 155 mph.
4. Performance Criteria:
    a. Will not shrink, stain, or yellow.
    b. Will not support mold growth.
    c. Hardness, Shore A: 20-25
    d. Tensile Strength: >100 psi
    e. Elongation at Break: >400% (ASTM D412)
    f. Transfer Free Time: 1-2 hours at 73°F (23°C), 50% Relative Humidity.
5. Technical Data:
    a. Air Barrier Association of America (ABAA) approved.
    b. Form: Viscous liquid, mild odor, light brown color.
    c. Specific Gravity: 1.26 to 1.3.
    d. pH: Not Applicable.
    e. Weight/Gallon: 10.75 pounds per gallon.
    f. Total Solids: 99%
    g. Flash Point: >200°F (93°C)
    h. VOC Content: <30 grams/liter. Complies with all known national, state, and local AIM VOC regulations.
6. Limitations:
    a. Not for use as liquid flashing membrane.
    b. Not for use with Insulated Concrete Forms.
    c. Not for use in place of appropriate through-wall flashing.
    d. Not for use below grade or in locations which are continuously immersed in water.

C. Fluid-Applied Membrane Flashing
1. Basis of Design, or equivalent: PROSOCO R-Guard FastFlash, Manufactured by PROSOCO. Inc., Lawrence, KS, (800) 255-4255, www.prosoco.com
2. Use: Continuous fluid-applied rough opening membrane flashing, as required by code, at all window, door, and louver openings on building exterior envelope.
3. Single component, Silyl-Terminated-Polymer (STP), waterproofing, adhesive and detailing compound used as a liquid flashing membrane for same day installation of windows, doors, other wall assemblies, or waterproofing, or air barrier components. Continuous Fluid-Applied

Membrane to produce a highly durable, seamless, elastomeric flashing membrane appropriate for vertical or horizontal, above-grade applications.

4. Performance Criteria
   a. Will not shrink, stain, or yellow.
   b. Will not support mold growth.
   c. Hardness, Shore A: 35-45
   d. Tensile Strength: >150 psi
   e. Elongation at Break: 350% ASTM D412
   f. Water Vapor Transmission: 21 perms ASTM E96
   g. Corrosive Properties: Non-Corrosive
5. Technical Data:
6. Form: Viscous Paste, Mild Odor, Red Color
7. Specific Gravity: 1.40 to 1.55
8. pH: N/A
9. Weight/Gallon: 11.75 to 12.5 pounds per gallon
10. Total Solids: 99%
11. Flash Point: >200° F (>93° C)
12. Freeze Point: N/A
13. VOC Content: <30 grams/liter. Complies with a all known national, state, and district AIM VOC regulations.

2.4 ACCESSORIES

A. Joint and Seam Filler:
   1. Basis of Design, or equivalent: PROSOCO R-Guard Joint and Seam Filler, manufactured by PROSOCO. Inc., Lawrence, KS. (800) 255-4255. www.prosoco.com
   2. Use: To be used in combination, as needed, with fluid-applied flashing membranes, waterproofing, or air barrier components, to fill openings and create transitions where flexible reinforcement is required to bridge larger gaps and provide continuous support.
   3. Single component, fiber-reinforced Silyl-Terminated-Polymer (STP) gun-grade detailing compound suitable for all climates and appropriate for vertical or horizontal above-grade applications to concrete, structural sheathing, architectural metals, painted metals, glass, PVC, and most other building materials.
   4. Performance Criteria:
      a. Will not shrink, stain, or yellow.
      b. Will not support mold growth.
      c. Hardness, Shore A: 40-50
      d. Tensile Strength: >70 psi
      e. Elongation at Break: >180& ASTM D412

f. Water Vapor Transmission: 19 perms @20 mils ASTM E96
g. Corrosive Properties: Non-Corrosive

5. Technical Data:
   a. Form: Viscous paste, mild odor, pale red
   b. Specific gravity: 1.4 to 1.5
   c. pH: N/A
   d. Weight/Gallon: 11.8 pounds per gallon.
   e. Total Solids: 99%
   f. VOC Content: <30 grams/liters. Complies with all known national, state, and district AIM VOC regulations.
6. Limitations:
   a. Not for use as a liquid flashing membrane.
   b. Not for use in a place of appropriate through-wall flashing.
   c. Not for use below grade or in locations which are continuously immersed in water.

B. Extruded, Elastomeric Silicone Material
1. Bases of Design, or Equivalent: PROSOCO R-Guard Surespan EX, manufactured by PROSOCO Inc., Lawrence, KS. (800) 255-4255. www.prosoco.com
2. Use: As needed, in combination with joint and seam filler and continuous fluid-applied membrane flashing to help create flexible and durable transitions between various types of air and water barriers, curtainwalls, storefronts, and windows being installed.
3. Extruded, elastomeric, pre-cured silicone material designed for high movement, dynamic joints too large for joint and seam filler.
4. Adhesive:
   a. Bases of Design, or equivalent: PROSOCO R-Guard Surespan Adhesive, manufactured by PROSOCO Inc., Lawrence, KS. (800) 255-4255. www.prosoco.com
   b. Use: Adhere and seal extruded, elastomeric silicone material, as needed, as part of whole building envelope water and air barrier system.
   c. Single-Component, Silyl-Terminated-Polymer (STP) silicone and polyurethane adhesive suitable for all-climate and bondable directly to damp and dry surfaces.

PART 3 - EXECUTION

3.1 PREPARATION

A. Examine conditions for compliance with system manufacturer’s requirements for installation, and other specific conditions affecting performance of air barrier system.
B. All surfaces must be sound, clean and free of surface oxidation, grease, dirt, excess mortar or other contaminants detrimental to application. Fill or bridge damaged surfaces, voids or gaps larger than one inch. Fill voids and gaps measuring one inch or less with liquid applied fill coat and seam filler as necessary to ensure continuity.

1. Surfaces to receive primary fluid applied air and water barrier must be dry or damp, unless approved by air barrier manufacturer. Surfaces to receive (STP) fluid applied accessories must be dry, damp or wet to the touch. Brush away any standing water present before application. STP products will tolerate rain immediately after application.

C. Refer to manufacturer's product data sheets for requirements for condition of and preparation of substrates.
   1. Surfaces shall be sound an free of voids, spalled areas, loose aggregates, and sharp protrusions.
   2. Remove contaminants such as grease, oil, and wax from exposed surfaces.
   3. Remove dust, dirt, loose stone and debris.
   4. Use repair materials and methods that are acceptable to manufacturer of air and water-resistive barrier system.
   5. Refer to manufacturer's product data sheets and manufacturer's installation guidelines for additional information on preparing structural walls to receive the primary air and water resistive barrier.

D. Exterior Sheathing:
   1. Ensure that sheathing is properly installed with ends, corners and edges properly fastened. Remove and replace damaged sheathing.
   2. Mechanical fasteners used to secure sheathing boards or penetrate sheathing boards shall be set flush with sheathing, and spot overdriven fasteners with liquid applied fill coat and seam filler.
   3. Seal the cut edges of gypsum wall boards with exposed in rough openings for windows and doors at corners, as recommended by manufacturer.

E. Masonry and concrete substrates:
   1. Masonry head and bed joints should be fully filled and tooled.
   2. Mechanically remove loose mortar fins, mortar accumulations and protrusions, and debris.
   3. Fill cracks, joints and gaps with liquid applied fill coat and seam filler as herein specified.

3.2 INSTALLATION –

A. Fluid-applied air & water-resistive barrier
   1. Install products according to manufacturer's instructions and approved submittals drawings.
      a. When manufacturer's instructions deviate from specifications, submit proposed resolution for Contracting Officer's Representative consideration.
   2. Apply air and water-restive barrier to a clean and dry substrate within temperature and weather limitations per manufacturer's written instructions.
   3. Do not dilute or alter mix, unless specified by product manufacturer.
   4. Stir, as required by product manufacturer.
   5. Back roll as necessary to ensure no pinholes, voids, or gaps in the membrane.

6. Install air barrier components according to requirements of ABAA Quality Assurance Program.
7. Install transition strips and accessory materials.
8. Seal air barrier to adjacent components of building air barrier system.
9. Install flexible opening transition at each opening perimeter. Extend transition onto each substrate minimum 75 mm (3 inches).
    a. Fill gaps at perimeter of openings with foam sealant.
10. At penetrations, seal transition strips around penetrating objects with termination mastic.
    a. Fill gaps at perimeter of penetrations with sprayed polyurethane foam sealant.
11. At top of through-wall flashings, seal with continuous transition strip of manufacturer's recommended material to suit application.
12. Apply air barrier in full contact with substrate to produce continuous seal with transitions.
13. Apply fluid membrane in thickness recommended by manufacturer, and minimum specified thickness.
14. Leave air barrier exposed until tested and inspected and tested by Contracting Officer’s Representative.

B. Liquid-Applied Flashing at Windows, Doors, Louvers, Openings, and Penetrations.
    1. General: Comply with weather and air barrier manufacturer’s installation instructions, temperature limitations, product data, and shop drawings.
    2. Apply liquid flashing membrane over surfaces to seal and waterproof rough openings per manufacturer’s written instructions. Spread the wet product to create an opaque, monolithic flashing membrane which surrounds the rough opening and extend 4 to 6 inches over the face of the structural wall. Apply additional coats as needed to achieve void and pinhole free surfaces.

C. Fiber Reinforced Fill Coat and Seam Filler
    1. General: Comply with weather and air barrier manufacturer’s installation instructions, temperature limitations, product data, and shop drawings.
    2. Apply liquid applied fill coat and seam filler for seams, joints, cracks, gaps, primed rough gypsum edges at sheathing, rough openings per manufacturer’s written instructions
        a. Do not dilute or alter mix, unless specified to by product manufacturer.
        b. Stir, as required by product manufacturer.

3.3 FLUID-APPLIUED FLASHING TRANSITIONS

A. General: Comply with weather and air barrier manufacturer’s installation instructions, temperature limitations, product data, and shop drawings.

B. Apply fiber reinforced fill coat and seam filler and liquid flashing membrane as liquid flashing membrane to waterproof the transitions in rough opening and between dissimilar materials per manufacturer’s written instructions.

1. Fill any voids between the top of the flashing leg and the vertical wall with fiber reinforced fill coat and seam filler.
2. Spread the wet liquid flashing membrane to create a monolithic “cap-flash” flashing membrane per manufacturer’s written instructions.
3. Apply additional coats as needed to achieve void and pinhole-free surface.
4. Allow treated surfaces to skin before installing other wall assembly, waterproofing, or air barrier components.

C. Apply preformed silicone sealant extrusion to provide a continuous airtight and water-tight seal between material frame and substrate per manufacturer’s written instructions.
   1. Embed material in bead of liquid flashing membrane per manufacturer’s written instructions.

3.4 FIELD QUALITY CONTROL

A. Field Inspections and Tests: Performed by testing laboratory specified in Section 01 45 29, TESTING LABORATORY SERVICES.
   1. Perform inspections and tests before concealing air barrier with subsequent work.
B. Inspections:
   1. Compatibility of materials within air barrier system and adjacent materials.
   2. Suitability of substrate and support for air barrier.
   3. Suitability of conditions under which air barrier is applied.
   4. Adequacy of substrate priming.
   5. Application and treatment of joints and edges of transition strips, flexible opening transitions, and accessory materials.
   6. Continuity and gap-free installation of air barrier, transition strips, and accessory materials.
C. Field Tests:
   1. Qualitative air-leakage testing according to ASTM E1186.
   2. Quantitative air-leakage testing according to ASTM E783.
D. Inspection and Test Frequency: Determined by installed air barrier surface area.
   1. Up to 900 square meter (10,000 square feet): One inspection.
   2. 901 - 3,300 square meter (10,001 - 35,000 square feet): Two inspections.
   3. 3,300 - 7,000 square meter (35,001 - 75,000 square feet): Three inspections.
   4. 7,001 - 11,600 square meter (75,001 - 125,000 square feet): Four inspections.
   5. 11,601 - 19,000 square meter (125,001 - 200,000 square feet): Five inspections.
   6. Over 19,000 square meter (200,000 square feet): Six inspections.
E. Submit inspection and test reports to Contracting Officer’s Representative within seven calendar days of completing inspection and test.
F. Audit:
   1. Provide installer and site inspection audit by ABAA.
   2. Coordinate scheduling of work and associated audit inspections.

3. Cooperate with ABAA's testing agency. Allow access to work and staging areas.
4. Notify ABAA in writing of schedule for Work of this Section to allow sufficient time for testing and inspection.
5. Pay for site inspections by ABAA to verify conformance with the ABAA Quality Assurance Program.

G. Defective Work: Correct deficiencies, make necessary repairs, and retest as required to demonstrate compliance with specified requirements.

3.5 CLEANING

A. Remove masking materials.

B. Clean spills and overspray using cleaning agents recommended by manufacturers of affected construction.

3.6 PROTECTION

A. Protect air barrier from construction operations.

B. Protect air barrier from exposure to UV light exposure exceeding manufacturer's recommendation.

C. Replace overexposed materials and retest.

- - E N D - -

SECTION 07 40 00
METAL SOFFIT PANELS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies uninsulated, vented metal soffit panels as shown on contract documents.

1.2 RELATED WORK

A. Section 07 92 00, JOINT SEALANTS: Sealant.

1.3 QUALITY ASSURANCE

A. Manufacturer’s Qualifications: Provide metal soffit panels products of a manufacturer regularly engaged for not less than five (5) years in the fabrication of metal panels of the type and design indicated.

B. Installer: A firm with three (3) years of successful experience with installation of roofing and siding panels of type and scope equivalent to Work of this Section. Submit installer qualifications.

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. Postconsumer recycled content as specified in PART 2 - PRODUCTS.

C. Samples: Metal panel, 152 mm (6 inch) square, showing finish, each color and texture.

D. Shop Drawings: Soffit panels, showing details of construction and installation. Collateral steel framing thickness and kind of material, closures, flashing, fastenings and related components and accessories. Show interfaces and relationships to work at other trades and continuity with adjacent thermal, weather, air and vapor barriers.

E. Manufacturer's Literature and Data: Soffit panels

F. Manufacturer’s Certificates: Indicating manufacturer’s qualifications specified.

G. Installer qualifications.

H. Manufacturer warranty.

1.5 QUALITY ASSURANCE

A. Approval by Contracting Officer Representative (COR) is required of products of proposed manufacturer.

B. Certify manufacturer has five (5) years continuous documented experience in fabrication of metal roofing and siding panels.

C. Source: For each material type required for work of this section, provide primary materials, which are products of one manufacturer. Provide secondary or accessory materials, which are acceptable to manufacturers of primary materials.

D. Installer: A firm with a minimum of three (3) years' experience in type of work required by this section and which is acceptable to manufacturers of primary materials.

E. Regulatory Code Agencies Requirements: Provide metal soffit system which have been evaluated and is in compliance with the following:
   1. International Code Council (ICC)
   2. Miami/Dade County Florida (Notice of Acceptance)
   3. State of Florida (Florida Product Approval)

F. Delegated Design Engineer Qualifications: A professional engineer licensed to practice in the State of Florida where Project is located and who is experienced in providing engineering services of the type indicated.

1.6 WARRANTY

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

B. Manufacturer Warranty: Manufacturer shall warranty their metal soffit panels for a minimum of ten (10) years from the date of installation and final acceptance by the Government. Submit manufacturer warranty.

C. Warranty on Panel Finishes: Manufacturer's shall warrant their soffit panel finish and provide standard agreement to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
      a. Color fading more than 5 Hunter units when tested according to ASTM D2244.
      b. Chalking in excess of a No. 8 rating when testing according to ASTM D4214.
      c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
   2. Finish Warranty Period: 10 years from date of installation and final acceptance by the COR.

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 Architecture Manufacturers Association (AAMA):

611-14 ..... Anodized Architectural Aluminum

621-02 ..... Voluntary Specifications for High Performance Organic Coatings on Coil Coated Architectural Hot Dipped Galvanized (HDG) and Zinc-Aluminum Coated Steel Substrates

2605-13 ..... Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels

C. American Iron and Steel Institute (AISI):

SG03-02 ..... Cold-Formed Steel Design Manual

D. ASTM International (ASTM):

A463/A463M-15..... Steel Sheet, Cold-Rolled, Aluminum-Coated, by the Hot-Dip Process

A653/A653M-20..... Steel Sheet, Zinc-Coated (Galvanized), or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

A924/A924M-19..... Steel Sheet, Metallic Coated by the Hot-Dip Process

A1008/A1008M-18..... Steel, Sheet, Cold-Rolled, Carbon, Structural, High Strength Low Alloy

B209-14 ..... Aluminum and Aluminum Alloy Sheet and Plate

B209M-14 ..... Aluminum and Aluminum Alloy Sheet and Plate (Metric)

D2244-16..... Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates

D4214-07(2015) ..... Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films

E119-20 ..... Fire Test of Building Construction and Materials

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS FOR SOFFIT PANELS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014500 "Quality Requirements," to design soffit panel system.

B. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592.

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: All MCM products shall carry Florida Product Approvals (FPAs).
3. Minimum Panel rib depth: 3/8”.
4. Panel width: 12 inches.

2.2 METAL SOFFIT PANELS

A. General: Provide factory-formed, vented metal soffit panels designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.MCM Panel Materials:

B. Metal Soffit Panels: Vented panels formed with vertical panel edges and intermediate stiffening ribs symmetrically spaced between panel edges.

1. Material: .032 inches aluminum.
2. Panel Coverage: 12 inches (305) mm.
3. Height: 3/8 inches
4. Texture: Smooth

2.3 MANUFACTURER

A. Metal Vented Soffit Panel System.
   1. Basis of Design: Subject to compliance with requirements, ATAS International, Inc., "Wind-Lok Soffit" – MPV120 or comparable product by one of the following or approved equal:
      a. Berridge.
      b. PAC-CLAD

2.4 ALUMINUM PLATE AND SHEET

A. ASTM B209M (B209).

2.5 FASTENERS

A. Fasteners for Aluminum Panels to be aluminum or stainless steel.
B. Fasteners of size, type and holding strength as recommended by panel manufacturer.

2.6 FABRICATION

A. General:
   1. Provide panels for full depth of soffit with no horizontal joints, except at cut-outs or openings as required for the passage of pipes, conduits, vents, exposed support steel, and the like.
   2. Overall thickness of panels is shown in the contract documents.
   3. Provide connection between panels by interlocking male and female joints..
   4. Provide collateral steel framing, metal and bituminous closures, fastenings, flashing, clip, caulking, and related components and accessories.
      a. Sub-girts: 1.0 mm (0.0396 inches) thick galvanized steel hat channels designed to receive panel fasteners or clips.
      b. Accessories, fastenings, and flashings to be the same material and finish as the panels. Thickness and installation of accessories and flashing to be as recommended by the panel manufacturer.

2.7 FINISH

A. For vented soffit panels, provide finishes as follows for face sheets. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
B. Provide aluminum alloy for color coating as required to produce specified color. Color for sheet aluminum to not deviate more than the colors of extrusion samples.
   1. Three-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish coating not less than 70 percent PVDF resin by weight in both color coat and clear topcoat.
      a. Color to be selected from manufacturer's full range of standard colors.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install panels in accordance with the manufacturer's approved erection instructions and diagrams, except as specified otherwise.

B. Install panels in full and firm contact with supports and with each other at side and end laps.
C. Where panels are cut in the field, or where factory applied coverings or coatings are abraded or damaged in handling or installation, make finish repairs with material of the same type and color as the weather coating, before being installed.
D. Seal cut ends and edges, including those at openings through the sheets.
E. Correct defects or errors in the materials in a manner approved by the COR.
F. Replace defective materials which cannot be corrected with non-defective material.
G. Provide molded closure strips where indicated and whenever sheets terminate with open ends after installation.
H. Soffit Panels:
    1. Apply panels with the joint configuration perpendicular to soffit depth. Install panels perpendicular to support framing above.
    2. Seal side and end laps with joint sealing material.
    3. Flash and seal soffit panels around perimeter andat other similar openings and penetrations. Install closure strips, flashings, and sealing material in an approved manner that will assure complete weather tightness.
I. Flashing:
    1. Provide flashing and related closures and accessories in connection with the preformed metal panels as indicated and as necessary to provide a watertight installation.
    2. Install details of installation, which are not indicated, in accordance with the panel manufacturer's printed instruction and details, or the approved shop drawings.
    3. Allow for expansion and contraction of flashing.
J. Fasteners:
    1. Space fasteners in accordance with the manufacturer's recommendations, and as necessary to withstand the design loads indicated.
    2. Install fasteners in valleys or crowns as recommended by the manufacturer of the panel being used.
    3. Install fasteners in straight lines within a tolerance of 13 mm (1/2-inch) in the length of a bay.
    4. Drive exposed penetrating type fasteners normal to the surface, and to a uniform depth to seat gasketed washers properly, and drive so as not to damage factory applied coating.
    5. Exercise care in drilling pilot holes for fastenings to keep drills perpendicular and centered in valleys, or crowns, as applicable. After drilling, remove metal filings and burrs from holes prior to installing fasteners and washers. Do not torque fasteners to exceed values recommended by the manufacturer.
    6. Remove panels deformed or otherwise damaged by over-torqued fastenings, and provide new panels.

7. Remove metal shavings and filings from roofs on completion to prevent rusting and discoloration of the panels.

3.2 ISOLATION OF ALUMINUM

A. Isolate aluminum in contact with or fastened to dissimilar metals other than stainless steel, white bronze, or other metal compatible with aluminum by one of the following:
   1. Painting the dissimilar metal with a prime coat of Zinc-Molybdate followed by two coats of aluminum paint.
   2. Placing a non-abrasive tape or gasket between the aluminum and the dissimilar metal.

B. Paint aluminum in contact with, or built into mortar, concrete, plaster, or other masonry materials with a coat of alkali-resistant bituminous paint.

C. Paint aluminum in contact with wood or other absorptive materials that may become repeatedly wet, with two coats of bituminous paint, or two coats of aluminum paint. Seal joints with caulking material.

3.3 PROTECTION AND CLEANING

A. Protect panels and other components from damage during and after erection, and until project is accepted by the COR.

B. After completion of work, all exposed finished surfaces of panels are to be cleaned of soil, discoloration and disfiguration. Touch-up abraded surfaces of panels.

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SECTION 07 54 16
ETHYLENE INTERPOLYMER (KEE) ROOFING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies Ethylene Interpolymer (ketone ethylene ester (KEE)) sheet roofing fully adhered and mechanically fastened to roof deck.

1.2 RELATED WORK

A. Section 06 10 00, ROUGH CARPENTRY: Treated wood framing, blocking, and nailers.

B. Section 07 22 00, ROOF AND DECK INSULATION: Roof Insulation.

C. Section 07 60 00, FLASHING AND SHEET METAL: Sheet Metal Components and Wind Uplift Requirements for Roof-Edge Design.

D. Miscellaneous Items:

1. Section 07 71 00, ROOF SPECIALTIES.

1.3 PERFORMANCE REQUIREMENTS

A. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by membrane roofing manufacturer, based on testing and field experience.

B. Roofing System Energy Performance Requirements: Provide a roofing system identical to components that have been successfully tested by a qualified independent testing and inspecting agency to meet the following requirements:

1. Energy Performance, Energy Star: Provide roofing system that is listed on DOE's ENERGY STAR "Roof Products Qualified Product List" for low-slope roof products.
2. Solar Reflectance Index: Not less than 78 when calculated according to ASTM E1980 based on testing identical products by a qualified testing agency.
3. Energy Performance, Aged: Provide roofing system with minimum three-year-aged solar reflectance not less than 0.55 when tested in accordance with ASTM C1549 or ASTM E1918, and in addition, a minimum three-year-aged thermal emittance of 0.75 when tested in accordance with ASTM C1371 or ASTM E408.
    a. Where tested aged values are not available for proposed product, submit calculations to adjust initial solar reflectance to demonstrate compliance as indicated in ASHRAE 90.1-2013 Addendum F.
    b. Alternatively, provide roofing system with minimum three-year aged Solar Reflectance Index of not less than 64 when determined in accordance with the Solar Reflectance Index method in ASTM E1980 using a convection coefficient of 12 W/m2K (2.1 BTU/h-ft2).

C. Roofing System Physical Properties Requirements, as tested in accordance with ASTM D751, or listed ASTM reference.

1. Breaking strength: 520 lbs/ft, min.
2. Tear Strength: 150 lbs/ft, min.
3. Elongation at Break: 20% elongation before break, min.
4. Linear Dimension Change, as tested in accordance with ASTM D1204: .06% Max.
5. Change is Weight After Exposure in Water, as tested in accordance with ASTM D471: .07%, max.
6. Seam Strength; 800 lbs/ft, min.
7. Static Puncture Resistance, as tested in accordance with ASTM D5602: Pass
8. Dynamic Impact/ Puncture Resistance, as tested in accordance with ASTM 5635: 30 min, min.

D. Roofing system design standard requirements:
1. Recommendations of the NRCA applicable to sheet roofing for storage, handling and application.
2. Recommendations of FM Approvals 1-49 Loss Prevention Data Sheet for Perimeter Flashings.
3. Recommendations of ANSI/SPRI ES-1 for roof edge design.
4. Roofing System Design: Provide roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE 7. Provide design loads: as indicated on Structural Drawings.
5. FM Approvals Listing: Provide roofing membrane, base flashing, and component materials that comply with requirements in FM Approvals 4450 and FM Approvals 4470 as part of a roofing system and that are listed in FM Approvals "RoofNav" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals markings.
   a. Fire/Windstorm Classification: Class 1A-120.
   b. Hail Resistance: SH.
6. High Wind Zone Design Requirement: Contractor Option: In lieu of FM Approval Listing windstorm classification, provide roofing membrane, base flashing, and component materials that comply with Miami-Dade County requirements.

1.4 QUALITY ASSURANCE

A. Installer Qualifications:
1. A firm with a minimum of three (3) years' experience in type of work required by this section.
2. A firm licensed or approved in writing by manufacturer to perform work under warranty requirements of this Section.
3. Employ full-time supervisors who have worked on roofing projects of similar types and scopes for a minimum of three (3) years.

B. Inspector Qualifications: Inspection of work by inspector or manufacturer technical representative experienced in the installation and maintenance of the specified roofing system who is, qualified

to perform roofing observation and inspection specified in Field Quality Control Article. Inspector is to determine Installer's compliance with the requirements of this Project, and be approved by the manufacturer to issue warranty certification. The Roofing Inspector to be one of the following:

1. An authorized full-time technical employee of the manufacturer, not engaged in the sale of products.
2. An independent party certified as a Registered Roof Observer by the Roof Consultants Institute (RCI), retained by the Contractor or the Manufacturer and approved by the Manufacturer.

C. Product/Material Requirements:
   1. Obtain products from single manufacturer or from sources recommended by manufacturer for use with roofing system and incorporated in manufacturer's warranty.

D. Pre-Roofing Meeting:
   1. Upon completion of roof deck installation and prior to roofing application, hold a pre-roofing meeting arranged by the Contractor and attended by the Roofing Inspector, Material Manufacturers' Technical Representative, Roofing Applicator, Contractor, and Contracting Officer Representative (COR).
   2. Discuss specific expectations and responsibilities, construction procedures, specification requirements, application, environmental conditions, job and surface readiness, material storage, and protection.
   3. Inspect roof deck at this time to:
      a. Verify that work of other trades which penetrates roof deck is completed.
      b. Determine adequacy of deck anchorage, presence of foreign material, moisture and unlevel surfaces, or other conditions that would prevent application of roofing system from commencing or cause a roof failure.
      c. Examine samples and installation instructions of manufacturer.

1.5 SUBMITTALS

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

B. Product Data:
   1. Primer.
   2. Adhesive materials.
   3. Membrane sheet roofing and flashing membrane.
   4. Roofing cement.
   5. Roof walkway.
   6. Fastening requirements.
   7. Application instructions.

C. Shop Drawings: Include plans, sections, details, and attachments.
   1. Base flashings and terminations.

D. Certificates:
   1. Indicating materials and method of application of roofing system meets requirements of FM Approvals "RoofNav" for specified fire/windstorm classification.
   2. Indicating compliance with Miami-Dade County requirements.
   3. Indicating compliance with energy performance requirement.
E. Warranty: As specified.
F. Quality Assurance Submittals:
   1. Installer qualifications.
   2. Inspector qualifications.
G. Field reports of roofing inspector.
H. Temporary protection plan. Include list of proposed temporary materials.
I. Test reports.
J. Contract Close-out Submittals:
   1. Maintenance Manuals.
   2. Warranty signed by installer and manufacturer.

1.6 DELIVERY, STORAGE AND HANDLING

A. Comply with the recommendations of the NRCA applicable to single ply membrane roofing for storage, handling and 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. Provide protection of interior spaces in accordance with Section 01 00 00, GENERAL REQUIREMENTS.

1.8 WARRANTY

A. Construction Warranty: Comply with FAR clause 52.246-21 “Warranty of Construction”.
B. Manufacturer Warranty: Manufacturer shall warranty their ethylene interpolymer (KEE) roofing system for a minimum of ten (10) years from the date of installation and final acceptance by the Government. Submit manufacturer warranty.

1.9 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only. Editions of applicable publications current on date of issue of bidding documents apply unless otherwise indicated.
B. American National Standards Institute/Single-Ply Roofing Institute (ANSI/SPRI):
   ANSI/SPRI ES-1-03 .....Wind Design Standards for Edge Systems Used with Low Slope Roofing Systems
C. American Society of Civil Engineers (ASCE):

ASCE 7-16 ..... Minimum Design Loads for Buildings and Other Structures

D. ASTM International (ASTM):

C67-20 ..... Test Methods for Sampling and Testing Brick and Structural Clay Tile

C140/C140M-20a ..... Test Methods for Sampling and Testing Concrete Masonry Units and Related Units

C1371-04a(R2011)e1 ..... Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers

C1549-16 ..... Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer

D4263-83(2018) ..... Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method

D4434/D4434M-15 ..... Poly (Vinyl Chloride) Sheet Roofing

D6754/D6754M-15 ..... Ketone Ethylene Ester Based Sheet Roofing

E108-20a ..... Test Methods for Fire Tests of Roof Coverings

E408-13 ..... Test Methods for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques

E1918-16 ..... Test Method for Measuring Solar Reflectance of Horizontal and Low-Sloped Surfaces in the Field

E1980-11(2019) ..... Test Method for Measuring Solar Reflectance of Horizontal and Low-Sloped Surfaces in the Field

E. American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE)

ASHRAE 90.1-2013 ..... Energy Standard for Buildings Except Low-Rise Residential Buildings, Appendix f.

F. Cool Roof Rating Council:

CRRC-1-20 ..... Product Rating Program, www.coolroofs.org

G. FM Approvals:

RoofNav ..... Approved Roofing Assemblies and Products.

4450-89 ..... Approved Standard for Class 1 Insulated Steel Deck Roofs

4470-12 ..... Single-Ply, Polymer-Modified Bitumen Sheet, Built-Up Roof (BUR) and Liquid Applied Roof Assemblies for use in Class 1 and Noncombustible Roof Deck Construction

1-28-20 ..... Loss Prevention Data Sheet: Design Wind Loads.

1-29-20 ..... Loss Prevention Data Sheet: Above-Deck Roof Components

1-49-20 ..... Loss Prevention Data Sheet: Perimeter Flashing

H. National Roofing Contractors Association (NRCA):

Roofing and Waterproofing Manual

I. U.S. Department of Energy (DoE):
Roof Products Qualified Product List, www.energystar.gov

J. Environmental Protection Agency (EPA):
40 CFR 59(2014) .....National Volatile Organic Compound Emission Standards for Consumer and Commercial Products

PART 2 - PRODUCTS

2.1 KEE MEMBRANE ROOFING

A. KEE Sheet: ASTM D6754/D6754M, fabric reinforced, 1.5 mm (60 mils)thick, with no backing.
   1. Basis of Design:
      a. Manufacturer: Tremco
      b. Product: TremPly KEE Single Ply System
      c. Color: White

2.2 ACCESSORIES

A. Sheet Flashing: Manufacturer's standard sheet flashing of same material, type, reinforcement, thickness, and color as KEE sheet membrane.

B. Bonding Adhesive: Manufacturer's standard, water based.

C. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 25 by 3 mm (1 by 1/8 inch) thick; with anchors.

D. Metal Battens: Manufacturer's standard, aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 25 mm wide by 13 mm (1 inch wide by 0.05 inch) thick, prepunched.

E. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with FM Approvals 4470, designed for fastening membrane to substrate.

F. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resistant, surface-textured walkway pads or rolls, approximately 5 mm (3/16 inch) thick, and acceptable to membrane roofing system manufacturer.

G. Miscellaneous Accessories: Provide primer, sealers, preformed flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories acceptable to manufacturer.

2.3 ADHESIVE AND SEALANT MATERIALS

A. General: 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.
   1. Liquid-type auxiliary materials to comply with VOC limits of authorities having jurisdiction.
   2. Adhesives and sealants that are not on the exterior side of weather barrier to comply with the following limits for VOC content when calculated according to 40 CFR 59, (EPA Method 24):
      a. Plastic Foam Adhesives: 50 gram/liter.
      b. Gypsum Board and Panel Adhesives: 50 gram/liter.

c. Multipurpose Construction Adhesives: 70 gram/liter.
d. Fiberglass Adhesives: 80 gram/liter.
e. Single-Ply Roof Membrane Adhesives: 250 gram/liter.
f. Other Adhesives: 250 gram/\liter.
g. PVC Welding Compounds: 510 gram/liter.
h. Adhesive Primer for Plastic: 650 gram/liter
i. Single-Ply Roof Membrane Sealants: 450 gram/liter.
j. Non-membrane Roof Sealants: 300 gram/liter.
k. Sealant Primers for Nonporous Substrates: 250 gram/liter.
l. Sealant Primers for Porous Substrates: 775 gram/liter.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions with roofing Installer and roofing inspector to verify compliance with project requirements and suitability to accept subsequent roofing work. Correct unsatisfactory conditions before proceeding with roofing work.
B. Do not apply roofing if roof surface will be used for subsequent work platform, storage of materials, or staging or scaffolding will be erected thereon unless system is protected.

3.2 PREPARATION

A. Complete roof deck construction prior to commencing roofing work:
   1. Install curbs, blocking, edge strips, nailers, cants, and other components where insulation, roofing, and base flashing is attached to, in place ready to receive insulation and roofing.
   2. Complete deck and insulation to provide designed drainage to working roof drains.
   3. Document installation of related materials to be concealed prior to installing roofing work.
B. Dry out surfaces, including the flutes of metal deck that become wet from any cause during progress of the work before roofing work is resumed. Apply materials to dry substrates.
C. Sweep decks to broom clean condition. Remove dust, dirt or debris.
D. Remove projections that might damage materials.
E. Concrete Decks:
   1. Test concrete decks for moisture prior to application of roofing materials. Test for capillary moisture by plastic sheet method according to ASTM D4263. Submit test reports.
   2. Prime concrete decks, including precast units, with primer as specified. Keep primer back 101 mm (4 inches) from joints in precast units.
   3. Allow primer to dry before application of bitumen.

3.3 TEMPORARY PROTECTION

A. Install temporary protection at the end of day's work and when work is halted for an indefinite period, or work is stopped when precipitation is imminent. Comply with approved temporary protection plan.

B. Install temporary cap flashing over the top of base flashings where permanent flashings are not in place to provide protection against moisture entering the roof system through or behind the base flashing. Securely anchor in place to prevent blow off and damage by construction activities.
C. Provide for removal of water or drainage of water away from the work.
D. Provide temporary protection over installed roofing by means of duckboard walkways, plywood platforms, or other materials, as approved by COR, for roof areas that are to remain intact, and that are subject to foot traffic and damage. Provide notches in sleepers to permit free drainage.

3.4 INSTALLATION, GENERAL

A. FM Approvals Installation Standard: Install roofing membrane, base flashings, wood cants, blocking, curbs, and nailers, and component materials in compliance with requirements in FM 4450 and FM 4470 as part of a membrane roofing system as listed in FM Approval's "RoofNav" for fire/windstorm classification indicated. Comply with recommendations in FM Approvals' Loss Prevention Data Sheet 1-49, including requirements for wood nailers and cants.
B. NRCA Installation Standard: Install roofing system in accordance with applicable NRCA Manual Plates and NRCA recommendations.
C. Manufacturer Recommendations: Comply with roofing system manufacturer's written installation recommendations.
D. Coordination with related work: Coordinate roof operations with roof insulation and sheet metal work so that insulation and flashings are installed concurrently to permit continuous roofing operations.
E. Installation Conditions:
    1. Apply dry roofing materials. Apply roofing work over dry substrates and materials.
    2. Apply materials within temperature range and surface and ambient conditions recommended by manufacturer.
    3. Except for temporary protection, do not apply materials during damp or rainy weather, during excessive wind conditions, nor while moisture (dew, snow, ice, fog or frost) is present in any amount in or on the materials to be covered or installed:
        a. Do not apply materials when the temperature is below 4 degrees C (40 degrees F).
        b. Do not apply materials to substrate having temperature of 4 degrees C (40 degrees F) or less.

3.5 INSTALLATION OF ROOFING

A. Do not allow the membrane to come in contact with surfaces contaminated with asphalt, coal tar, oil, grease, or other substances which are not compatible with KEE and its adhesion to the substrate.
B. Install the membrane so the sheets run perpendicular to the long dimension of the insulation boards.

C. Commence installation at the low point of the roof and work towards the high point. Lap the sheets so the flow of water is not against the edges of the sheet.
D. Position the membrane so it is free of buckles and wrinkles.
E. Roll sheet out on deck; inspect for defects as being rolled out and remove defective areas. Allow for relaxing before proceeding.
    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 edges of laps with a continuous beveled bead of sealant to sheet edges to provide smooth transition.
    5. Finish seams same day as the membrane is being installed.
    6. Anchor perimeter to deck or wall as specified.
F. Repair areas of welded seams where samples have been taken or marginal welds, bond voids, or skips occurs.
G. Repair fishmouths and wrinkles by cutting to lay flat and installing patch over cut area extending 101 mm (4 inches) beyond cut.
H. Membrane Perimeter Anchorage:
    1. Install metal fastening strip at the perimeter of each roof level, curb flashing, expansion joints and similar penetrations as indicated and in accordance with membrane manufacturer's instructions on top of roof membrane to deck or wall.
    2. Mechanically Fastened Metal Fastening Strip:
        a. Set top of mechanical fastener flush with top surface of the metal fastening strip. Space mechanical fasteners a maximum 305 mm (12 inches) on center starting 25 mm (1 inch) from the end of the nailing strip.
        b. When strips are cut round corners and eliminate sharp corners.
        c. After mechanically fastening strip, cover and seal strip with a 152 mm (6 inch) wide roof membrane strip; heat weld to roof membrane and seal edges.
        d. At roof edge metal, turn the membrane down over the front edge of the blocking or the nailer to below blocking. Secure the membrane to the vertical portion of the nailer; or, if required by the membrane manufacturer, with fasteners spaced not over 305 mm (12 inches) on centers.
        e. At parapet walls, intersecting building walls and curbs, secure the membrane to the structural deck with fasteners 305 mm (12 inches) on centers or as shown on NRCA manual.
I. Adhered System:

1. Apply adhesive in quantities required by roof membrane manufacturer.
2. Fold sheet back on itself after rolling out and coat the bottom side of the membrane and the top of the deck with adhesive. Do not coat the lap joint area.
3. After adhesive has set according to adhesive manufacturer's application instruction, roll the membrane into the adhesive in a manner that minimizes voids and wrinkles.
4. Repeat for other half of sheet. Cut voids and wrinkles to lay flat and clean for repair patch over cut area.

J. Mechanically-Attached System:
1. Secure the membrane to the structural deck with fasteners through stress plate or batten strips spaced and patterned in accordance with the membrane manufacturer's instructions to achieve required wind uplift performance.
2. When fasteners are installed within the laps of adjoining sheets, position the fastener so that the stress plates are a minimum 13 mm (1/2 inch) from the edge of the sheets.
3. Where fasteners are installed over the membrane after the seams have been welded, cover the fasteners with a minimum 178 mm (7 inch) wide round KEE membrane cap centered over the fasteners. If batten strips are used, cover the strip with a minimum 178 mm (7 inch) wide KEE strip centered over the batten. Heat weld to the roof membrane and finish edges with sealant as specified. Finish edges with sealant as specified.
4. Before installing fasteners into cast in place concrete, pre-drill the correct size hole into the deck. Drill the hole 9 mm (3/8 inch) deeper than the fastener penetration.

3.6 INSTALLATION OF FLASHING

A. Install flashings as the membrane is being installed. If the flashing cannot be completely installed in one (1) day, complete the installation until the flashing is in a watertight condition and provide temporary covers or seals.

B. Flashing Roof Drains:
1. Install roof drain flashing as recommended by the membrane manufacturer, generally as follows:
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 the KEE roof membrane.
c. Adhere the KEE roof membrane to the metal flashing with the membrane manufacturer's recommended adhesive.
2. Turn down the metal drain flashing and KEE roof membrane into the drain body and install clamping ring and strainer.

C. Installing KEE Base Flashing and Pipe Flashing:
1. Install KEE flashing membranes to pipes, wall or curbs to a height not less than 203 mm (8 inches) above roof surfaces and 101 mm (4 inches) on roof membrane.

a. Adhere flashing to pipe, wall or curb with adhesive.
b. Form inside and outside corners of KEE flashing membrane in accordance with NRCA manual. Form pipe flashing with pipe boot in accordance with NRCA manual.
c. Lap ends not less than 101 mm (4 inches).
d. Heat weld flashing membranes together and flashing membranes to roof membranes. Finish exposed edges with sealant as specified.
e. Install flashing membranes in accordance with NRCA manual.

2. Anchor top of flashing to walls or curbs with fasteners spaced not over 203 mm (8 inches) on centers. Use fastening strip on ducts. Use pipe clamps on pipes or other round penetrations.
3. Apply sealant to top edge of flashing.

D. Installing Building Expansion Joints:
1. Install base flashing on curbs as indicated in construction documents.
2. Coordinate installation with metal expansion joint cover or roof expansion joint system.
3. Install flexible tubing 1-1/2 times width of joint over joint. Cover tubing with KEE flashing strip adhered to base flashing and lapping base flashing 101 mm (4 inches). Finish edges of laps with sealants as specified.

E. Repairs to membrane and flashings:
1. Remove sections of KEE sheet roofing or flashing that is creased wrinkled or fish mouthed.
2. Cover removed areas, cuts and damaged areas with a patch extending 101 mm (4 inches) beyond damaged, cut, or removed area. Heat weld to roof membrane or flashing. Finish edge of lap with sealant as specified.

3.7 FLEXIBLE WALKWAYS

A. Use reinforced sheet not less than 915 mm (3 feet) wide.
B. Heat weld walkway sheet to roof sheet at edges. Weld area 50 mm (2 inches) wide by the entire length of the walkway sheet.
C. Finish edges of laps with sealants as specified.

3.8 FIELD QUALITY CONTROL

A. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.
1. Notify COR 48 hours in advance of date and time of inspection.

B. Repair or remove and replace components of roofing work where test results or inspections indicate that they do not comply with specified requirements.
1. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.9 PROTECTING AND CLEANING

A. Protect membrane-roofing system from damage and wear during remainder of construction period.

B. Correct deficiencies in or remove membrane roofing system that does not comply with requirements; repair substrates; and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of acceptance by COR.

C. Clean overspray and spillage from adjacent construction. Clean membrane and restore surface to like-new condition meeting solar reflectance requirements.

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SECTION 07 60 00
FLASHING AND SHEET METAL

PART 1 - GENERAL

1.1 DESCRIPTION

A. Formed sheet metal work for wall and roof flashing, copings, roof edge metal, fasciae, drainage specialties, and formed expansion joint covers are specified in this section.

1.2 RELATED WORK

A. Section 07 54 16 ETHYLENE INTERPOLYMER (KEE) ROOFING Membrane base flashings and stripping.

B. Section 07 71 00 ROOF SPECIALTIES: Manufactured flashing, copings, roof edge metal, and fasciae.

C. Section 07 92 00, JOINT SEALANTS: Joint Sealants.

D. Division 22, PLUMBING: Integral flashing components of manufactured roof specialties and accessories or equipment.

E. Division 23 HVAC: Integral flashing components of manufactured roof specialties and accessories or equipment.

1.3 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only. Editions of applicable publications current on date of issue of bidding documents apply unless otherwise indicated.

B. Aluminum Association (AA):

AA-C22A41	Aluminum Chemically etched medium matte, with clear anodic coating, Class I Architectural, 0.7-mil thick
AA-C22A42	Chemically etched medium matte, with integrally colored anodic coating, Class I Architectural, 0.7 mils thick
AA-C22A44	Chemically etched medium matte with electrolytically deposited metallic compound, integrally colored coating Class I Architectural, 0.7-mil thick finish

C. American National Standards Institute/Single-Ply Roofing Institute/Factory Mutual (ANSI/SPRI/FM):

4435/ES-1-11	Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems

D. American Architectural Manufacturers Association (AAMA):

AAMA 620-02	Voluntary Specification for High Performance Organic Coatings on Coil Coated Architectural Aluminum

AAMA 621-02 ..... Voluntary Specification for High Performance Organic Coatings on Coil Coated Architectural Hot Dipped Galvanized (HDG) and Zinc-Aluminum Coated Steel Substrates

E. ASTM International (ASTM):

A240/A240M-20 ..... Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels and for General Applications.

A653/A653M-20 ..... Steel Sheet Zinc-Coated (Galvanized) or Zinc Alloy Coated (Galvanized) by the Hot- Dip Process

B32-08(2014) ..... Solder Metal

B209-14 ..... Aluminum and Aluminum-Alloy Sheet and Plate

B370-12(2019) ..... Copper Sheet and Strip for Building Construction

D173/D173M-03(2018) ..... Bitumen-Saturated Cotton Fabrics Used in Roofing and Waterproofing

D412-16 ..... Vulcanized Rubber and Thermoplastic Elastomers-Tension

D1187/D1187M-97(2018) ..... Asphalt Base Emulsions for Use as Protective Coatings for Metal

D1784-20 ..... Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds

D3656/D3656M-13 ..... Insect Screening and Louver Cloth Woven from Vinyl-Coated Glass Yarns

D4586/D4586M-07(2018) ..... Asphalt Roof Cement, Asbestos Free

F. Sheet Metal and Air Conditioning Contractors National Association (SMACNA): Architectural Sheet Metal Manual.

G. National Association of Architectural Metal Manufacturers (NAAMM):

AMP 500-06 ..... Metal Finishes Manual

H. Federal Specification (Fed. Spec):

A-A-1925A ..... Shield, Expansion; (Nail Anchors)

UU-B-790A ..... Building Paper, Vegetable Fiber

I. International Code Commission (ICC): International Building Code, Current Edition

1.4 PERFORMANCE REQUIREMENTS

A. Wind Uplift Forces: Resist the following forces per FM Approvals 1-49:

1. Wind Zone 1: 0.48 to 0.96 kPa (10 to 20 pound force/square foot): 1.92-kPa (40 pound force/square foot) perimeter uplift force, 2.87-kPa (60 pound force/square foot pound force/square foot) corner uplift force, and 0.96-kPa (20- pound force/square foot) outward force.

2. Wind Zone 1: 1.00 to 1.44 kPa (21 to 30 pound force/square foot): 2.87-kPa (60 pound force/square foot) perimeter uplift force, 4.31-kPa (90 pound force/square foot) corner uplift force, and 1.44-kPa (30-pound force/square foot) outward force.
3. Wind Zone 2: 1.48 to 2.15 kPa (31 to 45 pound force/square foot): 4.31-kPa (90 pound force/square foot) perimeter uplift force, 5.74-kPa (120 pound force/square foot) corner uplift force, and 2.15-kPa (45-pound force/square foot) outward force.
4. Wind Zone 3: 2.20 to 4.98 kPa (46 to 104 pound force/square foot): 9.96-kPa (208 pound force/square foot) perimeter uplift force, 14.94-kPa (312 pound force/square foot) corner uplift force, and 4.98-kPa (104-pound force/square foot) outward force.

B. Wind Design Standard: Fabricate and install copings, roof-edge flashings tested per ANSI/SPRI/FM ES-1 to resist design pressure.

1.5 SUBMITTALS

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

B. Shop Drawings: For all specified items, including:
1. Flashings
2. Copings
3. Gravel Stop-Fascia
4. Gutter and Conductors
5. Expansion joints
6. Fascia-cant

C. Manufacturer's Literature and Data: For all specified items, including:
1. Two-piece counterflashing
2. Thru wall flashing
3. Expansion joint cover, each type
4. Nonreinforced, elastomeric sheeting
5. Fascia-cant

D. Certificates: Indicating compliance with specified finishing requirements, from applicator and contractor.

PART 2 - PRODUCTS

2.1 FLASHING AND SHEET METAL MATERIALS

A. Stainless Steel: ASTM A240, Type 302B, dead soft temper.

B. Copper ASTM B370, cold-rolled temper.

C. Bituminous Coated Copper: Minimum copper ASTM B370, weight not less than 1 kg/m² (3 oz/sf). Bituminous coating shall weigh not less than 2 kg/m² (6 oz/sf); or, copper sheets may be bonded between two layers of coarsely woven bitumen-saturated cotton fabric ASTM D173. Exposed fabric surface shall be crimped.

D. Copper Covered Paper: Fabricated of electro-deposit pure copper sheets ASTM B 370, bonded with special asphalt compound to both sides of creped, reinforced building paper, UU-B-790, Type I, style 5, or to a three-ply sheet of asphalt impregnated crepe paper. Grooves running along the width of sheet.

E. Polyethylene Coated Copper: Copper sheet ASTM B370, weighing 1 Kg/m² (3 oz/sf) bonded between two layers of (two mil) thick polyethylene sheet.

F. Aluminum Sheet: ASTM B209, alloy 3003-H14, except alloy used for color anodized aluminum shall be as required to produce specified color. Alloy required to produce specified color shall have the same structural properties as alloy 3003-H14.

G. Galvanized Sheet: ASTM, A653.

H. Nonreinforced, Elastomeric Sheeting: Elastomeric substances reduced to thermoplastic state and extruded into continuous homogenous sheet (0.056 inch) thick. Sheeting shall have not less than 7 MPa (1,000 psi) tensile strength and not more than seven percent tension-set at 50 percent elongation when tested in accordance with ASTM D412. Sheeting shall show no cracking or flaking when bent through 180 degrees over a 1 mm (1/32 inch) diameter mandrel and then bent at same point over same size mandrel in opposite direction through 360 degrees at temperature of -30°C (-20 °F).

2.2 FLASHING ACCESSORIES

A. Solder: ASTM B32; flux type and alloy composition as required for use with metals to be soldered.

B. Rosin Paper: Fed-Spec. UU-B-790, Type I, Grade D, Style 1b, Rosin-sized sheathing paper, weighing approximately 3 Kg/10 m²(6 pounds/100 square feet).

C. Bituminous Paint: ASTM D1187, Type I.

D. Fasteners:

1. Use stainless steel for stainless steel and aluminum alloy. Use galvanized steel or stainless steel for galvanized steel.
2. Nails:
    a. Minimum diameter for copper nails: 3 mm (0.109 inch).
    b. Minimum diameter for aluminum nails 3 mm (0.105 inch).
    c. Minimum diameter for stainless steel nails: 2 mm (0.095 inch) and annular threaded.
    d. Length to provide not less than 22 mm (7/8 inch) penetration into anchorage.
3. Rivets: Not less than 3 mm (1/8 inch) diameter.
4. Expansion Shields: Fed Spec A-A-1925A.

E. Sealant: As specified in Section 07 92 00, JOINT SEALANTS for exterior locations.

F. Insect Screening: ASTM D3656, 18 by 18 regular mesh.

G. Roof Cement: ASTM D4586.

2.3 SHEET METAL THICKNESS

A. Except as otherwise shown or specified use thickness or weight of sheet metal as follows:

B. Concealed Locations (Built into Construction):

1. Stainless steel: 0.25 mm (0.010 inch) thick.
2. Galvanized steel: 0.5 mm (0.021 inch) thick.

C. Exposed Locations:

1. Stainless steel: 0.4 mm (0.015 inch).

D. Thickness of aluminum or galvanized steel is specified with each item.

2.4 FABRICATION, GENERAL

A. Jointing:

1. In general, copper, stainless steel and copper clad stainless-steel joints, except expansion and contraction joints, shall be locked and soldered.
2. Jointing of copper over 0.5 Kg (20 oz) weight or stainless steel over 0.45 mm (0.018 inch) thick shall be done by lapping, riveting and soldering.
3. Joints shall conform to following requirements:
   a. Flat-lock joints shall finish not less than 19 mm (3/4 inch) wide.
   b. Lap joints subject to stress shall finish not less than 25 mm (one inch) wide and shall be soldered and riveted.
   c. Unsoldered lap joints shall finish not less than 100 mm (4 inches) wide.
4. Flat and lap joints shall be made in direction of flow.
5. Edges of bituminous coated copper, copper covered paper, nonreinforced elastomeric sheeting and polyethylene coated copper shall be jointed by lapping not less than 100 mm (4 inches) in the direction of flow and cementing with asphalt roof cement or sealant as required by the manufacturer's printed instructions.
6. Soldering:
   a. Pre tin both mating surfaces with solder for a width not less than 38 mm (1 1/2 inches) of uncoated copper, stainless steel, and copper clad stainless steel.
   b. Wire brush to produce a bright surface before soldering lead coated copper.
   c. Treat in accordance with metal producers recommendations other sheet metal required to be soldered.
   d. Completely remove acid and flux after soldering is completed.

B. Expansion and Contraction Joints:

1. Fabricate in accordance with the Architectural Sheet Metal Manual recommendations for expansion and contraction of sheet metal work in continuous runs.
2. Space joints as shown or as specified.
3. Space expansion and contraction joints for copper, stainless steel, and copper clad stainless steel at intervals not exceeding 7200 mm (24 feet).

4. Space expansion and contraction joints for aluminum at intervals not exceeding 5400 mm (18 feet), except do not exceed 3000 mm (10 feet) for gravel stops and fascia-cant systems.
5. Fabricate slip-type or loose locked joints and fill with sealant unless otherwise specified.
6. Fabricate joint covers of same thickness material as sheet metal served.

C. Cleats:
1. Fabricate cleats to secure flashings and sheet metal work over 300 mm (12 inches) wide and where specified.
2. Provide cleats for maximum spacing of 300 mm (12 inch) centers unless specified otherwise.
3. Form cleats of same metal and weights or thickness as the sheet metal being installed unless specified otherwise.
4. Fabricate cleats from 50 mm (2 inch) wide strip. Form end with not less than 19 mm (3/4 inch) wide loose lock to item for anchorage. Form other end of length to receive nails free of item to be anchored and end edge to be folded over and cover nail heads.

D. Edge Strips or Continuous Cleats:
1. Fabricate continuous edge strips where shown and specified to secure loose edges of the sheet metal work.
2. Except as otherwise specified, fabricate edge strips or minimum 0.6 mm (0.024 inch) thick stainless steel or 1.25 mm (0.050 inch) thick aluminum.
3. Use material compatible with sheet metal to be secured by the edge strip.
4. Fabricate in 3000 mm (10 feet) maximum lengths with not less than 19 mm (3/4 inch) loose lock into metal secured by edge strip.
5. Fabricate Strips for fascia anchorage to extend below the supporting wood construction to form a drip and to allow the flashing to be hooked over the lower edge at least 19 mm (3/4-inch).
6. Fabricate anchor edge maximum width of 75 mm (3 inches) or of sufficient width to provide adequate bearing area to insure a rigid installation using 0.8 mm (0.031 inch) thick stainless steel or 1.6 mm (0.0625 inch) thick aluminum.

E. Drips:
1. Form drips at lower edge of sheet metal counter-flashings (cap flashings), fascias, gravel stops, wall copings, by folding edge back 13 mm (1/2 inch) and bending out 45 degrees from vertical to carry water away from the wall.
2. Form drip to provide hook to engage cleat or edge strip for fastening for not less than 19 mm (3/4 inch) loose lock where shown.

F. Edges:
1. Edges of flashings concealed in masonry joints opposite drain side shall be turned up 6 mm (1/4 inch) to form dam, unless otherwise specified or shown otherwise.

2. Finish exposed edges of flashing with a 6 mm (1/4 inch) hem formed by folding edge of flashing back on itself when not hooked to edge strip or cleat. Use 6 mm (1/4 inch) minimum penetration beyond wall face with drip for through-wall flashing exposed edge.
3. All metal roof edges shall meet requirements of IBC, current edition.

2.5 FINISHES

A. Use same finish on adjacent metal or components and exposed metal surfaces unless specified or shown otherwise.
B. In accordance with NAAMM Metal Finishes Manual AMP 500, unless otherwise specified.
C. Finish exposed metal surfaces as follows, unless specified otherwise:
   1. Stainless Steel: Finish No. 2B or 2D.
   2. Aluminum:
      a. Clear Finish: AA-C22A41 medium matte, clear anodic coating, Class 1 Architectural, 18 mm (0.7 mils) thick.
      b. Colored Finish: AA-C22A42 (anodized) or AA-C22A44 (electrolytically deposited metallic compound) medium matte, integrally colored coating, Class 1 Architectural, 18 mm (0.7 mils) thick. Dyes will not be accepted.
   3. Steel and Galvanized Steel:
      a. Finish painted under Section 09 91 00, PAINTING unless specified as prefinished item.
      b. Manufacturer's finish:
         1) Baked on prime coat over a phosphate coating.
         2) Baked-on prime and finish coat over a phosphate coating.
         3) Fluorocarbon Finish: AAMA 621, high performance organic coating.

2.6 THROUGH-WALL FLASHINGS

A. Form through-wall flashing to provide a mechanical bond or key against lateral movement in all directions. Install a sheet having 2 mm (1/16 inch) deep transverse channels spaced four to every 25 mm (one inch), or ribbed diagonal pattern, or having other deformation unless specified otherwise.
   1. Fabricate in not less than 2400 mm (8 feet) lengths; 3000 mm (10 feet) maximum lengths.
   2. Fabricate so keying nests at overlaps.
B. For Masonry Work When Concealed Except for Drip:
   1. Stainless steel.
   2. Form an integral dam at least 5 mm (3/16 inch) high at back edge.
   3. Form exposed portions of flashing with drip, approximately 6 mm (1/4 inch) projection beyond wall face.
C. For Masonry Work When Exposed Edge Forms a Receiver for Counter Flashing:
   1. Use same metal and thickness as counter flashing.
   2. Form an integral dam at least 5 mm (3/16 inch) high at back edge.

3. Form exposed portion as snap lock receiver for counter flashing upper edge.

D. For Flashing at Architectural Precast Concrete Panels or Stone Panels.
   1. Use plan flat sheet of stainless steel.
   2. Form exposed portions with drip as specified or receiver.

E. Window Sill Flashing and Lintel Flashing:
   1. Use stainless steel.
   2. Fabricate flashing at ends with folded corners to turn up 5 mm (3/16 inch) in first vertical masonry joint beyond masonry opening.
   3. Turn up back edge as shown.
   4. Form exposed portion with drip as specified or receiver.

F. Door Sill Flashing:
   1. Where concealed use, 0.5 mm (0.018 inch) thick stainless steel.
   2. Where shown on drawings as combined counter flashing under threshold, sill plate, door sill, or where subject to foot traffic, use either 0.6 mm (0.024 inch) stainless steel, or 0.6 mm (0.024 inch) thick stainless steel.
   3. Fabricate flashing at ends to turn up 5 mm (3/16 inch) in first vertical masonry joint beyond masonry opening with folded corners.

2.7 BASE FLASHING

A. Use metal base flashing at vertical surfaces intersecting built-up roofing without cant strips or where shown.
   1. Use either copper, or stainless steel, thickness specified unless specified otherwise.
   2. When flashing is over 250 mm (10 inches) in vertical height or horizontal width use either 0.5 Kg (20 oz) copper or 0.5 mm (0.018 inch) stainless steel.
   3. Use stainless steel at aluminum roof curbs where flashing contacts the aluminum.
   4. Use either copper, or stainless steel at pipe flashings.

B. Fabricate metal base flashing up vertical surfaces not less than 200 mm (8 inch) nor more than 400 mm (16 inch).

C. Fabricate roof flange not less than 100 mm (4 inches) wide unless shown otherwise. When base flashing length exceeds 2400 mm (8 feet) form flange edge with 13 mm (1/2 inch) hem to receive cleats.

D. Form base flashing bent from strip except pipe flashing. Fabricate ends for riveted soldered lap seam joints. Fabricate expansion joint ends as specified.

E. Pipe Flashing: (Other than engine exhaust or flue stack)
   1. Fabricate roof flange not less than 100 mm (4 inches) beyond sleeve on all sides.
   2. Extend sleeve up and around pipe and flange out at bottom not less than 13 mm (1/2 inch) and solder to flange and sleeve seam to make watertight.
   3. At low pipes 200 mm (8 inch) to 450 mm (18 inch) above roof:

a. Form top of sleeve to turn down into the pipe at least 25 mm (one inch).
b. Allow for loose fit around and into the pipe.

4. At high pipes and pipes with goosenecks or other obstructions which would prevent turning the flashing down into the pipe:
   a. Extend sleeve up not less than 300 mm (12 inch) above roofing.
   b. Allow for loose fit around pipe.

2.8 COUNTERFLASHING (CAP FLASHING OR HOODS)

A. Either copper or stainless steel, unless specified otherwise.

B. Fabricate to lap base flashing a minimum of 100 mm (4 inches) with drip:
   1. Form lock seams for outside corners. Allow for lap joints at ends and inside corners.
   2. In general, form flashing in lengths not less than 2400 mm (8 feet) and not more than 3000 mm (10 feet).
   3. Two-piece, lock in type flashing may be used in-lieu-of one piece counter-flashing.
   4. Manufactured assemblies may be used.
   5. Where counterflashing is installed at new work use an integral flange at the top designed to be extended into the masonry joint or reglet in concrete.
   6. Where counterflashing is installed at existing work use surface applied type, formed to provide a space for the application of sealant at the top edge.

C. One-piece Counterflashing:
   1. Back edge turned up and fabricate to lock into reglet in concrete.
   2. Upper edge formed to extend full depth of masonry unit in mortar joint with back edge turned up 6 mm (1/4 inch).

D. Two-Piece Counterflashing:
   1. Receiver to extend into masonry wall depth of masonry unit with back edge turned up 6 mm (1/4 inch) and exposed edge designed to receive and lock counterflashing upper edge when inserted.
   2. Counterflashing upper edge designed to snap lock into receiver.

E. Surface Mounted Counterflashing; one or two piece:
   1. Use at existing or new surfaces where flashing cannot be inserted in vertical surface.
   2. One piece fabricate upper edge folded double for 65 mm (2 1/2 inches) with top 19 mm (3/4 inch) bent out to form "V" joint sealant pocket with vertical surface. Perforate flat double area against vertical surface with horizontally slotted fastener holes at 400 mm (16 inch) centers between end holes. Option: One piece surface mounted counter-flashing (cap flashing) may be used. Fabricate as detailed on Plate 51 of SMACNA Architectural Sheet Metal Manual.
   3. Two pieces: Fabricate upper edge to lock into surface mounted receiver. Fabricate receiver joint sealant pocket on upper edge and lower edge to receive counterflashing, with slotted fastener holes at 400 mm (16 inch) centers between upper and lower edge.

F. Pipe Counterflashing:
   1. Form flashing for water-tight umbrella with upper portion against pipe to receive a draw band and upper edge to form a "V" joint sealant receiver approximately 19 mm (3/4 inch) deep.
   2. Fabricate 100 mm (4 inch) over lap at end.
   3. Fabricate draw band of same metal as counter flashing. Use 0.6 Kg (24 oz) copper or 0.33 mm (0.013 inch) thick stainless steel or copper coated stainless steel.
   4. Use stainless steel bolt on draw band tightening assembly.
   5. Vent pipe counter flashing may be fabricated to omit draw band and turn down 25 mm (one inch) inside vent pipe.

G. Where vented edge decks intersect vertical surfaces, form in one piece, shape to slope down to a point level with and in front of edge-set notched plank; then, down vertically, overlapping base flashing.

2.9 CONDUCTORS (DOWNSPOUTS)

A. Fabricate conductors of 0.6 (0.025 inch) thick aluminum in sections approximately 3000 mm (10 feet) long with 19 mm (3/4 inch) wide flat locked seams.
   1. Fabricate open face channel shape with hemmed longitudinal edges.

B. Fabricate elbows by mitering, riveting, and soldering except seal aluminum in lieu of solder. Lap upper section to the inside of the lower piece.

C. Fabricate conductor brackets or hangers of same material as conductor, 2 mm (1/16 inch) thick by 25 mm (one inch) minimum width. Form to support conductors 25 mm (one inch) from wall surface in accordance with Architectural Sheet Metal Manual for rectangular and round shapes.

D. Conductor Heads:
   1. Fabricate of same material as conductor.
   2. Fabricate conductor heads to not less than 250 mm (10 inch) wide by 200 mm (8 inch) deep by 200 mm (8 inches) from front to back.
   3. Form front and side edges channel shape not less than 13 mm (1/2 inch) wide flanges with edge hemmed.
   4. Slope bottom to sleeve to conductor or downspout at not less than 60-degree angle.
   5. Extend wall edge not less than 25 mm (one inch) above front edge.
   6. Solder joints for watertight assembly.
   7. Fabricate outlet tube or sleeve at bottom not less than 50 mm (2 inches) long to insert into conductor.

2.10 REGLETS

A. Fabricate reglets of one of the following materials:
   1. 0.4 Kg (16 ounce) copper.
   2. Stainless steel, not less than 0.3 mm (0.012 inch) thick.

3. Plastic coated extruded aluminum, not less than 1.4 mm (0.055 inch) thick prefilled with butyl rubber sealer and complete with plastic wedges inserted at 1000 mm (40 inches) on centers.
4. Plastic, ASTM D1784, Type II, not less than 2 mm (0.075 inch) thick.

B. Fill open-type reglets with fiberboard or other suitable separator, to prevent crushing of the slot during installation.

C. Bend edges of reglets for setting into concrete to an angle of not less than 45 degrees, and make wide enough to provide firm anchorage in the concrete.

D. Fabricate reglets for building into horizontal masonry mortar joints not less than 19 mm (3/4 inch) deep, nor more than 25 mm (one inch) deep.

E. Fabricate mitered corners, fittings, and special shapes as may be required by details.

F. Reglets for concrete may be formed to receive flashing and have a 10 mm (3/8 inch), 45 degree snap lock.

2.11 ENGINE EXHAUST PIPE OR FLUE OR STACK FLASHING

A. Flashing at penetrations through roofing shall consist of a metal collar, sheet metal flashing sleeve and hood.

B. Fabricate collar with roof flange of 1.2 mm (0.047 inch) minimum thick black iron or galvanized steel sheet.
1. Fabricate inside diameter of collar 100 mm (4 inches) larger than the outside diameter of the item penetration the roofing.
2. Extend collar height from structural roof deck to not less than 350 mm (14 inches) above roof surface.
3. Fabricate collar roof flange not less than 100 mm (4 inches) wide.
4. Option: Collar may be of steel tubing 3 mm (0.125 inch) minimum wall thickness, with not less than four, 50 mm x 100 mm x 3 mm (2 inch by 4 inch by 0.125 inch) thick tabs bottom edge evenly spaced around tube in lieu of continuous roof flange. Full butt weld joints of collar.

C. Fabricate sleeve base flashing with roof flange of either copper, stainless steel, or copper clad stainless steel.
1. Fabricate sleeve roof flange not less than 100 mm (4 inches) wide.
2. Extend sleeve around collar up to top of collar.
3. Flange bottom of sleeve out not less than 13 mm (1/24 inch) and soldered to 100 mm (4 inch) wide flange to make watertight.
4. Fabricate interior diameter 50 mm (2 inch) greater than collar.

D. Fabricate hood counter flashing from same material and thickness as sleeve.
1. Fabricate the same as pipe counter flashing except allow not less than 100 mm (4 inch) lap below top of sleeve and to form vent space minimum of 100 mm (4 inch) wide.
2. Hem bottom edge of hood 13 mm (1/2 inch).
3. Provide a 50 mm (2 inch) deep drawband.

E. Fabricate insect screen closure between sleeve and hood. Secure screen to sleeve with sheet metal screws.

2.12 SCUPPERS

A. Fabricate scuppers with minimum of 100 mm (4 inch) wide flange.
B. Provide flange at top on through wall scupper to extend to top of base flashing.
C. Fabricate exterior wall side to project not less than 13 mm (1/2 inch) beyond face of wall with drip at bottom outlet edge.
D. Fabricate not less than 100 mm (4 inch) wide flange to lap behind gravel stop fascia.
E. Fabricate exterior wall flange for through wall scupper not less than 25 mm (one inch) wide on top and sides with edges hemmed.
F. Fabricate gravel stop bar of 25 mm x 25 mm (one by one inch) angle strip soldered to bottom of scupper.
G. Fabricate scupper not less than 200 mm (8 inch) wide and not less than 125 mm (5 inch) high for through wall scupper.
H. Solder joints watertight.

2.13 GOOSENECK ROOF VENTILATORS

A. Form of 1.3 mm (0.0508 inch) thick sheet aluminum, reinforce as necessary for rigidity, stiffness, and connection to curb, and to be watertight.
    1. Form lower-edge to sleeve to curb.
    2. Curb:
        a. Form for 100 mm (4 inch) high sleeve to ventilator.
        b. Form for concealed anchorage to structural curb and to bear on structural curb.
        c. Form bottom edge of curb as counterflashing to lap base flashing.
B. Provide open end with 1.6 mm (16 gage), stainless steel wire guard of 13 mm (1/2 inch) square mesh.
    1. Construct suitable aluminum angle frame to retain wire guard.
    2. Rivet angle frame to end of gooseneck.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
    1. Install flashing and sheet metal items as shown in Sheet Metal and Air Conditioning Contractors National Association, Inc., publication, ARCHITECTURAL SHEET METAL MANUAL, except as otherwise shown or specified.
    2. Apply Sealant as specified in Section 07 92 00, JOINT SEALANTS.
    3. Apply sheet metal and other flashing material to surfaces which are smooth, sound, clean, dry and free from defects that might affect the application.

4. Remove projections which would puncture the materials and fill holes and depressions with material compatible with the substrate. Cover holes or cracks in wood wider than 6 mm (1/4 inch) with sheet metal compatible with the roofing and flashing material used.
5. Coordinate with masonry work for the application of a skim coat of mortar to surfaces of unit masonry to receive flashing material before the application of flashing.
6. Apply a layer of 7 Kg (15 pound) saturated felt followed by a layer of rosin paper to wood surfaces to be covered with copper. Lap each ply 50 mm (2 inch) with the slope and nail with large headed copper nails.
7. Confine direct nailing of sheet metal to strips 300 mm (12 inch) or less wide. Nail flashing along one edge only. Space nail not over 100 mm (4 inches) on center unless specified otherwise.
8. Install bolts, rivets, and screws where indicated, specified, or required in accordance with the SMACNA Sheet Metal Manual. Space rivets at 75 mm (3 inch) on centers in two rows in a staggered position. Use neoprene washers under fastener heads when fastener head is exposed.
9. Coordinate with roofing work for the installation of metal base flashings and other metal items having roof flanges for anchorage and watertight installation.
10. Nail continuous cleats on 75 mm (3 inch) on centers in two rows in a staggered position.
11. Nail individual cleats with two nails and bend end tab over nail heads. Lock other end of cleat into hemmed edge.
12. Install flashings in conjunction with other trades so that flashings are inserted in other materials and joined together to provide a watertight installation.
13. Where required to prevent galvanic action between dissimilar metal isolate the contact areas of dissimilar metal with sheet lead, waterproof building paper, or a coat of bituminous paint.
14. Isolate aluminum in contact with dissimilar metals others than stainless steel, white bronze or other metal compatible with aluminum by:
    a. Paint dissimilar metal with a prime coat of zinc-chromate or other suitable primer, followed by two coats of aluminum paint.
    b. Paint dissimilar metal with a coat of bituminous paint.
    c. Apply an approved caulking material between aluminum and dissimilar metal.
15. Paint aluminum in contact with or built into mortar, concrete, plaster, or other masonry materials with a coat of bituminous paint.
16. Paint aluminum in contact with absorptive materials that may become repeatedly wet with two coats of bituminous paint or two coats of aluminum paint.
17. Bitumen Stops:
    a. Install bitumen stops for built-up roof opening penetrations through deck and at formed sheet metal gravel stops.

b. Nail leg of bitumen stop at 300 mm (12 inch) intervals to nailing strip at roof edge before roofing material is installed.

3.2 THROUGH-WALL FLASHING

A. General:

1. Install continuous through-wall flashing between top of concrete foundation walls and bottom of masonry building walls; at top of concrete floors; under masonry, concrete, or stone copings and elsewhere as shown.
2. Where exposed portions are used as counterflashings, lap base flashings at least 100 mm (4 inches) and use thickness of metal as specified for exposed locations.
3. Exposed edge of flashing may be formed as a receiver for two-piece counter flashing as specified.
4. Terminate exterior edge beyond face of wall approximately 6 mm (1/4 inch) with drip edge where not part of counter flashing.
5. Turn back edge up 6 mm (1/4 inch) unless noted otherwise where flashing terminates in mortar joint or hollow masonry unit joint.
6. Terminate interior raised edge in masonry backup unit approximately 38 mm (1 1/2 inch) into unit unless shown otherwise.
7. Under copings terminate both edges beyond face of wall approximately 6 mm (1/4 inch) with drip edge.
8. Lap end joints at least two corrugations, but not less than 100 mm (4 inches). Seal laps with sealant.
9. Where dowels, reinforcing bars and fastening devices penetrate flashing, seal penetration with sealing compound. Sealing compound is specified in Section 07 92 00, JOINT SEALANTS.
10. Coordinate with other work to set in a bed of mortar above and below flashing so that total thickness of the two layers of mortar and flashing are same as regular mortar joint.
11. Where ends of flashing terminate turn ends up 25 mm (1 inch) and fold corners to form dam extending to wall face in vertical mortar or veneer joint.
12. Turn flashing up not less than 200 mm (8 inch) between masonry or behind exterior veneer.
13. When flashing terminates in reglet extend flashing full depth into reglet and secure with lead or plastic wedges spaced 150 mm (6 inch) on center.
14. Continue flashing around columns:
    a. Where flashing cannot be inserted in column reglet hold flashing vertical leg against column.
    b. Counterflash top edge with 75 mm (3 inch) wide strip of saturated cotton unless shown otherwise. Secure cotton strip with roof cement to column. Lap base flashing with cotton strip 38 mm (1 1/2 inch).

B. Flashing at Top of Concrete Foundation Walls Where concrete is exposed. Turn up not less than 200 mm (8 inch) high and into masonry backup mortar joint or reglet in concrete backup as specified.

C. Flashing at Top of Concrete Floors (except where shelf angles occur): Place flashing in horizontal masonry joint not less than 200 mm (8 inch) below floor slab and extend into backup masonry joint at floor slab 38 mm (1 1/2 inch).

D. Flashing at Cavity Wall Construction: Where flashing occurs in cavity walls turn vertical portion up against backup under waterproofing, if any, into mortar joint. Turn up over insulation, if any, and horizontally through insulation into mortar joint.

E. Flashing at Veneer Walls:
   1. Install near line of finish floors over shelf angles or where shown.
   2. Turn up against sheathing.
   3. At stud framing, hem top edge 19 mm (3/4 inch) and secure to each stud with stainless steel fasteners through sheathing.
   4. At concrete backing, extend flashing into reglet as specified.
   5. Coordinate with installation of waterproofing or asphalt felt for lap over top of flashing.

F. Lintel Flashing when not part of shelf angle flashing:
   1. Install flashing full length of lintel to nearest vertical joint in masonry over veneer.
   2. Turn ends up 25 mm (one inch) and fold corners to form dam and extend end to face of wall.
   3. Turn back edge up to top of lintel; terminate back edge as specified for back-up wall.

G. Window Sill Flashing:
   1. Install flashing to extend not less than 100 mm (4 inch) beyond ends of sill into vertical joint of masonry or veneer.
   2. Turn back edge up to terminate under window frame.
   3. Turn ends up 25 mm (one inch) and fold corners to form dam and extend to face of wall.

H. Door Sill Flashing:
   1. Install flashing under bottom of plate sills of doors over curbs opening onto roofs. Extend flashing out to form counter flashing or receiver for counter flashing over base flashing. Set in sealant.
   2. Extend sill flashing 200 mm (8 inch) beyond jamb opening. Turn ends up one inch in vertical masonry joint, extend end to face of wall. Join to counter flashing for water tight joint.
   3. Where doors thresholds cover over waterproof membranes install sill flashing over water proof membrane under thresholds. Extend beyond opening to cover exposed portion of waterproof membrane and not less than 150 mm (6 inch) beyond door jamb opening at ends. Turn up approximately 6 mm (1/4 inch) under threshold.

I. Flashing at Masonry, Stone, or Precast Concrete Copings:
   1. Install flashing with drips on both wall faces unless shown otherwise.

2. Form penetration openings to fit tight against dowel or other item with edge turned up. Seal penetrations with sealant.

3.3 BASE FLASHING

A. Install where roof membrane type base flashing is not used and where shown.
   1. Install flashing at intersections of roofs with vertical surfaces or at penetrations through roofs, to provide watertight construction.
   2. Install metal flashings and accessories having flanges extending out on top of the built-up roofing before final bituminous coat and roof aggregate is applied.
   3. Set flanges in heavy trowel coat of roof cement and nail through flanges into wood nailers over bituminous roofing.
   4. Secure flange by nailing through roofing into wood blocking with nails spaced 75 mm (3 inch) on centers or, when flange over 100 mm (4 inch) wide terminate in a 13 mm (1/2 inch) folded edge anchored with cleats spaced 200 mm (8 inch) on center. Secure one end of cleat over nail heads. Lock other end into the seam.

B. For long runs of base flashings install in lengths of not less than 2400 mm (8 feet) nor more than 3000 mm (ten feet). Install a 75 mm (3 inch) wide slip type, loose lock expansion joint filled with sealant in joints of base flashing sections over 2400 mm (8 feet) in length. Lock and solder corner joints at corners.

C. Extend base flashing up under counter flashing of roof specialties and accessories or equipment not less than 75 mm (3 inch).

3.4 COUNTERFLASHING (CAP FLASHING OR HOODS)

A. General:
   1. Install counterflashing over and in conjunction with installation of base flashings, except as otherwise specified or shown.
   2. Install counterflashing to lap base flashings not less than 100 mm (4 inch).
   3. Install upper edge or top of counterflashing not less than 225 mm (9 inch) above top of the roofing.
   4. Lap joints not less than 100 mm (4 inch). Stagger joints with relation to metal base flashing joints.
   5. Use surface applied counterflashing on existing surfaces and new work where not possible to integrate into item.
   6. When fastening to concrete or masonry, use screws driven in expansion shields set in concrete or masonry. Use screws to wood and sheet metal. Set fasteners in mortar joints of masonry work.

B. One Piece Counterflashing:
   1. Where flashing is installed at new masonry, coordinate to insure proper height, embed in mortar, and end lap.

2. Where flashing is installed in reglet in concrete insert upper edge into reglet. Hold flashing in place with lead wedges spaced not more than 200 mm (8 inch) apart. Fill joint with sealant.
3. Where flashing is surface mounted on flat surfaces.
    a. When top edge is double folded anchor flat portion below sealant "V" joint with fasteners spaced not over 400 mm (16 inch) on center:
        1) Locate fasteners in masonry mortar joints.
        2) Use screws to sheet metal or wood.
    b. Fill joint at top with sealant.
4. Where flashing or hood is mounted on pipe.
    a. Secure with draw band tight against pipe.
    b. Set hood and secure to pipe with a one by 25 mm x 3 mm (1 x 1/8 inch) bolt on stainless steel draw band type clamp, or a stainless worm gear type clamp.
    c. Completely fill joint at top with sealant.

C. Two-Piece Counterflashing:
1. Where receiver is installed at new masonry coordinate to insure proper height, embed in mortar, and lap.
2. Surface applied type receiver:
    a. Secure to face construction in accordance, with manufacturers' instructions.
    b. Completely fill space at the top edge of receiver with sealant.
3. Insert counter flashing in receiver in accordance with fabricator or manufacturer's instructions and to fit tight against base flashing.

D. Where vented edge occur install so lower edge of counterflashing is against base flashing.
E. When counter flashing is a component of other flashing install as shown.

3.5 REGLETS

A. Install reglets in a manner to provide a watertight installation.
B. Locate reglets not less than 225 mm (9 inch) nor more than 400 mm (16 inch) above roofing, and not less than 125 mm (5 inch) nor more than 325 mm (13 inch) above cant strip.
C. Butt and align end joints or each section of reglet and securely hold in position until concrete or mortar are hardened:
1. Coordinate reglets for anchorage into concrete with formwork construction.
2. Coordinate reglets for masonry to locate horizontally into mortar joints.

3.6 COPINGS

A. General:
1. On walls topped with a wood plank, install a continuous edge strip on the front and rear edge of the plank. Lock the coping to the edge strip with a 19 mm (3/4 inch) loose lock seam.
2. Where shown turn down roof side of coping and extend down over base flashing as specified for counter-flashing. Secure counter-flashing to lock strip in coping at continuous cleat.

3. Install ends adjoining existing construction so as to form space for installation of sealants. Sealant is specified in Section 07 92 00, JOINT SEALANTS.

B. Aluminum Coping:
1. Install with 6 mm (1/4 inch) joint between ends of coping sections.
2. Install joint covers, centered at each joint, and securely lock in place.

3.7 ENGINE EXHAUST PIPE OR STACK FLASHING

A. Set collar where shown and secure roof tabs or flange of collar to structural deck with 13 mm (1/2 inch) diameter bolts.
B. Set flange of sleeve base flashing not less than 100 mm (4 inch) beyond collar on all sides as specified for base flashing.
C. Install hood to above the top of the sleeve 50 mm (2 inch) and to extend from sleeve same distance as space between collar and sleeve beyond edge not sleeve:
1. Install insect screen to fit between bottom edge of hood and side of sleeve.
2. Set collar of hood in high temperature sealant and secure with one by 3 mm (1/8 inch) bolt on stainless steel draw band type, or stainless steel worm gear type clamp. Install sealant at top of head.

3.8 CONDUCTORS (DOWNSPOUTS)

A. Where scuppers discharge into downspouts install conductor head to receive discharge with back edge up behind drip edge of scupper. Fasten and seal joint. Sleeve conductors to gutter outlet tubes and fasten joint and joints between sections.
B. Set conductors plumb and clear of wall, and anchor to wall with two anchor straps, located near top and bottom of each section of conductor. Strap at top shall be fixed to downspout, intermediate straps and strap at bottom shall be slotted to allow not less than 13 mm (1/2 inch) movement for each 3000 mm (10 feet) of downspout.
C. Install elbows, offsets and shoes where shown and required. Slope not less than 45 degrees.

3.9 GOOSENECK ROOF VENTILATORS

A. Install on structural curb not less than 200 mm (8 inch) high above roof surface.
B. Securely anchor ventilator curb to structural curb with fasteners spaced not over 300 mm (12 inch) on center.
C. Anchor gooseneck to curb with screws having neoprene washers at 150 mm (6 inch) on center.

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SECTION 07 71 00
ROOF SPECIALTIES

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies copings, gravel stops, fascias, and expansion joints.

1.2 RELATED WORK

A. Section 07 21 13, THERMAL INSULATION: General Insulation.

B. Section 07 22 00, ROOF AND DECK INSULATION: Rigid Insulations for Roofing.

C. Section 07 92 00, JOINT SEALANTS: Sealant Material and Installation.

D. Section 09 06 00, SCHEDULE FOR FINISHES: Color and Texture of Finish

1.3 QUALITY CONTROL

A. Provide roof accessories that products of manufacturers regularly engaged in producing the kinds of products specified.

B. For each accessory type provide products made by the same manufacturer.

C. Assemble each accessory to the greatest extent possible before delivery to the site.

D. Provide each accessory with FM approval listing for class specified.

1.4 PERFORMANCE REQUIREMENTS

A. Provide roof accessories that withstand exposure to weather and resist thermal movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, or installation.

B. Provide roof accessories listed in FM Approvals “RoofNav” and approved for windstorm classification Class 1A-120. Identify materials with FM Approval markings.

C. Manufacture and install roof accessories to allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects.

1. Provide clips that resist rotation and avoid shear stress as a result of thermal movements.
2. For design purposes, base provisions for thermal movement on assumed ambient temperature (range) from minus 18 degrees C (0 degrees F), ambient to 82 degrees C (180 degrees F).

1.5 SUBMITTALS

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

B. Shop Drawings: Each item specified showing design, details of construction, installation and fastenings.

C. Manufacturer's Literature and Data: Each item specified.

D. Certificates: Stating that aluminum has been given specified thickness of anodizing.

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. ASTM International (ASTM):

A240/A240M-20	Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
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
B209-14	Aluminum and Aluminum Alloy-Sheet and Plate
B209M-14	Aluminum and Aluminum Alloy-Sheet and Plate (Metric)
B221-14	Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
B221M-13	Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes (Metric)
B32-08(2014)	Solder Metal
B370-12(2019)	Copper Sheet and Strip for Building Construction
B882-10(2018)	Pre-Patinated Copper for Architectural Applications
C612-14(2019)	Mineral Fiber Block and Board Thermal Insulation
D1187/D1187M-97(2018)	Asphalt-Base Emulsions for Use as Protective Coatings for Metal
D1970/D1970M-20	Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection
D226/D226M-17	Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
D4869/D4969M-16a	Asphalt-Saturated Organic Felt Underlayment Used In Steep Slope Roofing

C. National Association of Architectural Metal Manufacturers (NAAMM):

AMP 500-06	Metal Finishes Manual

D. American Architectural Manufacturers Association (AAMA):

2605-11	High Performance Organic Coatings on Architectural Extrusions and Panels.
611-14	Anodized Architectural Aluminum

E. FM Global (FM):

RoofNav	Approved Roofing Assemblies and Products

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum, Extruded: ASTM B221M (B221).

B. Aluminum Sheet: ASTM B209M (B209).

C. Galvanized Sheet Steel: ASTM A653/A653M; G-90 coating.

D. Stainless-Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304.

E. Copper Sheet: ASTM B370, cold-rolled copper sheet, H00 or H01 temper.

F. Insulation: ASTM C612, Class 1 or 2.

G. Asphalt Coating: ASTM D1187, Type I, quick setting.

2.2 UNDERLAYMENT

A. Self-Adhering Modified Bitumen Underlayment:

1. Provide self-adhering modified bitumen membrane underlayment material in compliance with ASTM D1970/D1970M, suitable for use as underlayment for metal copings and fascias.
2. Provide membrane resistant to cyclical elevated temperatures for extended period of time in high heat service conditions (stable after testing at 116 degrees C (240 degrees F)).
3. Provide membrane with integral non-tacking top surface of polyethylene film or other surface material to serve as separator between bituminous material and metal products to be applied above.
4. Provide primer.

B. Felt Underlayment: Provide No. 30 asphalt saturated organic, non-perforated felt underlayment in compliance with ASTM D226/D226M, Type II, or ASTM D4869/D4869M.

C. Slip Sheet: Provide 0.24 kg per square meter (5 pounds per 100 sf) rosin sized unsaturated building paper for slip sheet.

2.3 SOLDER

A. Copper Solder conforming to ASTM B32, lead-free solder .

2.4 COPINGS

A. Fabricate of aluminum sheet not less than 1.6 mm(0.063 inch) thick.

B. Turn outer edges down each face of wall as shown on construction documents.

C. Maximum lengths of 3.05 M (10 feet).

D. Shop fabricate external and internal corners as one-piece assemblies with not less than 305 mm (12 inch) leg lengths.

E. Provide 101 mm (4 inch) wide 0.81 mm (0.032 inch) thick watertight joint covers.

F. Provide anchor gutter bar of 0.81 mm (0.032 inch) thick with anchor holes formed for underside of joint.

G. Provide concealed guttered splice plate of 0.81 mm (0.032 inch) thick with butyl or other resilient seal strips anchored to splice plate for underside of joint. Use galvanized steel anchor plate providing compression spring anchoring of coping cover.

H. Finish: Three-coat fluoropolymer; Color to be selected from manufacturer standard color options.

I. Factory fabricated scupper assemblies:
   1. Fabricate scupper assembly with extended plates to match copings in 508 mm (20 inch) minimum lengths.
   2. Extend outlet opening not less than 50 mm (2 inches) with drip edge.
   3. Fabricate with stainless steel core or sleeve to drain water from toe of cant and flash in to built-up roofing with 101 mm (4 inch) wide flange.

J. Finish on aluminum: Three-coat fluoropolymer. Color to be selected from manufacturer standard color options.

2.5 FINISH:

A. In accordance with NAAMM AMP 500-505.

PART 3 - FLUOROPOLYMER FINISHES: HIGH PERFORMANCE ORGANIC COATING. PREPARE, PRETREAT, AND APPLY COATING TO EXPOSED METAL SURFACES TO COMPLY WITH COATING AND RESIN MANUFACTURERS' WRITTEN INSTRUCTIONS. THREE-COAT FLUOROPOLYMER: AAMA 2605. FLUOROPOLYMER FINISH CONTAINING NOT LESS THAN 70 PERCENT PVDF RESIN BY WEIGHT IN BOTH COLOR COAT AND TOP COLOR COAT.EXECUTION

3.1 INSTALLATION

A. Examine substrates, areas, and conditions, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage where applicable, and securely anchored.

C. Install roof accessories where indicated in construction documents.

D. Secure with fasteners in accordance with manufacture's printed installation instructions and approved shop drawings unless shown otherwise. Provide fasteners suitable for application, for metal types being secured and designed to meet performance requirements.

E. Where soldered joints are required, clean surfaces to be soldered, removing oils and foreign matter.
   1. Pre-tin edges of sheets to be soldered to a width of 38 mm (1-1/2 inches).
   2. Reduce pre-tinning where pre-tinned surface would show in completed work.
   3. Do not use torches for soldering.
   4. Heat surfaces to receive solder and flow solder into joint.
   5. Fill joint completely.
   6. Completely remove flux and spatter from exposed surfaces.

F. Coordinate to install insulation where shown; see Section 07 21 13, THERMAL INSULATION and Section 07 22 00, ROOF AND DECK INSULATION.

G. Comply with section 07 92 00, JOINT SEALANTS to install sealants where required by manufactures installation instructions.

H. Coordinate with roofing work for installation of items in sequence to prevent water infiltration.

I. Aluminum Coping:

1. Install sections of coping with approximately 6 mm (1/4-inch) space between ends of sections.
2. Center joint gutter bar and covers at joints and lock in place.
3. When snap-on system is installed ensure front and back edges are locked in place.

3.2 PROTECTION OF ALUMINUM

A. Provide protection for aluminum against galvanic action wherever dissimilar materials are in contact, by painting the contact surfaces of the dissimilar material with two (2) coats of asphalt coating (complete coverage), or by separating the contact surfaces with a preformed neoprene tape having pressure sensitive adhesive coating on one (1) side.

B. Paint aluminum in contact with wood, concrete and masonry, or other absorptive materials, that may become repeatedly wet, with two (2) coats of asphalt coating.

3.3 ADJUSTING

A. Adjust expansion joints to close tightly and be watertight; insuring maximum allowance for building movement.

3.4 PROTECTION

A. Protect roof accessories from damage during installation and after completion of the work from subsequent construction.

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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 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:

A. Sustainable Design Requirements: Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

B. Firestopping Penetrations: Section 07 84 00, FIRESTOPPING.

C. Mechanical Work: Section 22 05 11 COMMON WORK RESULTS FOR PLUMBING, 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 other joint sealants for compliance with requirements indicated by referencing standard specifications and test methods.

D. Lab Tests: Submit samples of materials that will be in contact or affect joint sealants to joint sealant manufacturers for tests as follows:

1. Adhesion Testing: Before installing elastomeric sealants, test their adhesion to protect joint substrates according to the method in ASTM C794 to determine if primer or other specific joint preparation techniques are required.
2. Compatibility Testing: Before installing elastomeric sealants, determine compatibility when in contact with glazing and gasket materials.
3. Stain Testing: Perform testing per ASTM C1248 on interior and exterior sealants to determine if sealants or primers will stain adjacent surfaces. No sealant work is to start until results of

these tests have been submitted to the Contracting Officer Representative (COR) and the COR has given written approval to proceed with the work.

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 90 degrees F or less than 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. Exterior Sealants:

1. Vertical surfaces, provide non-staining ASTM C920, Type S or M, Grade NS, Class 25
2. Horizontal surfaces, provide ASTM C920, Type S or M, Grade P, Class 25, Use T.
3. Provide location(s) of exterior sealant as follows:
   a. Joints formed where frames and subsills of windows, doors, louvers, and vents adjoin masonry, concrete, or metal frames. Provide sealant at exterior surfaces of exterior wall penetrations.
   b. Metal to metal.
   c. Masonry to masonry or stone.
   d. Stone to stone.
   e. Cast stone to cast stone.
   f. Masonry expansion and control joints.
   g. Wood to masonry.
   h. Masonry joints where shelf angles occur.
   i. Voids where items penetrate exterior walls.
   j. Metal reglets, where flashing is inserted into masonry joints, and where flashing is penetrated by coping dowels.

B. Floor Joint Sealant:

1. ASTM C920, Type S or M, Grade P, Class 25,
2. 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.

C. 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. Vertical and Horizontal Surfaces: ASTM C920, Type S or M, Grade NS, Class 25, Use NT.
3. 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. Interior surfaces of exterior wall penetrations.

d. Joints at masonry walls and columns, piers, concrete walls or exterior walls.

e. Perimeter of lead faced control windows and plaster or gypsum wallboard walls.

f. Exposed isolation joints at top of full height walls.

g. Joints between bathtubs and ceramic tile; joints between shower receptors and ceramic tile; joints formed where nonplanar tile surfaces meet.

h. Joints formed between tile floors and tile base cove; joints between tile and dissimilar materials; joints occurring where substrates change.

i. Behind escutcheon plates at valve pipe penetrations and showerheads in showers.

D. 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 WEEPS:

A. Weep/Vent Products: Provide the following unless otherwise indicated or approved.

1. Round Plastic Tubing: Medium-density polyethylene, 10 mm (3/8-inch) OD by thickness of stone or masonry veneer.

2.5 FILLER:

A. Mineral fiberboard: ASTM C612, Class 1.

B. Thickness same as joint width.

C. Depth to fill void completely behind back-up rod.

2.6 PRIMER:

A. As recommended by manufacturer of caulking or sealant material.

B. Stain free type.

2.7 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.

B. Weeps: Place weep holes and vents in joints where moisture may accumulate, including at base of cavity walls, above shelf angles, at all flashing, and as indicated on construction documents.

1. Use round plastic tubing to form weep holes.
2. Space weep holes formed from plastic tubing not more than 406 mm (16 inches) o.c.
3. Trim tubing material used in weep holes flush with exterior wall face after sealant has set.

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.

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 and exterior locations.
2. Hollow metal door frames for wood doors at interior locations.

1.2 RELATED WORK

A. Section 08 71 00, DOOR HARDWARE: Door Hardware:

B. Card Readers and Biometric Devices: Section 28 13 00, PHYSICAL ACCESS CONTROL SYSTEM.

C. Intrusion Alarm: Section 28 16 00, INTRUSION DETECTION 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)

D3656/D3656M-13 ..... Insect Screening and Louver Cloth Woven from Vinyl Coated Glass Yarns

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.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Regularly manufactures specified products.
2. Manufactured specified products with satisfactory service on five similar installations for a minimum of five years.

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. Stair Doors: Temperature rise rated fire doors.
3. Smoke Control Doors and Frames: UL 1784; NFPA 80 labeled, maximum 3.0 cubic feet/minute/square foot at 24.9 Pa (0.10 inches water gauge) pressure differential.
4. Blast Resistant Doors: Door, Frame and Anchorage:
    a. Standoff Distance: 50 feet (Mission Critical Protected)
    b. Design Threat W1 at the standoff distance not to exceed pressure and impulse associated with GP2 threat for Mission Critical Protected buildings.
    c. Frame Rotation not to exceed L/40 (Mission Critical Protected) while experiencing design level pressure and impulse.
    d. Glazing: Glazing shall meet the blast requirements shown in Specification 08 80 00.
    e. Minimum gauge of metal used on blast resistant doors shall be 14 gauge.

2.2 MATERIALS

A. Sheet Steel: ASTM A1008/A1008M, cold-rolled.

B. Galvanized Sheet Steel: ASTM A653.

C. Aluminum Sheet: ASTM B209M (ASTM B209).

D. 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. Stainless Steel Recycled Content: 70 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 3 and Physical Performance Level A, extra-heavy duty; Model 2, seamless .

2. Exterior Doors: Level 4 and Physical Performance Level A, maximum heavy duty (minimum 14 ga.; Model 2, seamless .

B. Door Faces:
1. Interior Doors Sheet steelZ180 or ZF180 (G60 or A60).

C. Door Cores:
1. Interior Doors: 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 3 Hollow Metal Doors: 1.3 mm (0.053 inch) thick.
b. Wood Doors : 1.3 mm (0.053 inch) thick.

B. Frame Materials:
1. Interior Frames: Sheet steel Z180 or ZF180 (G60 or A60)
2. Exterior Frames: Galvanized sheet steel minimum Z180 or ZF180 (G60 or A60) .

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. 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. Frame Anchors:
    a. Floor anchors:
        1) Provide extension type floor anchors to compensate for depth of floor fills.
        2) Provide 1.3 mm (0.053 inch) thick steel clip angles welded to jamb and drilled to receive floor fasteners.
        3) Provide 50 mm by 50 mm by 9 mm (2 inch by 2 inch by 3/8 inch) clip angle for lead lined frames, drilled for floor fasteners.
        4) Provide mullion 2.3 mm (0.093 inch) thick steel channel anchors, drilled for two floor fasteners and frame anchor screws.
        5) Provide continuous 1 mm (0.042 inch) thick steel rough bucks drilled for floor fasteners and frame anchor screws for sill sections.
            a) Space floor bolts 50 mm (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 set in masonry: Provide adjustable anchors designed for friction fit against frame and extended into masonry minimum 250 mm (10 inches). Provide one of following types:
            a) Wire Loop Type: 5 mm (3/16 inch) diameter wire.
            b) T-Shape type.
            c) Strap and stirrup type: Corrugated or perforated sheet steel.
        4) Anchors for stud partitions: Provide tabs for securing anchor to sides of studs. Provide one of the following:
            a) Welded type.
            b) Lock-in snap-in type.
        5) Anchors for frames set in prepared openings:
            a) Steel pipe spacers 6 mm (1/4 inch) inside diameter, welded to plate reinforcing at jamb stops, or hat shaped formed strap spacers 50 mm (2 inches) wide, welded to jamb near stop.
            b) Drill jamb stop and strap spacers for 6 mm (1/4 inch) flat head bolts to pass through frame and spacers.
            c) Two piece frames: Subframe or rough buck drilled for 6 mm (1/4 inch) bolts.
        6) Anchors for observation windows and other continuous frames set in stud partitions.
            a) Weld clip anchors to sills and heads of continuous frames over 1200 mm (4 feet) long.

b) Space maximum 600 mm (24 inches) on centers.

7) Modify frame anchors to fit special frame and wall construction.

8) Provide special anchors where shown on drawings and where required to suit application.

2.7 FINISHES

A. 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.

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: stainless steel.

1. Metal Framing: Steel drill screws.

2. Masonry and Concrete: Expansion bolts and power actuated drive pins.

F. Galvanizing Repair Paint: MPI No. 18.

G. 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 COR 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. Masonry Walls:
a. Embed anchors in mortar.
b. Fill space between frame and masonry with grout or mortar as walls are built.
2. Metal Framed Walls: Secure anchors to sides of studs with two fasteners through anchor tabs.
3. Prepared Masonry and Concrete Openings:
a. Direct Securement: 6 mm (1/4 inch) diameter expansion bolts through spacers.
b. Subframe or Rough Buck Securement:
1) 6 mm (1/4 inch) diameter expansion bolts on 600 mm (24 inch) centers.
2) Power activated drive pins on 600 mm (24 inches) centers.
c. Secure two-piece frames to subframe or rough buck with machine screws on both faces.

E. Touch up damaged factory finishes.
1. Repair galvanized surfaces with galvanized repair paint.
2. Repair painted surfaces with touch up primer.

3.4 DOOR INSTALLATION

A. Install doors plumb and level.

B. Adjust doors for smooth operation.

C. Touch up damaged factory finishes.
1. Repair galvanized surfaces with galvanized repair paint.
2. Repair painted surfaces with touch up primer.

3.5 CLEANING

A. Clean exposed door and frame surfaces. Remove contaminants and stains.

3.6 PROTECTION

A. Protect doors and frames from 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 71 00, DOOR HARDWARE: Installation of Door Hardware.

1.3 APPLICABLE PUBLICATIONS

A. Comply with references to the 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.
C. National Fire Protection Association (NFPA):
   1. 80-16 - Fire Doors and Other Opening Protectives.
   2. 252-12 - Fire Tests of Door Assemblies.
D. UL LLC (UL):
   1. 10C-09 - Positive Pressure Fire Tests of Door Assemblies.
E. 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. 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:
      Show volatile organic compound types and quantities.

F. Test Reports: Indicate products comply 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 a minimum of 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. Provide each product from one manufacturer.
B. 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: Match existing adjacent doors. Typically rotary cut birch, AA grade.
   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.

E. FABRICATION

F. 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.

G. Rout doors for hardware using templates and location heights specified in Section 08 71 00, DOOR HARDWARE.

H. Factory fit doors to frame, bevel lock edge of doors 3 mm (1/8 inch) for each 50 mm (2 inches) of door thickness.

I. 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).

J. Finish surfaces, including both faces, top and bottom and edges of the doors smooth to touch.

K. 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.

2.3 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.

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 COR 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 COR.

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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 05 50 00, METAL FABRICATIONS: Wire Mesh and Screen Access Doors.

B. Section 08 71 00, DOOR HARDWARE: Lock Cylinders.

C. Section 09 91 00, PAINTING: Field Painting.

D. Section 09 06 00, SCHEDULE FOR FINISHES: Finish Color.

E. Section 21 13 13, WET-PIPE SPRINKLER SYSTEMS: Access Doors for Control or Drain Valves.

F. Section 22 40 00, PLUMBING FIXTURES: Access Doors for Plumbing Valves.

G. 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.

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.

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. Steel Sheet: ASTM A1008/A1008M.

B. Galvanized Steel: ASTM A653/A653M.

C. 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.

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.

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 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.
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.
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.
E. Gaskets:
    1. Provide gasketing for an airtight installation
    2. Provide gasketing in accordance with manufacturer’s written recommendations.

2.5 FABRICATION - GENERAL

A. Size: Minimum 600 mm (24 inches) square door unless otherwise shown.
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.

2.6 FINISHES

A. Stainless Steel Exposed Surfaces: NAAMM AMP 500; No.06 Metal Finishes.

2.7 ACCESSORIES

A. Fasteners: Type and size recommended by access door manufacturer, to suit application.
   1. Stainless Steel 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.

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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SECTION 08 71 00
DOOR HARDWARE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Door hardware and related items necessary for complete installation and operation of doors.

1.2 RELATED WORK

A. Caulking: Section 07 92 00 JOINT SEALANTS.

B. Application of Hardware: Section 08 14 00, WOOD DOORS Section 08 11 13, HOLLOW METAL DOORS AND FRAMES.

C. Painting: Section 09 91 00, PAINTING.

D. Card Readers: Section 28 13 00, PHYSICAL ACCESS CONTROL SYSTEMS.

E. Electrical: Division 26, ELECTRICAL.

F. 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 the most current version of the International Building Code (IBC).

C. Hardware for Labeled Fire Doors and Exit Doors: Conform to requirements of NFPA 80 for labeled fire doors and to NFPA 101 for exit doors, as well as to other requirements specified. Provide hardware listed by UL, except where heavier materials, large size, or better grades are specified herein under paragraph HARDWARE SETS. In lieu of UL labeling and listing, test reports from a nationally recognized testing agency may be submitted showing that hardware has been tested in accordance with UL test methods and that it conforms to NFPA requirements.

D. Hardware for application on metal and wood doors and frames shall be made to standard templates. Furnish templates to the fabricator of these items in sufficient time so as not to delay the construction.

E. The following items shall be of the same manufacturer, except as otherwise specified:

1. Mortise locksets.
2. Hinges for hollow metal and wood doors.
3. Surface applied overhead door closers.
4. Exit devices.
5. Floor closers.

1.4 WARRANTY

A. Automatic door operators shall be subject to the terms of FAR Clause 52.246-21, except that the Warranty period shall be two years in lieu of one year for all items except as noted below:

1. Locks, latch sets, 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.

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, COR 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 system . Provide removable core cylinders that are removable only with a special key or tool without disassembly of knob or lockset. Cylinders shall be 7 pin SFIC type. Keying information shall be furnished at a later date by the COR.

C. Keying: A new Great Grandmaster key shall be established for this project. The key system shall be small format (Best size and profile) removable core type as previously described. The key blanks shall be protected by a utility patent with a minimum seven years remaining on the patent from the start of construction, and protected by contract-controlled distribution. The manufacturer shall furnish code pattern listings in both paper and electronic formats so keys may be reproduced by code.; provide electronic format in file type required by project's key control software. The manufacturer shall design the new key system with the capacity to rekey the existing system and also provide for 25 percent expansion capability beyond this requirement. Submit a keying chart for approval showing proposed keying layout and listing expansion capacity.

1. Keying information will be furnished to the Contractor by the COR.

2. Supply information regarding key control of cylinder locks to manufacturers of equipment having cylinder type locks. Notify COR immediately when and to whom keys or keying information is supplied. Return all such keys to 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)

PART 2 - PRODUCTS

2.1 BUTT HINGES

A. ANSI A156.1. Provide only three-knuckle hinges, except five-knuckle where the required hinge type is not available in a three-knuckle version (e.g., some types of swing-clear hinges). The following types of butt hinges shall be used for the types of doors listed, except where otherwise specified:

1. Exterior Doors: Type A2112/A5112 for doors 900 mm (3 feet) wide or less and Type A2111/A5111 for doors over 900 mm (3 feet) wide. Hinges for exterior outswing doors shall have non-removable pins. Hinges for exterior fire-rated doors shall be of stainless steel material.
2. Interior Doors: Type A8112/A5112 for doors 900 mm (3 feet) wide or less and Type A8111/A5111 for doors over 900 mm (3 feet) wide. Hinges for doors exposed to high humidity areas (shower rooms, toilet rooms, kitchens, janitor rooms, etc. shall be of stainless steel material.

B. Provide quantity and size of hinges per door leaf as follows:

1. Doors up to 1210 mm (4 feet) high: 2 hinges.
2. Doors 1210 mm (4 feet) to 2260 mm (7 feet 5 inches) high: 3 hinges minimum.
3. Doors greater than 2260 mm (7 feet 5 inches) high: 4 hinges.
4. Doors up to 900 mm (3 feet) wide, standard weight: 114 mm x 114 mm (4-1/2 inches x 4-1/2 inches) hinges.
5. Doors over 900 mm (3 feet) to 1065 mm (3 feet 6 inches) wide, standard weight: 127 mm x 114 mm (5 inches x 4-1/2 inches).
6. Doors over 1065 mm (3 feet 6 inches) to 1210 mm (4 feet), heavy weight: 127 mm x 114 mm (5 inches x 4-1/2 inches).
7. Provide heavy-weight hinges where specified.
8. At doors weighing 330 kg (150 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.
   3. Base Metal for Hinges for Fire-Rated Assemblies: Stainless steel.
   4. Provide with non-removable pin (hospital tip option) at lockable outswing doors.
   5. Where required to clear adjacent casing, trim, and wall conditions and allow full door swing, provide wide throw hinges of minimum width required.
   6. Provide with manufacturer’s cut-outs for separate mortised power transfers and/or mortised automatic door bottoms where they occur.
   7. Where thru-wire power transfers are integral to the hinge, provide hinge with easily removable portion to allow easy access to wiring connections.
   8. Where models are specified that provide an integral wrap-around edge guard for the hinge edge of the door, provide manufacturer’s adjustable threaded stud and machine screw mechanism to allow the door to be adjusted within the wrap-around edge guard.

2.3 DOOR CLOSING DEVICES

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

2.4 OVERHEAD CLOSERS

A. Conform to ANSI A156.4, Grade 1.

B. Closers shall conform to the following:
   1. The closer shall have minimum 50 percent adjustable closing force over minimum value for that closer and have adjustable hydraulic back check effective between 60 degrees and 85 degrees of door opening.
   2. Where specified, closer shall have hold-open feature.
   3. Size Requirements: Provide multi-size closers, sizes 1 through 6, except where multi-size closer is not available for the required application.
   4. Material of closer body shall be forged or cast.
   5. Arm and brackets for closers shall be steel, malleable iron or high strength ductile cast iron.

6. Where closers are exposed to the exterior or are mounted in rooms that experience high humidity, provide closer body and arm assembly of stainless steel material.
7. Closers shall have full size metal cover; plastic covers will not be accepted.
8. Closers shall have adjustable hydraulic back-check, separate valves for closing and latching speed, adjustable back-check positioning valve, and adjustable delayed action valve.
9. Provide closers with any accessories required for the mounting application, including (but not limited to) drop plates, special soffit plates, spacers for heavy-duty parallel arm fifth screws, bull-nose or other regular arm brackets, longer or shorter arm assemblies, and special factory templating. Provide special arms, drop plates, and templating as needed to allow mounting at doors with overhead stops and/or holders.
10. Closer arms or backcheck valve shall not be used to stop the door from overswing, except in applications where a separate wall, floor, or overhead stop cannot be used.
11. Provide parallel arm closers with heavy duty rigid arm.
12. Where closers are to be installed on the push side of the door, provide parallel arm type except where conditions require use of top jamb arm.
13. Provide all surface closers with the same body attachment screw pattern for ease of replacement and maintenance.
14. All closers shall have a 1 ½" (38mm) minimum piston diameter.

2.5 FLOOR CLOSERS AND FLOOR PIVOT SETS

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

B. Where floor closer appears in hardware set provide the following as applicable.

1. Double Acting Floor Closers: Type C06012.
2. Single Acting Floor Closer: Type C06021 (center pivoted). (Intermediate pivot is not required).
3. Single Acting Floor Closers: Type C06041 (offset pivoted).
4. Single Acting Floor Closer for Labeled Fire Doors: Type C06051 (offset pivoted).
5. Single Acting Floor Closers For Lead Lined Doors: Type C06071 (offset pivoted).

2.6 DOORSTOPS

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).

2.7 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.

2.8 FLOOR DOOR HOLDERS

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

2.9 LOCKS AND LATCHES

A. Conform to ANSI A156.2. Locks and latches for doors 45 mm (1-3/4 inch) thick or over shall have beveled fronts. Lock cylinders shall have not less than seven pin SFIC. Cylinders for all locksets shall be removable core type. Cylinders shall be furnished with construction removable cores and construction master keys. Cylinder shall be removable by special key or tool. Construct all cores so that they will be interchangeable into the core housings of all mortise locks, rim locks, cylindrical locks, and any other type lock included in the Great Grand Master Key System. Disassembly of lever or lockset shall not be required to remove core from lockset. All locksets or latches on double doors with fire label shall have latch bolt with 19 mm (3/4 inch) throw, unless shorter throw allowed by the door manufacturer's fire label. Provide temporary keying device or construction core to allow opening and closing during construction and prior to the installation of final cores.

B. In addition to above requirements, locks and latches shall comply with following requirements:

1. Mortise Lock and Latch Sets: Conform to ANSI/BHMA A156.13. Mortise locksets shall be series 1000, minimum Grade 2. All locksets and latch sets, 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 facility standards. No substitute lever material shall be accepted. All locks and latch sets 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 latch sets 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.
4. Locks on designated doors in Psychiatric (Mental Health) areas shall be paddle type with arrow projection covers and be UL Listed. Provide these locks with paddle in the down position on both sides of the door. Locks shall be fabricated of wrought stainless steel.

2.10 PUSH-BUTTON COMBINATION LOCKS

A. ANSI/BHMA A156.5, Grade 1. Battery operated pushbutton entry.

B. Construction: Heavy duty mortise lock housing conforming to ANSI/BHMA A156.13, Grade 1. Lever handles and operating components in compliance with the ABAAS and the ADA Accessibility Guidelines. Match lever handles of locks and latch sets on adjacent doors.

C. Special Features: Key override to permit a master keyed security system and a pushbutton security code activated passage feature to allow access without using the entry code.

2.11 ELECTROMAGNETIC LOCKS

A. ANSI/BHMA A156.23; electrically powered, of strength and configuration indicated; with electromagnet attached to frame and armature plate attached to door. Listed under Category E in BHMA's "Certified Product Directory."

1. Type: Full exterior or full interior, as required by application indicated.
2. Strength Ranking: 1500 pound force (6672 N
3. Inductive Kickback Peak Voltage: Not more than 0 V.
4. Residual Magnetism: Not more than 0 pound force (0 N) to separate door from magnet.

2.12 ELECTRIC STRIKES

A. ANSI/ BHMA A156.31 Grade 1.

B. General: Use fail-secure electric strikes at fire-rated doors.

2.13 KEYS

A. Stamp all keys with change number and key set symbol. Furnish keys in quantities as follows:

Locks/Keys	**Quantity**
Cylinder locks	2 keys each
Cylinder lock change key blanks	100 each different key way
Master-keyed sets	6 keys each
Grand Master sets	6 keys each
Great Grand Master set	5 keys
Control key	2 keys

B. Psychiatric keys shall be cut so that first two bittings closest to the key shoulder are shallow to provide greater strength at point of greatest torque.

2.14 ARMOR PLATES, KICK PLATES, MOP PLATES AND DOOR EDGING

A. Conform to ANSI Standard A156.6.

B. Provide protective plates and door edging as specified below:

1. Kick plates, mop plates and armor plates of metal, Type J100 series.
2. Provide kick plates and mop plates where specified. Kick plates shall be 254 mm (10 inches) or 305 mm (12 inches) high. Mop plates shall be 152 mm (6 inches) high. Both kick and mop plates shall be minimum 1.27 mm (0.050 inches) thick. Provide kick and mop plates beveled on all 4 edges (B4E). On push side of doors where jamb stop extends to floor, make kick plates 38 mm (1-1/2 inches) less than width of door, except pairs of metal doors which shall have plates 25 mm (1 inch) less than width of each door. Extend all other kick and mop plates to within 6 mm (1/4 inch) of each edge of doors. Kick and mop plates shall butt astragals. For jamb stop requirements, see specification sections pertaining to door frames.
3. Kick plates and/or mop plates are not required on following door sides:
   a. Armor plate side of doors;
   b. Exterior side of exterior doors;
   c. Closet side of closet doors;
   d. Both sides of aluminum entrance doors.
4. Armor plates for doors are listed under Article "Hardware Sets". Armor plates shall be thickness as noted in the hardware set, 875 mm (35 inches) high and 38 mm (1-1/2 inches) less than width of doors, except on pairs of metal doors. Provide armor plates beveled on all 4 edges (B4E). Plates on pairs of metal doors shall be 25 mm (1 inch) less than width of each door. Where top of intermediate rail of door is less than 875 mm (35 inches) from door bottom, extend armor plates to within 13 mm (1/2 inch) of top of intermediate rail. On doors equipped with panic devices, extend armor plates to within 13 mm (1/2 inch) of panic bolt push bar.
5. Where louver or grille occurs in lower portion of doors, substitute stretcher plate and kick plate in place of armor plate. Size of stretcher plate and kick plate shall be 254 mm (10 inches) high.
6. Provide stainless steel edge guards where so specified at wood doors. Provide mortised type instead of surface type except where door construction and/or ratings will not allow. Provide edge guards of bevel and thickness to match wood door. Provide edge guards with factory cut-outs for door hardware that must be installed through or extend through the edge guard. Provide full-height edge guards except where door rating does not allow; in such cases, provide edge guards to height of bottom of typical lockset armor front. Forward edge guards to wood door manufacturer for factory installation on doors.

2.15 EXIT DEVICES

A. Conform to ANSI Standard A156.3. Exit devices shall be Grade 1; type and function are specified in hardware sets. Provide flush with finished floor strikes for vertical rod exit devices in interior of building. Trim shall have cast satin stainless steel lever handles of design similar to locksets, unless otherwise specified. Provide key cylinders for keyed operating trim and, where specified, cylinder dogging.

B. Surface vertical rod panics shall only be provided less bottom rod; provide fire pins as required by exit device and door fire labels. Do not provide surface vertical rod panics at exterior doors.

C. Concealed vertical rod panics shall be provided less bottom rod at interior doors, unless lockable or otherwise specified; provide fire pins as required by exit device and door fire labels. Where concealed vertical rod panics are specified at exterior doors, provide with both top and bottom rods.

D. Where removable mullions are specified at pairs with rim panic devices, provide mullion with key-removable feature.

E. At non-rated openings with panic hardware, provide panic hardware with key cylinder dogging feature.

F. Exit devices for fire doors shall comply with Underwriters Laboratories, Inc., requirements for Fire Exit Hardware. Submit proof of compliance.

2.16 FLUSH BOLTS (LEVER EXTENSION)

A. Conform to ANSI A156.16. Flush bolts shall be Type L24081 unless otherwise specified. Furnish proper dustproof strikes conforming to ANSI A156.16, for flush bolts required on lower part of doors.

B. Lever extension manual flush bolts shall only be used at non-fire-rated pairs for rooms only accessed by maintenance personnel.

C. Face plates for cylindrical strikes shall be rectangular and not less than 25 mm by 63 mm (1 inch by 2-1/2 inches).

D. Friction-fit cylindrical dustproof strikes with circular face plate may be used only where metal thresholds occur.

E. Provide extension rods for top bolt where door height exceeds 2184 mm (7 feet 2 inches).

2.17 FLUSH BOLTS (AUTOMATIC)

A. Conform to ANSI A156.3. 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 flush-bolt. Face plates for dustproof strike shall be rectangular and not less than 38 mm by 90 mm (1-1/2 by 3-1/2 inches).

B. At interior doors, provide auto flush bolts less bottom bolt, unless otherwise specified, except at wood pairs with fire-rating greater than 20 minutes; provide fire pins as required by auto flush bolt and door fire labels.

2.18 DOOR PULLS 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.

2.19 PUSH PLATES

A. 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.

2.20 COMBINATION PUSH AND PULL PLATES

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

2.21 COORDINATORS

A. Conform to ANSI A156.16. Coordinators, when specified for fire doors, shall comply with Underwriters Laboratories, Inc., requirements for fire door hardware. Coordinator may be omitted on exterior pairs of doors where either door will close independently regardless of the position of the other door. Coordinator may be omitted on interior pairs of non-labeled open where open back strike is used. Open back strike shall not be used on labeled doors. Paint coordinators to match door frames, unless coordinators are plated. Provide bar type coordinators, except where gravity coordinators are required at acoustic pairs. For bar type coordinators, provide filler bars for full width and, as required, brackets for push-side surface mounted closers, overhead stops, and vertical rod panic strikes.

2.22 THRESHOLDS

A. Conform to ANSI A156.21, mill finish extruded aluminum, except as otherwise specified. In existing construction, thresholds shall be installed in a bed of sealant with 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.

Provide with miter returns where threshold extends more than 12 mm (0.5 inch) beyond face of frame.

2.23 MISCELLANEOUS HARDWARE

A. Access Doors (including Sheet Metal, Screen and Woven Wire Mesh Types): Except for fire-rated doors and doors to Temperature Control Cabinets, equip each single or double metal access door with Lock Type E07213, conforming to ANSI A156.11. Key locks as directed. Ship lock prepaid to the door manufacturer. Hinges shall be provided by door manufacturer.

B. Cylinders for Various Partitions and Doors: Key cylinders same as entrance doors of area in which partitions and door occur, // except as otherwise specified //. Provide cylinders to operate locking devices where specified for following partitions and doors:

1. Folding doors and partitions.
2. Wicket door (in roll-up door assemblies).
3. Slide-up doors.
4. Swing-up doors.
5. Fire-rated access doors-Engineer's key set.
6. Doors from corridor to electromagnetic shielded room.
7. Day gate on vault door.

Mutes: Conform to ANSI A156.16. Provide door mutes or door silencers Type L03011 or L03021, depending on frame material, of white or light gray color, on each steel or wood door frame, except at fire-rated frames, lead-lined frames and frames for sound-resistant, lightproof and electromagnetically shielded doors. Furnish 3 mutes for single doors and 2 mutes for each pair of doors, except double-acting doors. Provide 4 mutes or silencers for frames for each Dutch type door. Provide 2 mutes for each edge of sliding door which would contact door frame.

2.24 FINISHES

A. Exposed surfaces of hardware shall have ANSI A156.18, finishes as specified below. Finishes on all hinges, pivots, closers, thresholds, etc., shall be as specified below under "Miscellaneous Finishes." For field painting (final coat) of ferrous hardware, see Section 09 91 00, PAINTING.

B. 626 or 630: All surfaces on exterior and interior of buildings, except where other finishes are specified.

C. Miscellaneous Finishes:

1. Hinges --exterior doors: 626 or 630.
2. Hinges --interior doors: 652 or 630.
3. Pivots: Match door trim.
4. Door Closers: Factory applied paint finish. Dull or Satin Aluminum color.
5. Thresholds: Mill finish aluminum.
6. Cover plates for floor hinges and pivots: 630.
7. Other primed steel hardware: 600.

D. Hardware Finishes for Existing Buildings: U.S. Standard finishes shall match finishes of hardware in (similar) existing spaces .

E. 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.

2.25 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. Hardware Heights from Finished Floor:

1. Exit devices centerline of strike (where applicable) 1024 mm (40-5/16 inches).
2. Locksets and latch sets centerline of strike 1024 mm (40-5/16 inches).
3. Deadlocks centerline of strike 1219 mm (48 inches).
4. Hospital arm pull 1168 mm (46 inches) to centerline of bottom supporting bracket.
5. Centerline of door pulls to be 1016 mm (40 inches).
6. Push plates and push-pull shall be 1270 mm (50 inches) to top of plate.
7. Push-pull latch to be 1024 mm (40-5/16 inches) to centerline of strike.
8. Locate other hardware at standard commercial heights. Locate push and pull plates to prevent conflict with other hardware.

3.2 INSTALLATION

A. Closer devices, including those with hold-open features, shall be equipped and mounted to provide maximum door opening permitted by building construction or equipment. Closers shall be mounted on side of door inside rooms, inside stairs, and away from corridors . At exterior doors, closers shall be mounted on interior side. Where closers are mounted on doors they shall be mounted with hex nuts and bolts; foot shall be fastened to frame with machine screws.

B. Hinge Size Requirements:

Door Thickness	Door Width	Hinge Height
45 mm (1-3/4 inch)	900 mm (3 feet) and less	113 mm (4-1/2 inches)

Door Thickness	Door Width	Hinge Height
45 mm (1-3/4 inch)	Over 900 mm (3 feet) but not more than 1200 mm (4 feet)	125 mm (5 inches)
35 mm (1-3/8 inch) (hollow core wood doors)	Not over 1200 mm (4 feet)	113 mm (4-1/2 inches)

C. Hinge leaves shall be sufficiently wide to allow doors to swing clear of door frame trim and surrounding conditions.

D. Where new hinges are specified for new doors in existing frames or existing doors in new frames, sizes of new hinges shall match sizes of existing hinges; or, contractor may reuse existing hinges provided hinges are restored to satisfactory operating condition as approved by COR. Existing hinges shall not be reused on door openings having new doors and new frames. Coordinate preparation for hinge cut-outs and screw-hole locations on doors and frames.

E. Hinges Required Per Door:

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 COR 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 COR 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)

VOLUME 01 DATA CENTER - SCHEDULED DOOR HARDWARE

Refer to “PART 3 – EXECUTION” for required specification sections.

A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

1. Quantities listed are for each pair of doors, or for each single door.
2. The supplier is responsible for handing and sizing all products.
3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.
4. At existing openings with new hardware the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.

B. Manufacturer’s Abbreviations:

1. MK - McKinney
2. RO - Rockwood
3. YA - ASSA ABLOY ACCENTRA
4. MC - Medeco
5. RU - Corbin Russwin
6. NO - Norton
7. PE - Pemko
8. SU - Securitron

Volume 01 - Hardware Sets

Set: 1.0

Doors: 104, 105

Description: EXT ELEC / GEN PR (Added CR & ELEC STRIKE)

1	Hinge (A5111- Elec)	T4A3386 QC_	US32D	MK	
5	Hinge (A5111)	T4A3386 4-1/2" x 4-1/2"	US32D	MK	

1	Mullion	KRM200	600	YA	
1	Rim Exit Device, Nightlatch	7150WS AU627F	630	YA	
1	Rim Exit Device, Exit Only	7150WS EO	630	YA	
1	Interchangeable Core - X4 (E09241)	33700007N	26	MC	
1	Cylinder housing - SFIC	as required	626	RU	
1	ElectroLynx Adaptor	2004M		HS	
1	SMART Pac Bridge Rectifier	2005M3		HS	
1	Electric Strike	9600-LBSM	630	HS	
2	Surface Closer (C02021-Spg Stop)	CPS8501	689	NO	
2	Armor Plate (J101)	K1050 35" CSK	US32D	RO	
2	Door Stop (L02251 / L02121)*	403/470	US26D	RO	
1	Astragal (R0Y834)	18041CNB		PE	
1	Astragal	S772D [mtg on mull]		PE	
1	Adhesive Gasketing (R0Y154)	S88BL		PE	
1	Rain Guard	346C x LAR		PE	
2	Sweep (R3B434)	315CN		PE	
1	Threshold (J321000)	2715A		PE	
1	Wiring Diagram	By Security Contractor		SA	
1	Frame Harness	QC-C3000P		MK	
1	Access Control Reader	by Security Contractor		OT	
1	Position Switch	DPS		SU	
1	Power Supply	AQL (Amperage & relays as req'd)		SU	

Notes: *Waiver may be required to comply with Buy American Act. Compliancy of this product to current Buy American-type regulations must be validated with the manufacturer.
Hardware listed for design criteria, confirm with specific door manufacturer the hardware requirements to meet specified windstorm rating - Provide 3rd party test results for confirmation.
Hardware listed for design purposes, verify with specific door mfg requirements for doors to meet DOD UDF 4-010-01 standards for blast doors. Provide third party test results to verify product meets standards.

Coordinate reader location with contractor.

Coordinate power with electrical contractor.

- Doors normally closed and secure.
- Authorized access by valid read at reader releases electric strike for entry
- Egress free for immediate exit at all times
- Door remains locked (fail secure) in event of power loss.
- Keyed cylinder override for emergency access.
- Door monitored for door ajar and forced entry.

Set: 2.0

Doors: 101

Description: EXT - CORR (ADD CR & ELEC Strike)

2	Hinge (A5111)	T4A3386 NRP USA	US32D	MK	
1	Hinge (A5111- Elec)	T4A3386 QC_ 4 1/2" x 4 1/2"	US32D	MK	⚡
1	Rim Exit Device, Nightlatch	7150WS AU627F	630	YA	
1	Interchangeable Core - X4 (E09241)	33700007N	26	MC	
1	Cylinder housing - SFIC	as required	626	RU	
1	ElectroLynx Adaptor	2004M		HS	⚡
1	SMART Pac Bridge Rectifier	2005M3		HS	⚡
1	Electric Strike	9600-LBSM	630	HS	⚡
1	Surface Closer (C02021-Spg Stop)	CPS8501	689	NO	
1	Kick Plate (J102)	K1050 10" CSK	US32D	RO	
1	Door Stop (L02251 / L02121)*	403/470	US26D	RO	
1	Adhesive Gasketing (R0Y154)	S88BL		PE	
1	Rain Guard	346C x LAR		PE	
1	Threshold (J36100)	2005AT		PE	
1	Wiring Diagram	By Security Contractor		SA	
1	Frame Harness	QC-C3000P		MK	⚡
1	Access Control Reader	by Security Contractor		OT	

1	Position Switch	DPS	SU	
1	Power Supply	AQL (Amperage & relays as req'd)	SU	

Notes:
*Waiver may be required to comply with Buy American Act. Compliancy of this product to current Buy American-type regulations must be validated with the manufacturer.
Hardware listed for design criteria, confirm with specific door manufacturer the hardware requirements to meet specified windstorm rating - Provide 3rd party test results for confirmation.
Hardware listed for design purposes, verify with specific door mfg requirements for doors to meet DOD UDF 4-010-01 standards for blast doors. Provide third party test results to verify product meets standards.

Coordinate reader location with contractor.
Coordinate power with electrical contractor.

- Doors normally closed and secure.
- Authorized access by valid read at reader releases electric strike for entry
- Egress free for immediate exit at all times
- Door remains locked (fail secure) in event of power loss.
- Keyed cylinder override for emergency access.
- Door monitored for door ajar and forced entry.

Set: 3.0

Doors: 108
Description: EXT-CONDENSER YARD

6	Hinge	T4A3386 NRP USA	US32D	MK
1	Mullion	KRM200	600	YA
1	Rim Exit Device, Nightlatch	7150WS AU627F	630	YA
1	Rim Exit Device, Exit Only	7150WS EO	630	YA
1	Interchangeable Core - X4 (E09241)	33700007N	26	MC
1	Cylinder housing - SFIC	as required	626	RU
2	Surface Closer (C02021-Spg Stop)	CPS8501	689	NO
2	Armor Plate (J101)	K1050 35" CSK	US32D	RO
1	Threshold (J321000)	2715A		PE

Notes: *Waiver may be required to comply with Buy American Act. Compliancy of this product to current Buy American-type regulations must be validated with the manufacturer.
Hardware listed for design criteria, confirm with specific door manufacturer the hardware requirements to meet specified windstorm rating - Provide 3rd party test results for confirmation.
Hardware listed for design purposes, verify with specific door mfg requirements for doors to meet DOD UDF 4-010-01 standards for blast doors. Provide third party test results to verify product meets standards.

Set: 4.0

Doors: 100, 100a

Description: DATA PR (Add CR& ELEC STRIKE)

2	Continuous Hinge (A31031G) ELEC	CFM_HD1-M SER12		PE	
1	Self Latching Flush Bolt (Type 27)	2805/2905	US32D	RO	
1	Dust Proof Strike (L04021)*	570	US26D	RO	
1	Storeroom Lock (F07)	AUR 8805FL A620 Less Core	626	YA	
1	Interchangeable Core - X4 (E09241)	33700007N	26	MC	
1	Electric Strike	1600-CLB-LMS	630	HS	
1	ElectroLynx Adaptor	2004M		HS	
1	SMART Pac Bridge Rectifier	2005M3		HS	
1	Coordinator (Type 21A)*	2600 Series (Brackets To Suit)	Black	RO	
2	Surface Closer (C02011 / C02021)	R / PR8501 M	689	NO	
2	Kick Plate (J102)	K1050 10" CSK	US32D	RO	
2	Door Stop (L02251 / L02121)*	403/470	US26D	RO	
2	Silencer (L03011)	608		RO	
1	Wiring Diagram	By Security Contractor		SA	
1	Frame Harness	QC-C3000P		MK	
1	Access Control Reader	by Security Contractor		OT	
1	Position Switch	DPS		SU	
1	Power Supply	AQL (Amperage & relays as req'd)		SU	

Notes:

Coordinate reader location with contractor.

Coordinate power with electrical contractor.

- Doors normally closed and secure.
- Authorized access by valid read at reader releases electric strike for entry
- Egress free for immediate exit at all times
- Door remains locked (fail secure) in event of power loss.
- Keyed cylinder override for emergency access.
- Door monitored for door ajar and forced entry.

Set: 5.0

Doors: 104a

Description: ELEC - RATED

3	Hinge (A8112)	TA2714 x USA	US26D	MK	
1	Fire Rated Rim Exit, Nightlatch	7100F AU627F	630	YA	
1	Interchangeable Core - X4 (E09241)	33700007N	26	MC	
1	Surface Closer (C02021-PT4G)	CPS8501 M	689	NO	
1	Adhesive Gasketing (R0Y154)	S88BL		PE	

Set: 6.0

Doors: 102

Description: MEP (ADD CR ELEC STRIKE)

3	Hinge (A8112)	TA2714 x USA	US26D	MK	
1	Storeroom Lock (F07)	AUR 8805FL A620 Less Core	626	YA	
1	Interchangeable Core - X4 (E09241)	33700007N	26	MC	
1	Electric Strike	1600-CLB-LMS	630	HS	⚡
1	ElectroLynx Adaptor	2004M		HS	⚡
1	SMART Pac Bridge Rectifier	2005M3		HS	⚡
1	Surface Closer (C02011 / C02021)	R / PR8501 M	689	NO	

1	Kick Plate (J102)	K1050 10" CSK	US32D	RO	
1	Door Stop (L02251 / L02121)*	403/470	US26D	RO	
1	Adhesive Gasketing (R0Y154)	S88BL		PE	
1	Wiring Diagram	By Security Contractor		SA	
1	Frame Harness	QC-C3000P		MK	
1	Access Control Reader	by Security Contractor		OT	
1	Power Supply	AQL (Amperage & relays as req'd)		SU	

Notes:

Coordinate reader location with contractor.

Coordinate power with electrical contractor.

- Doors normally closed and secure.
- Authorized access by valid read at reader releases electric strike for entry
- Egress free for immediate exit at all times
- Door remains locked (fail secure) in event of power loss.
- Keyed cylinder override for emergency access.
- Door monitored for door ajar and forced entry.

Set: 7.0

Doors: 107

Description: STOR

3	Hinge (A8112)	TA2714 x USA	US26D	MK
1	Storeroom Lock (F07)	AUR 8805FL A620 Less Core	626	YA
1	Interchangeable Core - X4 (E09241)	33700007N	26	MC
1	Door Stop (L02251 / L02121)*	403/470	US26D	RO
3	Silencer (L03011)	608		RO

Set: 8.0

Doors: 103

Description: HAC

3	Hinge (A8112)	TA2714 x USA	US26D	MK	
1	Storeroom Lock (F07)	AUR 8805FL A620 Less Core	626	YA	
1	Interchangeable Core - X4 (E09241)	33700007N	26	MC	
1	Surface Closer (C02011 / C02021)	R / PR8501 M	689	NO	
1	Mop Plate (J103)	K1050 6" CSK	US32D	RO	
1	Door Stop (L02251 / L02121)*	403/470	US26D	RO	
3	Silencer (L03011)	608		RO	

Set: 9.0

Doors: 106

Description: ENTRANCE (ADD CR ELEC STRIKE)

1	Continuous Hinge (A31031G) ELEC	CFM_HD1-M SER12		PE	⚡
1	Entry Lock (F04)	AUR 8807FL A620 Less Core	626	YA	
1	Interchangeable Core - X4 (E09241)	33700007N	26	MC	
1	Electric Strike	1600-CLB-LMS	630	HS	⚡
1	ElectroLynx Adaptor	2004M		HS	⚡
1	SMART Pac Bridge Rectifier	2005M3		HS	⚡
1	Door Stop (L02251 / L02121)*	403/470	US26D	RO	
3	Silencer (L03011)	608		RO	
1	Wiring Diagram	By Security Contractor		SA	
1	Frame Harness	QC-C3000P		MK	⚡
1	Access Control Reader	by Security Contractor		OT	
1	Position Switch	DPS		SU	⚡
1	Power Supply	AQL (Amperage & relays as req'd)		SU	⚡

Notes:

Coordinate reader location with contractor.

Coordinate power with electrical contractor.

- Doors normally closed and secure.
- Authorized access by valid read at reader releases electric strike for entry
- Egress free for immediate exit at all times
- Door remains locked (fail secure) in event of power loss.
- Keyed cylinder override for emergency access.
- Door monitored for door ajar and forced entry.

Volume 02 - Hardware Sets

Set: 10.0

Doors: 110-12, 117-11, 122-14, 247-12, 347-12, A030A-1, A132-1, A210-1, A241-1, A305-1, A341-1, A402-1, A441-1, A502-1, A543-1, B050C-1, D304-1, E154-1, E261-1, E303-1, E357A-1, E448-1, E503-1, EB51A-1, H133-1, H235-1, H335-1, H435-1, J227-1, J327-1, J427-1, J525-1, J527-1, FB23B-1, FB28L-1, C259-1

Description: TELCOM

1	Continuous Hinge (A31031G)	CFM (height) HD1		PE
1	Storeroom Lock (F07)	AUR 8805FL A620 Less Core	626	YA
1	Interchangeable Core - X4 (E09241)	33700007N	26	MC
1	Surface Closer (C02011 / C02021)	R / PR8501 M	689	NO
1	Door Stop (L02251 / L02121)*	403/470	US26D	RO
1	Adhesive Gasketing (R0Y154)	S88BL		PE

Set: 11.0

Doors: C085A-1, E571A-1, H519-1, J142-1, 202A-28, F122-1, G161-1

Description: TELCOM

1	Continuous Hinge (A31031G)	CFM (height) HD1		PE
1	Storeroom Lock (F07)	AUR 8805FL A620 Less Core	626	YA
1	Interchangeable Core - X4 (E09241)	33700007N	26	MC
1	Surface Closer (C02021-Spg Stop)	CPS8501	689	NO

Set: 12.0

Doors: A306-1, E447-1
Description: OFFICE

3	Hinge (A8112)	TA2714 x USA	US26D	MK
1	Storeroom Lock (F07)	AUR 8805FL A620 Less Core	626	YA
1	Interchangeable Core - X4 (E09241)	33700007N	26	MC
1	Door Stop (L02251 / L02121)*	403/470	US26D	RO
3	Silencer (L03011)	608		RO

- - - E N D - - -

SECTION 08 90 00
LOUVERS AND VENTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies fixed and operable wall louvers, door louvers and wall vents.

1.2 RELATED WORK

A. Section 08 11 13, HOLLOW METAL DOORS AND FRAMES: Louvers in Steel Doors.

B. Section 09 06 00, SCHEDULE FOR FINISHES: Color of finish.

1.3 SUBMITTALS

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

B. Shop Drawings:

1. Each type, showing material, finish, size of members, operating devices, method of assembly, and installation and anchorage details.

C. Manufacturer's Literature and Data:

1. Each type of louver and vent.

D. Color samples.

E. Blast Design Calculations: Louver System and Anchorage

1. Submit calculations for review and approval prepared by qualified blast consultant, with a minimum of 5 years' experience in design of blast resistant window systems, verifying louver assembly including anchors comply with specified blast resistance performance. The magnitudes of the design threats W1, W2 and GP1, GP2 are defined in the Physical Security Design Standards Data Definitions which is a document separate from the referenced VA Security Design Manual. The Physical Security Design Standards Data Definitions are provided on a need to know basis by the blast/structural engineer performing the blast design on VA projects. It is the responsibility of the engineer of blast resistant windows to request and obtain the Physical Security Design Data Standard Data Definitions from the VA Office of Construction and Facilities Management (CFM). Any associated delays or increased costs due to failure to obtain this information will be borne by the contractor.

1.4 APPLICABLE PUBLICATIONS:

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

B. The Master Painters Institute (MPI):
Approved Product List – Updated Monthly

C. ASTM International (ASTM):

A240/A240M-20 ..... Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

A653/A653M-20 ..... Steel Sheet Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot Dip Process

A1008/A1008M-20 ..... Steel, Sheet, Carbon, Cold Rolled, Structural, and High Strength Low-Alloy with Improved Formability

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)

D1187/D1187M-97(2018) ..... Asphalt-Base Emulsions for Use as Protective Coatings for Metal

D. National Association of Architectural Metal Manufacturers (NAAMM):
AMP 500-06 ..... Metal Finishes Manual

E. National Fire Protection Association (NFPA):
90A-15..... Installation of Air Conditioning and Ventilating Systems

F. American Architectural Manufacturers Association (AAMA):
2605-13 ..... High Performance Organic Coatings on Architectural Extrusions and Panels

G. Air Movement and Control Association, Inc. (AMCA):
500-L-07 Testing Louvers

H Department of Veterans Affairs:
VA Physical Security Design Manual for Life Safety Protected Facilities January 2015
VA Physical Security Design Manual for Mission Critical Protected Facilities January 2015

I. Protective Design Center
PDC-TR-08 Single Degree of Freedom Structural Response Limits for Antiterrorism Design

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Aluminum, Extruded: ASTM B221M (B221).

B. Fasteners: Fasteners for securing louvers and wall vents to adjoining construction, except as otherwise specified or indicated in construction documents, to be toggle or expansion bolts of size and type as required for each specific type of installation and service condition.

1. Where type, size, or spacing of fasteners is not shown or specified, submit shop drawings showing proposed fasteners, and method of installation.

2. Fasteners for louvers, louver frames, and wire guards to be of stainless steel or aluminum with same finish as louvers.

C. Inorganic Zinc Primer: MPI No. 19.

D. Bituminous Coating: ASTM D1187/D1187M; cold applied asphalt mastic emulsion.

2.2 EXTERIOR WALL LOUVERS:

A. General:

1. Provide fixed type louvers of size and design shown.
2. Heads, sills and jamb sections are to have formed caulking slots or be designed to retain caulking. Head sections are to have exterior drip lip, and sill sections an integral water stop.
3. Furnish louvers with sill extension or separate sill as shown.
4. Frame is to be mechanically fastened or welded construction with welds dressed smooth and flush.

B. Performance Characteristics:

1. Weather louvers are to have a minimum of 45 percent free area and to pass 946fpm free area velocity at a pressure drop not exceeding 0.15 inch water gauge and carry not more than 0.01 ounces of water per square foot of free area for 15 minutes when tested per AMCA Standard 500-L.
2. Louvers are to bear AMCA certified rating seals for air performance and water penetration ratings.
3. Blast Resistance:
   A. Louvers in exterior walls shall be blast resistant and meet the following criteria per the VA Physical Security & Resiliency Design Manual 2020 (Revised June 1, 2025):
      1. Standoff Distance: 50 feet (Critical Protected)
         a. Design Threat W1 at the standoff distance not to exceed pressure and impulse associated with GP2 threat for Critical Protected Buildings.
         b. Deformation not to exceed those defined by B2 response per the Protective Design Center document PDC-TR-06-08 while experiencing design level pressures.

C. Aluminum Louvers:

1. General: Frames, blades, sills, and mullions (sliding interlocking type); 2 mm (0.078-inch) thick extruded 6063-T6 aluminum. Blades to be drainable type and have reinforcing bosses.
2. Louvers, fixed: Make frame sizes 13 mm (1/2-inch) smaller than openings. Single louvers frames are not to exceed 1676 mm (66 inches) wide. When openings exceed 1676 mm (66 inches), provide twin louvers separated by mullion members.

3. Louvers are to withstand the effects or gravity loads and the following wind loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver-blade rattle or flutter, or permanent damage to fasteners and anchors.
    a. Wind load acting inward or outward of not less than 30 pound per square foot.

2.3 CLOSURE ANGLES AND CLOSURE PLATES:

A. Fabricate from 2 mm (0.078-inch) thick stainless steel or aluminum.
B. Provide continuous closure angles and closure plates on inside head, jambs and sill of exterior wall louvers.
C. Secure angles and plates to louver frames with screws, and to masonry or concrete with fasteners as indicated in construction documents.

2.4 WALL VENTS:

A. Fabricate exterior wall vents from either 4.7 mm (0.185-inch) thick aluminum plate or 6 mm (1/4-inch) thick cast iron, perforated in diamond lattice pattern, with not over 19 mm (3/4-inch) openings.
B. Vents are to have aluminum screen frame with aluminum alloy insect screening mounted on back of vent by means of 19 mm x 5 mm (3/4-inch by 3/16-inch) top and bottom bars screwed to grille.
C. Vent Frames in Masonry: Fabricate of 45 mm x 30 mm x 5 mm (1-3/4 inch by 1-1/4 inch by 3/16-inch) steel angles bolted with 6 mm (1/4-inch) diameter expansion bolts at jambs.

2.5 AIR INTAKE VENTS:

A. Fabricate exterior louvered wall ventilators for fresh air intake for air conditioning units from extruded aluminum, ASTM B221M (B221). Form with integral horizontal louvers and frame, with drip extending beyond face of wall and integral water stops.
B. Provide 0.8 mm (0.032-inch) thick aluminum sleeves in cavity walls.

2.6 BRICK VENTS:

A. Vents are to be of size shown formed of approximately 3 mm (0.125 inch) thick cast aluminum, or 3 mm (0.118 inch) extruded aluminum.
B. Provide vents complete with aluminum screen frame with corrosion resistant insect screening mounted on back of vent.
C. Provide vents with required anchors.

2.7 FINISH:

A. In accordance with NAAMM Metal Finishes Manual: AMP 500-505
B. Aluminum Louvers :
    1. Anodized finish

a. AA-M10C22A44, Chemically etched medium matte, with electronically deposited metallic compound, Class I Architectural, 0.17 mm (0.7 mils) thick color anodic coating. Dyes will not be accepted.

2.8 PROTECTION:

A. Provide protection for aluminum against galvanic action wherever dissimilar materials are in contact, by painting the contact surfaces of the dissimilar material with a heavy coat of bituminous coating (complete coverage), or by separating the contact surfaces with a performed synthetic rubber tape having pressure sensitive adhesive coating on one side.

B. Isolate the aluminum from plaster, concrete and masonry by coating aluminum with zinc-chromate primer.

C. Protect finished surfaces from damage during fabrication, erection, and after completion of the work. Strippable plastic coating on finish is not approved.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Set work accurately, in alignment and where indicated in construction documents. Install plumb, level, free of rack and twist, and set parallel or perpendicular as required to line and plane of surface.

B. Furnish setting drawings and instructions for installation of anchors and for the positioning of items having anchors to be built into masonry construction. Provide temporary bracing for such items until masonry is set.

C. Provide anchoring devices and fasteners as shown and as necessary for securing louvers and vents to building construction as specified. Power actuated drive pins may be used, except for removal items and where members would be deformed or substrate damaged by their use.

D. Set wall louvers and vents in masonry walls during progress of the work. If wall louvers and vents are not delivered to job in time for installation in prepared openings, make provision for later installation. Set in cast-in-place concrete in prepared openings.

3.2 CLEANING AND ADJUSTING:

A. After installation, all exposed prefinished and plated items and all items fabricated from stainless steel and aluminum are to be cleaned as recommended by the manufacturer and protected from damage until completion of the project.

B. All movable parts, including hardware, are to be cleaned and adjusted to operate as designed without binding or deformation of the members, so as to be centered in the opening of frame, and where applicable, to have all contact surfaces fit tight and even without forcing or warping the components.

C. Restore louvers and vents damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Contracting Officer Representative (COR) damaged units and replace with new units.

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SECTION 09 05 16
SUBSURFACE PREPARATION FOR FLOOR FINISHES

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies subsurface preparation requirements for areas to receive the installation of applied and resinous flooring. This section includes removal of existing floor coverings, testing concrete for moisture and pH, remedial floor coating for concrete floor slabs having unsatisfactory moisture or pH conditions, and floor leveling and repair as required.

1.2 RELATED WORK

A. Section 07 92 00, JOINT SEALANTS.
B. Section 09 67 23 60, RESINOUS (Urethane and Epoxy Mortar) FLOORING

1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA and TEST DATA.
B. Written approval confirming product compatibility with subfloor material manufacturer and the flooring manufacturer.
C. Product Data:
   1. Moisture remediation system
   2. Underlayment Primer
   3. Cementitious Self-Leveling Underlayment
D. Test Data:
   1. Moisture test and pH results performed by a qualified independent testing agency or warranty holding manufacturer’s technical representative.

1.4 DELIVERY AND STORAGE

A. Deliver materials in containers with labels legible and intact and grade-seals unbroken.
B. Store material to prevent damage or contamination.

1.5 APPLICABLE PUBLICATIONS

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

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

2.2 CEMENTITIOUS SELF-LEVELING UNDERLAYMENT

A. System Descriptions:
   1. High performance self-leveling underlayment resurfacer. Single component, self-leveling, cementitious material designed for easy application as an underlayment for all types of flooring materials. It is used for substrate repair and leveling.

B. Products: Subject to compliance with applicable fire, health, environmental, and safety requirements for storage, handling, installation, and clean up. Gypsum-based products are unacceptable.

C. System Characteristics:
   1. Wearing Surface: smooth
   2. Thickness: Per architectural drawings, ranging from feathered edge to 1", per application. Applications greater than 1" require additional 3/8" aggregate to mix or as recommended by manufacturer.

D. Underlayment shall be calcium aluminate cement-based, containing Portland cement. Gypsum-based products are unacceptable.

E. Compressive Strength: Minimum 4100 psi in 28 days in accordance with ASTM C109/C109M.

F. Flexural Strength: Minimum 1000 psi in 28 days in accordance with ASTM C348

G. Dry Time: Underlayment shall receive the application of 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.

Property	Test	Value
Compressive Strength	ASTM C109/C109M	2,200 psi @ 24 hrs 3,000 psi @ 7 days
Initial set time Final Set time	ASTM C191	30-45 min. 1 to 1.5 hours
Bond Strength	ASTM D7234	100% bond to concrete failure

PART 3 - EXECUTION

3.1 ENVIRONMENTAL REQUIREMENTS

A. Maintain ambient temperature of work areas at not less than 16 degree C (60 degrees F), without interruption, for not less than 24 hours before testing and not less than three days after testing.

B. Maintain higher temperatures for a longer period of time where required by manufacturer's recommendation.

C. Do not install materials when the temperatures of the substrate or materials are not within 60-85 degrees F/ 16-30 degrees C.

3.2 SURFACE PREPARATION

A. Existing concrete slabs with existing floor coverings:
   1. Conduct visual observation of existing floor covering for adhesion, water damage, alkaline deposits, and other defects.

2. Remove existing floor covering and adhesives. Comply with local, state and federal regulations and the RFCI Recommended Work Practices for Removal of Resilient Floor Coverings, as applicable to the floor covering being removed.

B. Concrete shall meet the requirements of ASTM F710 and be sound, solid, clean, and free of all oil, grease, dirt, curing compounds, and any substance that might act as a bond-breaker before application. As required prepare slab by mechanical methods. No chemicals or solvents shall be used.

C. General: Prepare and clean substrates according to flooring manufacturer's written instructions for substrate indicated.

D. Prepare concrete substrates per ASTM D4259 as follows:
   1. Dry abrasive blasting.
   2. Wet abrasive blasting.
   3. Vacuum-assisted abrasive blasting.
   4. Centrifugal-shot abrasive blasting.
   5. Comply with manufacturer's written instructions.

E. Repair damaged and deteriorated concrete according to flooring manufacturer's written recommendations.

F. Verify that concrete substrates are dry.

G. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with application only after substrates have maximum moisture-vapor-emission rate of per flooring 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, to create floor flatness or levelness corrections to meet the tolerance requirements as or detailed on drawings, to address non-moving cracks or joints, and to provide a smooth surface for the installation of floor covering.

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 22 16
NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies steel studs wall systems, shaft wall systems, ceiling or soffit suspended or furred framing, wall furring, fasteners, and accessories for the screw attachment of gypsum board, 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

In accordance with the requirements of ASTM C754.

1.6 APPLICABLE PUBLICATIONS

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

B. American Society For Testing And Materials (ASTM)

A641-09.....Zinc-Coated (Galvanized) Carbon Steel Wire

A653/653M-11.....Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.

C11-10.....Terminology Relating to Gypsum and Related Building Materials and Systems

C635-07 .....Manufacture, Performance, and Testing of Metal Suspension System for Acoustical Tile and Lay-in Panel Ceilings

C636-08 .....Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels

C645-09 .....Non-Structural Steel Framing Members

C754-11 .....Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products

C841-03(R2008) .....Installation of Interior Lathing and Furring

C954-10 .....Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness

E580-11.....Application of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Requiring Moderate Seismic Restraint.

PART 2 - PRODUCTS

2.1 PROTECTIVE COATING

Galvanize steel studs, runners (track), rigid (hat section) furring channels, "Z" shaped furring channels, and resilient furring channels, with coating designation of G40 or equivalent.

2.2 STEEL STUDS AND RUNNERS (TRACK)

A. ASTM C645, modified for thickness specified and sizes as shown.

1. Use C 645 steel, 0.75 mm (0.0296-inch) minimum base-metal (30 mil).
2. Runners same thickness as studs.
3. Exception: Members that can show certified third party testing with gypsum board in accordance with ICC ES AC86 (Approved May 2012) need not meet the minimum thickness limitation or minimum section properties set forth in ASTM C 645. The submission of an

evaluation report is acceptable to show conformance to this requirement. Use C 645 steel, 0.48mm (0.019 inch) minimum base-metal (19 mil).

B. Provide not less than two cutouts in web of each stud, approximately 300 mm (12 inches) from each end, and intermediate cutouts on approximately 600 mm (24-inch) centers.

C. Doubled studs for openings and studs for supporting concrete backer-board.

D. Studs 3600 mm (12 feet) or less in length shall be in one piece.

E. Provide deep leg deflection track at the top of walls extending to deck above.

F. Shaft Wall Framing:

1. Conform to rated wall construction.
2. C-H Studs or C-T Studs.
3. E Studs.
4. J Runners.
5. Steel Jamb-Strut.

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.

2. For concrete or masonry walls: Metal slots with adjustable inserts or adjustable wall furring brackets. Spacers may be fabricated from 1 mm (0.0396-inch) thick galvanized steel with corrugated edges.

H. Power Actuated Fasteners: Type and size as recommended by the manufacturer of the material being fastened.

2.5 SUSPENDED CEILING SYSTEM FOR GYPSUM BOARD (OPTION)

A. Conform to ASTM C635, heavy duty, with not less than 35 mm (1-3/8 inch) wide knurled capped flange face designed for screw attachment of gypsum board.

B. Wall track channel with 35 mm (1-3/8 inch) wide flange.

PART 3 - EXECUTION

3.1 INSTALLATION CRITERIA

A. Where fire rated construction is required for walls, partitions, columns, beams and floor-ceiling assemblies, the construction shall be same as that used in fire rating test.

B. Construction requirements for fire rated assemblies and materials shall be as shown and specified, the provisions of the Scope paragraph (1.2) of ASTM C754 and ASTM C841 regarding details of construction shall not apply.

3.2 INSTALLING STUDS

A. Install studs in accordance with ASTM C754, except as otherwise shown or specified.

B. Space studs not more than 610 mm (24 inches) on center.

C. Cut studs 6 mm to 9 mm (1/4 to 3/8-inch) less than floor to underside of structure overhead when extended to underside of structure overhead.

D. Where studs are shown to terminate above suspended ceilings, provide bracing as shown or extend studs to underside of structure overhead.

E. Extend studs to underside of structure overhead for fire, rated partitions, smoke partitions, shafts, and insulated exterior wall furring.

F. At existing plaster ceilings and where shown, studs may terminate at ceiling as shown. G. 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 SHAFT WALL SYSTEM

A. Conform to UL Design No. U438 for two-hour fire rating.

B. Position J runners at floor and ceiling with the short leg toward finish side of wall. Securely attach runners to structural supports with power driven fasteners at both ends and 600 mm (24 inches) on center.

C. After liner panels have been erected, cut C-H studs and E studs, from 9 mm (3/8-inch) to not more than 13 mm (1/2-inch) less than floor-to-ceiling height. Install C-H studs between liner panels with liner panels inserted in the groove.

D. Install full-length steel E studs over shaft wall line at intersections, corners, hinged door jambs, columns, and both sides of closure panels.

E. Suitably frame all openings to maintain structural support for wall:

1. Provide necessary liner fillers and shims to conform to label frame requirements.
2. Frame openings cut within a liner panel with E studs around perimeter.
3. Frame openings with vertical E studs at jambs, horizontal J runner at head and sill.

F. Elevator Shafts:

1. Frame elevator door frames with 0.87 mm (0.0341-inch) thick J strut or J stud jambs having 75 mm (three-inch) long legs on the shaft side.
2. Protrusions including fasteners other than flange of shaft wall framing system or offsets from vertical alignments more than 3 mm (1/8-inch) are not permitted unless shown.
3. Align shaft walls for plumb vertical flush alignment from top to bottom of shaft.

3.6 INSTALLING FURRED AND SUSPENDED CEILINGS OR SOFFITS

A. Install furred and suspended ceilings or soffits in accordance with ASTM C754 or ASTM C841 except as otherwise specified or shown for screw attached gypsum board ceilings and for plaster ceilings or soffits.

1. Space framing at 400 mm (16-inch) centers for metal lath anchorage.
2. Space framing at 600 mm (24-inch) centers for gypsum board anchorage.

B. New exposed concrete slabs:

1. Use metal inserts required for attachment and support of hangers or hanger wires with tied wire loops for embedding in concrete.

2. Furnish for installation under Division 3, CONCRETE.
3. Suspended ceilings under concrete rib construction shall have runner channels at right angles to ribs and be supported from ribs with hangers at ends and at 1200 mm (48-inch) maximum intervals along channels. Stagger hangers at alternate channels.

C. Concrete slabs on steel decking composite construction:
1. Use pull down tabs when available.
2. Use power activated fasteners when direct attachment to structural framing can not be accomplished.

D. Where bar joists or beams are more than 1200 mm (48 inches) apart, provide intermediate hangers so that spacing between supports does not exceed 1200 mm (48 inches). Use clips, bolts, or wire ties for direct attachment to steel framing.

E. 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 over head construction. Lap channels not less than 600 mm (2 feet) at midpoint back to back. Screw or bolt lap together with two fasteners.
2. Install bracing at an approximate 45 degree angle to carrying channels and structure overhead; secure as specified to structure overhead with two fasteners and to carrying channels with two fasteners or wire ties.

3.7 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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SECTION 09 29 00
GYPSUM BOARD

PART 1 – GENERAL

1.1 DESCRIPTION

This section specifies installation and finishing of gypsum board.

1.2 RELATED WORK

A. Installation of steel framing members for walls, partitions, furring, soffits, and ceilings: Section 09 22 16, NON-STRUCTURAL METAL FRAMING.

1.3 TERMINOLOGY

A. Definitions and description of terms shall be in accordance with ASTM C11, C840, and as specified.

B. Underside of Structure Overhead: In spaces where steel trusses or bar joists are shown, the underside of structure overhead shall be the underside of the floor or roof construction supported by the trusses or bar joists.

C. "Yoked": Gypsum board cut out for opening with no joint at the opening (along door jamb or above the door).

1.4 SUBMITTALS

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

B. Manufacturer's Literature and Data:

1. Cornerbead and edge trim.
2. Finishing materials.
3. Laminating adhesive.
4. Gypsum board, each type.

C. Shop Drawings:

1. Typical gypsum board installation, showing corner details, edge trim details and the like.
2. Typical sound rated assembly, showing treatment at perimeter of partitions and penetrations at gypsum board.
3. Typical shaft wall assembly.
4. Typical fire rated assembly and column fireproofing, indicating details of construction same as that used in fire rating test.

D. Samples:

1. Cornerbead.
2. Edge trim.
3. Control joints.

E. Test Results:
   1. Fire rating test, each fire rating required for each assembly.

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

In accordance with the requirements of ASTM C840.

1.6 ENVIRONMENTAL CONDITIONS

In accordance with the requirements of ASTM C840.

1.7 APPLICABLE PUBLICATIONS

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

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

C11-15	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.

B. Coreboard or Shaft Wall Liner Panels.

1. ASTM C1396, Type X.
2. ASTM C1658: Glass Mat Gypsum Panels,
3. Coreboard for shaft walls 300, 400, 600 mm (12, 16, or 24 inches) wide by required lengths 25 mm (one inch) thick with paper faces treated to resist moisture.

C. Water Resistant Gypsum Backing Board: ASTM C1178, Type X, 16 mm (5/8 inch) thick.

D. Paper facings shall contain 100 percent post-consumer recycled paper content.

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

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.

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. 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.

I. Electrical and Telecommunications Boxes:

1. Seal annular spaces between electrical and telecommunications receptacle boxes and gypsum board partitions.

J. Accessories:

1. Set accessories plumb, level and true to line, neatly mitered at corners and intersections, and securely attach to supporting surfaces as specified.
2. Install in one piece, without the limits of the longest commercially available lengths.
3. Corner Beads:
   a. Install at all vertical and horizontal external corners and where shown.
   b. Use screws only. Do not use crimping tool.
4. Edge Trim (casings Beads):
   a. At both sides of expansion and control joints unless shown otherwise.
   b. Where gypsum board terminates against dissimilar materials and at perimeter of openings, except where covered by flanges, casings or permanently built-in equipment.
   c. Where gypsum board surfaces of non-load bearing assemblies abut load bearing members.
   d. Where shown.

3.3 INSTALLING GYPSUM SHEATHING

A. Install in accordance with ASTM C840, except as otherwise specified or shown.
B. Use screws of sufficient length to secure sheathing to framing.
C. Space screws 9 mm (3/8 inch) from ends and edges of sheathing and 200 mm (8 inches) on center. Space screws a maximum of 200 mm (8 inches) on center on intermediate framing members.
D. Apply 600 mm by 2400 mm (2 foot by 8 foot) sheathing boards horizontally with tongue edge up.
E. Apply 1200 mm by 2400 mm or 2700 mm (4 ft. by 8 ft. or 9 foot) gypsum sheathing boards vertically with edges over framing.

3.4 CAVITY SHAFT WALL

A. Coordinate assembly with Section 09 22 16, NON-STRUCTURAL METAL FRAMING, for erection of framing and gypsum board.
B. Conform to UL Design No. U438 or FM WALL CONSTRUCTION 12-2/HR (Nonbearing for two-hour fire rating. Conform to FM WALL CONSTRUCTION 25-1/HR (Non-loadbearing) for one-hour fire rating where shown.
C. Cut coreboard (liner) panels 25 mm (one inch) less than floor-to-ceiling height, and erect vertically between J-runners on shaft side.
   1. Where shaft walls exceed 4300 mm (14 feet) in height, position panel end joints within upper and lower third points of wall.

2. Stagger joints top and bottom in adjacent panels.
3. After erection of J-struts of opening frames, fasten panels to J-struts with screws of sufficient length to secure to framing staggered from those in base, spaced 300 mm (12 inches) on center.

D. Gypsum Board:
   1. Two hour wall:
      a. Erect base layer (backing board) vertically on finish side of wall with end joints staggered. Fasten base layer panels to studs with 25 mm (one inch) long screws, spaced 600 mm (24 inches) on center.
      b. Use laminating adhesive between plies in accordance with UL or FM if required by fire test.
      c. Apply face layer of gypsum board required by fire test vertically over base layer with joints staggered and attach with screws of sufficient length to secure to framing staggered from those in base, spaced 300 mm (12 inches) on center.
   2. One hour wall with one layer on finish side of wall: Apply face layer of gypsum board vertically. Attach to studs with screws of sufficient length to secure to framing, spaced 300 mm (12 inches) on center in field and along edges.
   3. Where coreboard is covered with face layer of gypsum board, stagger joints of face layer from those in the coreboard base.

E. Treat joints, corners, and fasteners in face layer as specified for finishing of gypsum board.

F. Elevator Shafts:
   1. Protrusions including fasteners other than flange of shaft wall framing system or offsets from vertical alignments more than 3 mm (1/8-inch) are not permitted unless shown.
   2. Align shaft walls for plumb vertical flush alignment from top to bottom of shaft.

3.5 FINISHING OF GYPSUM BOARD

A. Finish joints, edges, corners, and fastener heads in accordance with ASTM C840. Use Level 4 finish for all finished areas open to public view.

B. Before proceeding with installation of finishing materials, assure the following:
   1. Gypsum board is fastened and held close to framing or furring.
   2. Fastening heads in gypsum board are slightly below surface in dimple formed by driving tool.

C. Finish joints, fasteners, and all openings, including openings around penetrations, on that part of the gypsum board extending above suspended ceilings to seal surface of non decorated smoke barrier, fire rated and sound rated gypsum board construction. After the installation of hanger rods, hanger wires, supports, equipment, conduits, piping and similar work, seal remaining openings and maintain the integrity of the smoke barrier, fire rated and construction/ Sanding is not required of non decorated surfaces.

3.6 REPAIRS

A. After taping and finishing has been completed, and before decoration, repair all damaged and defective work, including nondecorated surfaces.

B. Patch holes or openings 13 mm (1/2 inch) or less in diameter, or equivalent size, with a setting type finishing compound or patching plaster.

C. Repair holes or openings over 13 mm (1/2 inch) diameter, or equivalent size, with 16 mm (5/8 inch) thick gypsum board secured in such a manner as to provide solid substrate equivalent to undamaged surface.

D. Tape and refinish scratched, abraded or damaged finish surfaces including cracks and joints in non decorated surface to provide smoke tight construction fire protection equivalent to the fire rated construction.

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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.
      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: CONSTRUCTION DOCUMENTS: FINISH LEGEND.
C. Ceiling Suspension System: Section 09 22 16, NON-STRUCTURAL METAL FRAMING.
   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):

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. COR.
    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.

    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 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:

   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.

      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

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 or 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 floor-ceiling assembly.
C. Surface Burning Characteristics: When tested according to ASTM E84.
   1. Flame Spread Rating: per authorities having jurisdiction.
   2. Smoke Developed Rating: 450 maximum.

2.3 PRODUCTS - GENERAL

A. Basis of Design: Construction Drawings: FINISH LEGEND.
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.
D. Sustainable Construction Requirements:
   1. Mineral Base Recycled Content: 65 percent, post-consumer total recycled content, minimum. Select products with recycled content to achieve overall Project recycled content requirement.
   2. Steel Recycled Content: 30 percent total recycled content, minimum.
   3. Aluminum Recycled Content: 50 percent total recycled content, minimum.
   4. Biobased Content: 37 percent by weight biobased material, minimum.

5. Low Pollutant-Emitting Materials: Comply with VOC limits specified in Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS for the following products:
    a. Non-flooring adhesives and sealants.

2.4 ACOUSTICAL UNITS

A. 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. Type V Units - Perforated steel facing (pan) with mineral or glass fiber base backing.
        1) Steel: Galvanized steel, ASTM A653, with G30 coating. minimum 0.38 mm (0.015 inch) thick.
        2) Bonderize both sides. Apply two coats of baked-on enamel finish on surfaces exposed to view and one coat on concealed surfaces.
    d. Type VI Units - Perforated stainless steel facing (pan) with mineral or glass fiber base backing.
    e. Type VII Units - Perforated aluminum facing (pan) with mineral or glass fiber base backing.
        1) Aluminum sheets, minimum 0.635 mm (0.025 inch) thick.
        2) Apply two coats of baked-on enamel finish, free from gloss or sheen, on face and flanges.
    f. NRC (Noise Reduction Coefficient): ASTM C423, minimum 0.55 unless specified otherwise.
    g. CAC (Ceiling Attenuation Class): ASTM E413, 40-44 range unless specified otherwise.
    h. LR (Light Reflectance): Minimum 0.75.
3. Lay-in panels: Sizes as indicated on Drawings, with square edges .
    a. Sizes:
        1) Concealed Grid Upward Access System: 300 by 300 (12 by 12).
        2) Cross Score: 300 by 600 mm (12 by 24 inch) tile to simulate 300 by 300 mm (12 by 12 inch) tile edges.

3) Edge and Joint Detail: Square edges and joints as required to suit suspension and access system.

4. Perforated Metal Facing (Pan):
   a. Tiles Size: 300 by 300 (12 by 12).
      1) Cross Score Units: Larger than 300 by 300 mm (12 by 12 inches) to simulate 300 by 300 mm (12 by 12 inch) units.
      2) Edge and Joint Detail: Beveled edge, joints for snap-in attachment to suspension system.
   b. Panels: Sizes as indicated on Drawings with flat panel with square edges to finish flush with exposed grid suspension system.
   c. Sound Absorbent Element: Non-sifting mineral wool or glass fiber (formaldehyde-free). Density and thickness to provide specified noise reduction coefficient. Enclose sound absorbent elements within plastic envelopes.
   d. Support sound absorbent elements on wire spacer nominal 6 mm (1/4 inch) high. Fit sound absorbent element and the spacer into the unit.
5. Adhesive Applied Tile:
   a. Size: 300 by 300 mm (12 by 12 inch) size.
   b. Edges: Square.

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. Type III-A Units - Mineral base with painted finish.
   a. Form 1, modular, cast or molded.
   b. NRC: 0.75 minimum.
   c. Thickness: 19 mm (3/4 inch) minimum.
   d. Weight, 4.9 kg/sq. m (one pound per square foot).
3. Type XX-B Units - Combination mineral base and glass fiber with fabric finish.
   a. Back Half of Panel: Perforated water felted mineral fiber.
   b. Face Half of Panel: Glass fiber with glass cloth face.

c. NRC: 0.75 minimum.

d. Thickness: 28 mm (1 1/8 inches) minimum.

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. Galvanized cold-rolled steel.
   b. Extruded aluminum.
   c. Fire resistant plastic (glass fiber).
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 with8 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 Construction Documents: FINISH LEGEND.

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. Suspension System Support of Metal Type V, VI, and VII Tiles: Concealed grid type with runners for snap-in attachment of metal tile (pans).

E. 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

F. 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.

G. Clips: Galvanized steel, designed to secure framing member in place.

H. Tile Splines: ASTM C635.

I. Wire: ASTM A641.
1. Size:
a. Wire Hangers: Minimum diameter 2.68 mm (0.1055 inch).
b. Bracing Wires: Minimum diameter 3.43 mm (0.1350 inch).

2.6 ACCESSORIES

A. Adhesives: Low pollutant-emitting, water based type recommended by adhered product manufacturer for each application.

B. Perimeter Seal: Vinyl, polyethylene or polyurethane open cell sponge material, density of 1.3 plus or minus 10 percent, compression set less than 10 percent with pressure sensitive adhesive coating on one side.
1. Thickness: As required to fill voids between back of wall molding and finish wall.
2. Size: Minimum 9 mm (3/8 inch) wide strip.

C. Access Identification Markers: Colored markers with pressure sensitive adhesive on one side, paper or plastic, 6 to 9 mm (1/4 to 3/8 inch) diameter.
1. Color Code: Provide the following color markers for service identification:

Color	Service
Red	Sprinkler System: Valves and Controls
Green	Domestic Water: Valves and Controls
Yellow	Chilled Water and Heating Water
Orange	Ductwork: Fire Dampers
Blue	Ductwork: Dampers and Controls
Black	Gas: Laboratory, Medical, Air and Vacuum

PART 3 - EXECUTION

3.1 PREPARATION

A. Examine and verify substrate suitability for product installation.

B. Protect existing construction and completed work from damage.

C. Remove existing acoustical panels and suspension system to permit new installation.

1. Dispose of removed materials.

3.2 INSTALLATION - GENERAL

A. Install products according to manufacturer's instructions and approved submittal drawings.

1. When manufacturer's instructions deviate from specifications, submit proposed resolution for Contracting Officer's Representative consideration.

3.3 ACOUSTICAL UNIT INSTALLATION

A. Applications:

1. Cut acoustic units for perimeter borders and penetrations to fit tight against penetration for joint not concealed by molding.

B. Layout acoustical unit symmetrically, with minimum number of joints.

C. Installation:

1. Install acoustic tiles after wet finishes have been installed and solvents have cured.
2. Install lay-in acoustic panels in exposed grid with minimum 6 mm (1/4 inch) bearing at edges on supports.
    a. Install tile to lay level and in full contact with exposed grid.
    b. Replace cracked, broken, stained, dirty, or tile.
3. 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. Adhesive applied tile:
    a. Condition of surface according to ASTM D1779, Note 1, Cleanliness of Surface, and Note 4, Rigidity of Base Surface.
    b. Size or seal surface as recommended by manufacturer of adhesive and allow to dry before installing units.
5. 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. Moldings:
1. Install metal wall molding at perimeter of room, column, or edge at vertical surfaces.
2. Install special shaped molding at changes in ceiling heights and at other breaks in ceiling construction to support acoustical units and to conceal their edges.

B. Perimeter Seal:
1. Install perimeter seal between vertical leg of wall molding and finish wall, partition, and other vertical surfaces.
2. Install perimeter seal to finish flush with exposed faces of horizontal legs of wall molding.

C. Existing ceiling:
1. Where extension of existing ceilings occurs, match existing.
2. Where acoustical units are salvaged and reinstalled or joined, use salvaged units within a space. Do not mix new and salvaged units within a space which results in contrast between old and new acoustic units.
3. Comply with specifications for new acoustical units for new units required to match appearance of existing units.

D. 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 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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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

09 67 23 RESINOUS FLOORING

1.3 APPLICABLE PUBLICATIONS

A. Comply with references to extent specified in this section.

B. ASTM International (ASTM):

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.

D. Sustainable Construction Submittals:

1. Recycled Content: Identify post-consumer and pre-consumer recycled content percentage by weight.
2. Low Pollutant-Emitting Materials:
   a. 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.

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.

Install products when building is permanently enclosed and when wet construction is completed, dried, and cured.

1.8 WARRANTY

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

PART 2 - PRODUCTS

2.1 PRODUCTS

A. Basis of Design: Construction Drawings: FINISH LEGEND.

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, 100 mm (4 inches) high.

1. Type: Rubber or vinyl; use one type throughout.
2. ASTM F1861, Type TP thermoplastic rubber or Type TV thermoplastic vinyl, Group 2 - layered.

B. Applications:

1. Carpet Flooring Locations: Style A - Straight.
2. Other Locations: Style B - Cove.

2.3 ADHESIVES

A. Adhesives: Low pollutant-emitting, water based type recommended by adhered product manufacturer for each application.

PART 3 - EXECUTION

3.1 PREPARATION

A. Examine and verify substrate suitability for product installation.
B. Protect existing construction and completed work from damage.
C. Remove existing base to permit new installation.
    1. Dispose of removed materials.
D. Correct substrate deficiencies.
    1. Fill cracks, pits, and depressions with leveling compound.
    2. Remove protrusions; grind high spots.
    3. Apply leveling compound to achieve 3 mm (1/8 inch) in 3 m (10 feet) maximum surface variation.
E. Clean substrates. Remove contaminants capable of affecting subsequently installed product's performance.
    1. Mechanically clean concrete floor substrate according to ASTM D4259.
    2. Surface Profile: ICRI Guideline No. 310.2R.
F. Allow substrate to dry and cure.
G. Perform flooring manufacturer’s recommended bond, substrate moisture content, and pH tests.

3.2 INSTALLATION GENERAL

A. Install products according to manufacturer's instructions.
    1. When instructions deviate from specifications, submit proposed resolution for Contracting Officer consideration.

3.3 RESILIENT BASE INSTALLATION

A. Applications:
    1. Install resilient base in rooms scheduled on Drawings.
    2. Extend resilient base into closets, alcoves, and cabinet knee spaces, and around columns within scheduled room.
B. Lay out resilient base with minimum number of joints.
    1. Length: 600 mm (24 inches) minimum, each piece.
    2. Locate joints 150 mm (6 inches) minimum from corners and intersection of adjacent materials.
C. Installation:
    1. Apply adhesive uniformly for full contact between resilient base and substrate.
    2. Set resilient base with hairline butted joints aligned along top edge.
D. Field form corners and end stops.
    1. V-groove back of outside corner.
    2. V-groove face of inside corner and notch cove for miter joint.

E. Roll resilient base ensuring complete adhesion.

3.4 CLEANING

A. Remove excess adhesive before adhesive sets.

B. Clean exposed resilient base, resilient stair treads, and sheet rubber flooring 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 72 hours, minimum, after installation.

B. Protect products from construction traffic and operations.

1. Cover resilient base with reinforced kraft paper, and plywood or hardboard.
2. Maintain protection until directed by COR.

C. Replace damaged products and re-clean.

1. Damaged Products include cut, gouged, scraped, torn, and unbonded products.

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SECTION 09 65 19
RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 DESCRIPTION:

A. This section specifies the installation of luxury vinyl tile and accessories required for a complete installation.

1.2 RELATED WORK:

A. Sustainable Design Requirements: Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

B. Resilient Base: Section 09 65 13, RESILIENT BASE AND ACCESSORIES.

C. Subfloor Testing and Preparation: Section 09 05 16, SUBSURFACE PREPARATION FOR FLOOR FINISHES.

D. Color, Pattern and Texture for Resilient Tile Flooring and Accessories: CONSTRUCTION DRAWINGS: FINISH LEGEND.

1.3 SUBMITTALS:

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

B. Sustainable Design Submittals as described below:

1. Volatile organic compounds per volume as described in PART 2 - PRODUCTS.
2. Postconsumer and preconsumer recycled content as described in PART 2 - PRODUCTS.

C. Manufacturer's Literature and Data:

1. Description of each product.
2. Resilient material manufacturer’s recommendations for adhesives, underlayment, primers, and polish.
3. Application, installation and maintenance instructions.

D. Samples:

1. Tile: Each type, color, thickness and finish.
2. Edge Strips: Each type, color, thickness and finish.
3. Feature Strips: Each type, color, thickness and finish.

E. Shop Drawings:

1. Layout of patterns as shown on the construction documents.
2. Edge strip locations showing types and detail cross sections.

F. Test Reports:

1. Abrasion resistance: Depth of wear for each tile type and color and volume loss of tile, certified by independent laboratory. Tested per ASTM F510/F510M.
2. Moisture and pH test results as per Section 09 05 16, SUBSURFACE PREPARATION FOR FLOOR FINISHES.

1.4 DELIVERY:

A. Deliver materials to the site in original sealed packages or containers, clearly marked with the manufacturer's name or brand, type and color, production run number and date of manufacture.
B. Materials from containers which have been distorted, damaged or opened prior to installation are not acceptable.

1.5 STORAGE:

A. Store materials in a clean, dry, enclosed space off the ground, protected from harmful weather conditions and at temperature and humidity conditions recommended by the manufacturer. Protect adhesives from freezing. Store flooring, adhesives, and accessories in the spaces where they will be installed for at least 48 hours before beginning installation.

1.6 QUALITY ASSURANCE:

A. Installer Qualifications: A company specializing in installation with minimum three (3) years' experience and employs experienced flooring installers who have retained, and currently hold, an INSTALL Certification, or a certification from a comparable certification program.
   1. Installers to be certified by INSTALL or a comparable certification program with the following minimum criteria:
      a. US Department of Labor approved four (4) year apprenticeship program, 160 hours a year.
      b. Career long training.
      c. Manufacturer endorsed training.
      d. Fundamental journeyman skills certification.
B. Mockup: Build floor tile mockup to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Size: 9.3 sq. m (100 sq. ft.) for each type, color, and pattern. Locations as indicated on construction documents.
   2. COR approved mockup may become part of the completed Project if undisturbed at time of Substantial Completion.
C. Furnish product type materials from the same production run.

1.7 WARRANTY:

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

1.8 APPLICABLE PUBLICATIONS:

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

B. ASTM International (ASTM):

D2047-11 ..... Test Method for Static Coefficient of Friction of Polish-Coated Flooring Surfaces as Measured by the James Machine

D2240-05(R2010) ..... Test Method for Rubber Property—Durometer Hardness

D4078-02(R2008) ..... Water Emulsion Floor Finish

E648-14c ..... Critical Radiant Flux of Floor Covering Systems Using a Radiant Energy Source

E662-14 ..... Specific Optical Density of Smoke Generated by Solid Materials

E1155/E1155M-14 ..... Determining Floor Flatness and Floor Levelness Numbers

F510/F510M-14 ..... Resistance to Abrasion of Resilient Floor Coverings Using an Abrader with a Grit Feed Method

F710-11 ..... Preparing Concrete Floors to Receive Resilient Flooring

F925-13 ..... Test Method for Resistance to Chemicals of Resilient Flooring

F1344-12(R2013) ..... Rubber Floor Tile

F1700-13a ..... Solid Vinyl Floor Tile

F1869-11 ..... Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

F2170-11 ..... Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in Situ Probes

F2195-13 ..... Linoleum Floor Tile

C. Code of Federal Regulation (CFR):

40 CFR 59 ..... Determination of Volatile Matter Content, Water Content, Density Volume Solids, and Weight Solids of Surface Coating

D. International Standards and Training Alliance (INSTALL):

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS:

A. Provide adhesives, underlayment, primers, and polish recommended by resilient floor material manufacturer.

B. Critical Radiant Flux: 0.45 watts per sq. cm or more, Class I, per ASTM E648.

C. Smoke Density: Less than 450 per ASTM E662.

D. Slip Resistance – Not less

2.2 LUXURY VINYL TILE:

A. ASTM F1700, Class III, Printed Film Vinyl Tile, Type B.

B. Thickness: 20 mil (0.098 inch).

C. Size: 6” X 36”

D. Provide products with recycled content with not less than 30 percent.

E. Chemical Resistance: ASTM F925; pass.

2.6 ADHESIVES:

A. Provide water resistant type adhesive for flooring, base and accessories as recommended by the manufacturer to suit substrate conditions. VOC content to be less than the 50 grams/L when calculated according to 40 CFR 59 (EPA Method 24). Submit manufacturer’s descriptive data, documentation stating physical characteristics, and mildew and germicidal characteristics.

2.7 PRIMER FOR CONCRETE SUBFLOORS:

A. Provide in accordance with Section 09 05 16, SUBSURFACE PREPARATION FOR FLOOR FINISHES.

2.8 LEVELING COMPOUND FOR CONCRETE FLOORS:

A. Provide cementitious products with latex or polyvinyl acetate resins in the mix in accordance with Section 09 05 16, SUBSURFACE PREPARATION FOR FLOOR FINISHES.

2.9 POLISH AND CLEANERS:

A. Cleaners: As recommended in writing by floor tile manufacturer.

B. Polish: ASTM D4078.

2.10 MOULDING:

A. Provide tapered mouldings of vinyl and types as indicated on the construction documents for both edges and transitions of flooring materials specified. Provide vertical lip on moulding of maximum 6 mm (1/4 inch). Provide bevel change in level between 6 and 13 mm (1/4 and 1/2 inch) with a slope no greater than 1:2.

B. Fasteners for Aluminum Mouldings: Stainless steel of type required for substrate condition.

PART 3 - EXECUTION

3.1 ENVIRONMENTAL REQUIREMENTS:

A. Maintain flooring materials and areas to receive resilient flooring at a temperature above 20 degrees C (68 degrees F) for three (3) days before application, during application and two (2) days after application, unless otherwise directly by the flooring manufacturer for the flooring being

installed. Maintain a minimum temperature of 13 degrees C (55 degrees F) thereafter. Provide adequate ventilation to remove moisture from area and to comply with regulations limiting concentrations of hazardous vapors.

B. Do not install flooring until building is permanently enclosed and wet construction in or near areas to receive tile materials is complete, dry and cured.

3.2 SUBFLOOR TESTING AND PREPARATION:

A. Prepare and test surfaces to receive resilient tile and adhesive as per Section 09 05 16, SUBSURFACE PREPARATION FOR FLOOR FINISHES.

1. Remove existing resilient floor and existing adhesive.

B. Prepare concrete substrates in accordance with ASTM F710.

3.3 INSTALLATION:

A. Install in accordance with manufacturer's instructions for application and installation unless specified otherwise.

B. Mix tile from at least two containers. An apparent line either of shades or pattern variance is not acceptable.

C. Tile Layout:

1. If layout is not shown on construction documents, lay tile symmetrically about center of room or space with joints aligned.
2. Vary edge width as necessary to maintain full size tiles in the field, no edge tile to be less than 1/2 the field tile size, except where irregular shaped rooms make it impossible.
3. Place tile pattern in the same direction; do not alternate tiles unless specifically indicated in the construction documents to the contrary. Match tile installation to approved mockup.

D. Application:

1. Adhere floor tile to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
2. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
3. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
4. Roll tile floor with a minimum 45 kg (100 pound) roller.

E. Seal joints at pipes with sealants in accordance with Section 07 92 00, JOINT SEALANTS.

F. Installation of Edge Strips:

1. Locate edge strips under center line of doors unless otherwise shown on construction documents.

2. Set resilient edge strips in adhesive. Anchor metal edge strips with anchors and screws.
3. Where tile edge is exposed, butt edge strip to touch along tile edge.
4. Where thin set ceramic tile abuts resilient tile, set edge strip against floor file and against the ceramic tile edge.

3.4 CLEANING AND PROTECTION:

A. Clean adhesive marks on exposed surfaces during the application of resilient materials before the adhesive sets. Exposed adhesive is not acceptable.
B. Keep traffic off resilient material for a minimum 72 hours after installation.
C. Clean flooring as recommended in accordance with manufacturer's printed maintenance instructions and within the recommended time frame. As required by the manufacturer, apply the recommended number of coats and type of polish and/or finish in accordance with manufacturer's written instructions.
D. When construction traffic occurs over tile, cover resilient materials with reinforced kraft paper properly secured and maintained until removal is directed by COR. At entrances and where wheeled vehicles or carts are used, cover tile with plywood, hardboard, or particle board over paper, secured and maintained until removal is directed by COR.
E. When protective materials are removed and immediately prior to acceptance, replace damaged tile and mouldings, re-clean resilient materials.

3.5 LOCATION:

A. Unless otherwise indicated in construction documents, install tile flooring, under areas where casework, laboratory and pharmacy furniture and other equipment occur.
B. Extend tile flooring for room into adjacent closets and alcoves.

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SECTION 09 67 23.60
RESINOUS URETHANE AND EPOXY MORTAR FLOORING (RES-6A AND RES-6B)

PART 1 – GENERAL

1.1 DESCRIPTION

A. This section specifies Resinous (Resinous urethane and epoxy mortars) flooring:
   1. High Abuse Climatic Troweled and Sealed Urethane Mortar Flooring System with static dissipative properties.

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 CONSTRUCTION DOCUMENTS: FINISH LEGEND: Product: **EP-1**.
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. 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.

2. 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. Mockups: Apply mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and establish quality standards for materials and execution.
   1. Apply full-thickness mockups on 48 inch (1200 mm)square floor area selected by VA COR.
      a. If applicable include 48 inch (1200 mm)length of integral cove base.
   2. Approved mockups not damaged during the testing may become part of the completed work if undisturbed at time of Substantial Completion.

3. Sign off from COR on texture for slip resistance and clean ability must be complete before installation of flooring system.

E. Pre-Installation Conference:
   1. Convene a meeting not less than thirty days prior to starting work.
   2. Attendance:
      a. Contractor
      b. 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 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

F. Manufacturer’s Field Services: Manufacturer’s representative shall provide technical assistance and guidance for surface preparation and application of resinous flooring systems.

G. 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.

H. 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 be properly cured per referenced section 03 30 00, CAST-IN-PLACE CONCRETE. Standard cure time a minimum of 30 days. A vapor barrier must be present for concrete subfloors on or below grade.
      a. Resinous flooring applications where moisture testing resulting in readings exceeding limits as defined in this specification under part 3, section 3.4, paragraph B, shall employ an multiple component 15 mil thick system designed to suppress excess moisture in concrete.
      b. Application at a minimum thickness of 15 mils, over properly prepared concrete substrate as defined in section 3.4.
      c. Moisture suppression system must meet the design standards as follows:

Property	Test	Value
Tensile Strength	ASTM D638	4,400 psi
Volatile Organic Compound Limits (V.O.C.)	EPA & LEED	25 grams per liter
Permeance	ASTM E96 @ 16mils/ 0.4mm on concrete	0.1 perms
Tensile Modulus	ASTM D638	$1.9X10^5$ psi
Percent Elongation	ASTM D638	12%
Cure Rate	Per manufactures Data	4 hours Tack free with 24hr recoat window
Bond Strength	ASTM D7234	100% bond to concrete failure

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.
   1. Basis of Design: Stonhard, Inc. Stonkote ESD Floor Coating.

C. System Characteristics:
   1. Static Control Properties: ANSI/ESD S20.20
   2. Surface Resistance: <1.0 megaohms (ESD-S7.1)
   3. Body Voltage Generation: <100 volts (ESD STM97.2)
   4. Color and Pattern: See Construction Documents: FINISH LEGEND.
   5. Wearing Surface: Standard Gloss
   6. Integral Cove Base: None
   7. Overall System Thickness: 20-25 mil.

D. 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. Primer:
a. Material Basis; Stonhard Standard Primer
b. Resin: Epoxy
c. Formulation Description: 2 component 100 percent solids.
d. Application Method: squeegee back roll.
e. Number of Coats: one

3. Primer 2:
a. Material Basis: Stonhard SL Primer
b. Resin: Epoxy
c. Formulation Description: 3 component 100 percent solids
d. Application Method: squeegee over Stonhard Standard Primer wet-on-wet application.
e. Number of Coats: two

4. Body Coat:
a. Material Bases: Stonhard ESD Coating
b. Resin: Epoxy.
c. Finish: Standard Gloss
d. Formulation Description: Three-component, self-leveling, epoxy formulation consisting of resin, curing agent and selected, graded aggregates.
e. Application Method: 15 mil Squeegee, Back roll and Spike Roll.
f. Thickness of Coats: 20-25 mil
g. Number of Coats: One.

E. 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 x 10^{-5} mm/ ºC mm
Hardness Shore D	ASTM D2240	80 to 84
Bond Strength	ASTM D7234	100% bond to concrete failure

F. 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/or 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/or specified.
F. Anti-Microbial Additive: Incorporate anti-microbial chemical additive to prevent growth of most bacteria, algae, fungi, mold, mildew, yeast, etc.
G. 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 COR.
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 COR for the seamless resinous (urethane and epoxy mortar) flooring system.
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.

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. 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

D. 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.

3.9 TESTING

A. Flooring must be tested 24 hours after the application. Point-to-point and point-to-ground readings must all fall below 1.0x10 to the 6th power ohms.

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SECTION 09 67 23.60
RESINOUS URETHANE AND EPOXY MORTAR FLOORING (RES-6A AND RES-6B)

PART 1 – GENERAL

1.1 DESCRIPTION

A. This section specifies Resinous (Resinous urethane and epoxy mortars) flooring:
   1. High Abuse Climatic Troweled and Sealed Urethane Mortar Flooring System with static dissipative properties.

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 CONSTRUCTION DOCUMENTS: FINISH LEGEND: Product: **EP-1**.
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. 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.

2. 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. Mockups: Apply mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and establish quality standards for materials and execution.
   1. Apply full-thickness mockups on 48 inch (1200 mm)square floor area selected by VA Resident Engineer.
      a. If applicable include 48 inch (1200 mm)length of integral cove base.

2. Approved mockups not damaged during the testing may become part of the completed work if undisturbed at time of Substantial Completion.
3. Sign off from COR on texture for slip resistance and clean ability must be complete before installation of flooring system.

E. Pre-Installation Conference:
1. Convene a meeting not less than thirty days prior to starting work.
2. Attendance:
a. Contractor
b. 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 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

F. Manufacturer’s Field Services: Manufacturer’s representative shall provide technical assistance and guidance for surface preparation and application of resinous flooring systems.

G. 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.

H. 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 be properly cured per referenced section 03 30 00, CAST-IN-PLACE CONCRETE. Standard cure time a minimum of 30 days. A vapor barrier must be present for concrete subfloors on or below grade.
    a. Resinous flooring applications where moisture testing resulting in readings exceeding limits as defined in this specification under part 3, section 3.4, paragraph B, shall employ an multiple component 15 mil thick system designed to suppress excess moisture in concrete.
    b. Application at a minimum thickness of 15 mils, over properly prepared concrete substrate as defined in section 3.4.
    c. Moisture suppression system must meet the design standards as follows:

Property	Test	Value
Tensile Strength	ASTM D638	4,400 psi
Volatile Organic Compound Limits (V.O.C.)	EPA & LEED	25 grams per liter
Permeance	ASTM E96 @ 16mils/ 0.4mm on concrete	0.1 perms
Tensile Modulus	ASTM D638	$1.9X10^5$ psi
Percent Elongation	ASTM D638	12%

Cure Rate	Per manufactures Data	4 hours Tack free with 24hr recoat window
Bond Strength	ASTM D7234	100% bond to concrete failure

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.
   1. Basis of Design: Stonhard, Inc. Stonkote ESD Floor Coating.

C. System Characteristics:
   1. Static Control Properties: ANSI/ESD S20.20
   2. Surface Resistance: <1.0 megaohms (ESD-S7.1)
   3. Body Voltage Generation: <100 volts (ESD STM97.2)
   4. Color and Pattern: See Construction Documents: FINISH LEGEND.
   5. Wearing Surface: Standard Gloss
   6. Integral Cove Base: None
   7. Overall System Thickness: 20-25 mil.

D. 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. Primer:
   a. Material Basis; Stonhard Standard Primer
   b. Resin: Epoxy
   c. Formulation Description: 2 component 100 percent solids.
   d. Application Method: squeegee back roll.
   e. Number of Coats: one

3. Primer 2:
   a. Material Basis: Stonhard SL Primer
   b. Resin: Epoxy
   c. Formulation Description: 3 component 100 percent solids
   d. Application Method: squeegee over Stonhard Standard Primer wet-on-wet application.
   e. Number of Coats: two

4. Body Coat:
   a. Material Bases: Stonhard ESD Coating
   b. Resin: Epoxy.
   c. Finish: Standard Gloss
   d. Formulation Description: Three-component, self-leveling, epoxy formulation consisting of resin, curing agent and selected, graded aggregates.
   e. Application Method: 15 mil Squeegee, Back roll and Spike Roll.
   f. Thickness of Coats: 20-25 mil
   g. Number of Coats: One.

E. 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/ ºC mm
Hardness Shore D	ASTM D2240	80 to 84
Bond Strength	ASTM D7234	100% bond to concrete failure

F. 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/or 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/or specified.
F. Anti-Microbial Additive: Incorporate anti-microbial chemical additive to prevent growth of most bacteria, algae, fungi, mold, mildew, yeast, etc.
G. 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 Resident Engineer.
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 COR for the seamless resinous (urethane and epoxy mortar) flooring system.
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.

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. 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

D. 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.

3.9 TESTING

A. Flooring must be tested 24 hours after the application. Point-to-point and point-to-ground readings must all fall below 1.0x10 to the 6th power ohms.

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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 interior concrete block exposed to view.
7. Painting gypsum drywall exposed to view.
8. Painting of wood exposed to view, except items which are specified to be painted or finished under other Sections of these specifications. Back painting of all wood in contact with concrete, masonry or other moisture areas.
9. Painting pipes, pipe coverings, conduit, ducts, insulation, hangers, supports and other mechanical and electrical items and equipment exposed to view.
10. Painting surfaces above, behind or below grilles, gratings, diffusers, louvers lighting fixtures, and the like, which are exposed to view through these items.
11. Painting includes shellacs, stains, varnishes, coatings specified, and striping or markers and identity markings.
12. Incidental painting and touching up as required to produce proper finish for painted surfaces, including touching up of factory finished items.
13. 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 CONSTUCTION 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. Division 10 SPECIALTIES: Shop prime painting of steel and ferrous metals.
H. Division 21 FIRE SUPPRESSION: Shop prime painting of steel and ferrous metals.
I. Division 22 PLUMBING: Shop prime painting of steel and ferrous metals.
J. Division 23 HEATING; VENTILATION AND AIR-CONDITIONING: Shop prime painting of steel and ferrous metals.
K. Division 26 ELECTRICAL: Shop prime painting of steel and ferrous metals.
L. Division 27 COMMUNICATIONS: Shop prime painting of steel and ferrous metals.
M. 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 Construction Documents: FINISH LEGEND.
      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.
   5. Plastic floor coating.

1.4 DELIVERY AND STORAGE

A. Deliver materials to site in manufacturer's sealed container marked to show following:
   1. Name of manufacturer.
   2. Product type.
   3. Batch number.
   4. Instructions for use.
   5. Safety precautions.

B. In addition to manufacturer's label, provide a label legibly printed as following:
   1. Federal Specification Number, where applicable, and name of material.
   2. Surface upon which material is to be applied.
   3. 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 COR in writing of any anticipated problems using the coating systems as specified with substrates primed by others.

1.6 MOCK-UP PANEL

A. In addition to the samples specified herein to be submitted for approval, apply in the field, at their final location, each type and color of approved paint materials, applied 3.05 m (10 feet) wide, floor to ceiling of wall surfaces, before proceeding with the remainder of the work, for approval by the COR. Paint mock-ups to include one (1) door and frame assembly.

B. Finish and texture approved by COR will be used as a standard of quality and workmanship for remainder of work.

C. Repaint individual areas which are not approved, as determined by the COR, until approval is received.

1.7 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.

1.8 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.

1.9 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
5 .....Exterior Alkyd Wood Primer
6 .....Exterior, Latex for Exterior Wood Primer
7 .....Exterior Oil Wood Primer
8 .....Exterior Alkyd, Flat MPI Gloss Level 1
9 .....Exterior Alkyd Enamel MPI Gloss Level 6
10 .....Exterior Latex, Flat

11 .....Exterior Latex, Semi-Gloss
15 .....Exterior Latex, Low Sheen (MPI Gloss Level 3-4)
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
40 .....Exterior, Latex High Build
42 .....Textured Coating, Latex, Flat
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:

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.

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. All suction spots or “hot spots” in plaster after the application of the first coat are to be touched up before applying the second coat.
J. 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. Masonry (Clay and CMU's): 12 percent.
    d. Wood: 15 percent.
    e. Gypsum Board: 12 percent.
    f. Plaster: 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. Masonry, Concrete, Cement Board, Cement Plaster and Stucco:
   1. Clean and remove dust, dirt, oil, grease efflorescence, form release agents, laitance, and other deterrents to paint adhesion.
   2. Use emulsion type cleaning agents to remove oil, grease, paint and similar products. Use of solvents, acid, or steam is not permitted.
   3. Remove loose mortar in masonry work.
   4. Replace mortar and fill open joints, holes, cracks and depressions with new mortar specified in Section 04 05 13. Do not fill weep holes. Finish to match adjacent surfaces.
   5. Neutralize Concrete floors to be painted by washing with a solution of 1.4 Kg (3 pounds) of zinc sulfate crystals to 3.8 L (1 gallon) of water, allow to dry three (3) days and brush thoroughly free of crystals.
   6. Repair broken and spalled concrete edges with concrete patching compound to match adjacent surfaces as specified in Division 03, CONCRETE Sections. Remove projections to level of adjacent surface by grinding or similar methods.

E. Gypsum Plaster and Gypsum Board:
   1. Remove efflorescence, loose and chalking plaster or finishing materials.
   2. Remove dust, dirt, and other deterrents to paint adhesion.
   3. Fill holes, cracks, and other depressions with CID-A-A-1272A finished flush with adjacent surface, with texture to match texture of adjacent surface. Patch holes over 25 mm (1-inch) in diameter as specified in Section for plaster or gypsum board.

3.5 PAINT PREPARATION:

A. Thoroughly mix painting materials to ensure uniformity of color, complete dispersion of pigment and uniform composition.

B. Do not thin unless necessary for application and when finish paint is used for body and prime coats. Use materials and quantities for thinning as specified in manufacturer's printed instructions.

C. Remove paint skins, then strain paint through commercial paint strainer to remove lumps and other particles.

D. Mix two (2) component and two (2) part paint and those requiring additives in such a manner as to uniformly blend as specified in manufacturer's printed instructions unless specified otherwise.

E. For tinting required to produce exact shades specified, use color pigment recommended by the paint manufacturer.

3.6 APPLICATION:

A. Start of surface preparation or painting will be construed as acceptance of the surface as satisfactory for the application of materials.

B. Unless otherwise specified, apply paint in three (3) coats; prime, body, and finish. When two (2) coats applied to prime coat are the same, first coat applied over primer is body coat and second coat is finish coat.

C. Apply each coat evenly and cover substrate completely.

D. Allow not less than 48 hours between application of succeeding coats, except as allowed by manufacturer's printed instructions, and approved by COR.

E. Apply by brush or roller. Spray application for new or existing occupied spaces only upon approval by acceptance from COR in writing.

1. Apply painting materials specifically required by manufacturer to be applied by spraying.
2. In new construction and in existing occupied spaces, where paint is applied by spray, mask or enclose with polyethylene, or similar air tight material with edges and seams continuously sealed including items specified in “Building and Structural Work Field Painting”; “Work not Painted”; motors, controls, telephone, and electrical equipment, fronts of sterilizes and other recessed equipment and similar prefinished items.

F. Do not paint in closed position operable items such as access doors and panels, window sashes, overhead doors, and similar items except overhead roll-up doors and shutters.

3.7 PRIME PAINTING:

A. After surface preparation, prime surfaces before application of body and finish coats, except as otherwise specified.

B. Spot prime and apply body coat to damaged and abraded painted surfaces before applying succeeding coats.

C. Additional field applied prime coats over shop or factory applied prime coats are not required except for exterior exposed steel apply an additional prime coat.

D. Prime rabbets for stop and face glazing of wood, and for face glazing of steel.

E. Wood and Wood Particleboard:

1. Use same kind of primer specified for exposed face surface.
   a. Exterior wood: MPI 7 (Exterior Oil Wood Primer) for new construction and MPI 5(Exterior Alkyd Wood Primer) for repainting bare wood primer except where MPI 90 (Interior Wood Stain, Semi-Transparent) is scheduled.
   b. Interior wood except for transparent finish: MPI 45 (Interior Primer Sealer) or MPI 46 (Interior Enamel Undercoat), thinned if recommended by manufacturer.
   c. Transparent finishes as specified under “Transparent Finishes on Wood Except Floors Article”

2. Apply two (2) coats of primer MPI 7 (Exterior Oil Wood Primer) or MPI 5 (Exterior Alkyd Wood Primer) or sealer MPI 45 (Interior Primer Sealer) or MPI 46 (Interior Enamel Undercoat) to surfaces of wood doors, including top and bottom edges, which are cut for fitting or for other reason.
3. Apply one (1) coat of primer MPI 7 (Exterior Oil Wood Primer) or MPI 5 (Exterior Alkyd Wood Primer) or sealer MPI 45 (Interior Primer Sealer) or MPI 46 (Interior Enamel Undercoat) as soon as delivered to site to surfaces of unfinished woodwork, except concealed surfaces of shop fabricated or assembled millwork and surfaces specified to have varnish, stain or natural finish.
4. Back prime and seal ends of exterior woodwork, and edges of exterior plywood specified to be finished.
5. Apply MPI 67 (Interior Latex Fire Retardant, Top-Coat (UL Approved) to wood for fire retardant finish.

F. Metals except boilers, incinerator stacks, and engine exhaust pipes:
1. Steel and iron: MPI 79 (Marine Alkyd Metal Primer) or 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), MPI 108 (High Build Epoxy Marine Coating finish is specified.
2. Aluminum scheduled to be painted: MPI 95 (Fast Drying Metal Primer).
3. Machinery not factory finished: MPI 9 (Exterior Alkyd Enamel).

G. Gypsum Board and Hardboard:
1. Surfaces scheduled to have MPI 10 (Exterior Latex, Flat), MPI 11 (Exterior Latex, Semi-Gloss), MPI 53 (Interior Latex, Flat), MPI 54 (Interior Latex, Semi-Gloss, MPI Gloss Level 5: Use MPI 10 (Exterior Latex, Flat), MPI 11 (Exterior Latex, Semi-Gloss, MPI 53 (Interior Latex, MPI Gloss Level 3), MPI 52 (Interior Latex, MPI Gloss Level 3), MPI 54 (Interior Latex, Semi-Gloss, MPI Gloss Level 5) respectively.
2. Primer: MPI 50 (Interior Latex Primer Sealer) except use MPI 45 (Interior Primer Sealer) or MPI 46 (Interior Enamel Undercoat).

H. Concrete Masonry Units except glazed or integrally colored and decorative units:
1. MPI 4 (Block Filler) on interior surfaces.
2. Prime exterior surface as specified for exterior finishes.

3.8 EXTERIOR FINISHES:

A. Steel and Ferrous Metal Two (2) coats of MPI 94 (Exterior Alkyd, Semi-Gloss)on exposed surfaces, except on surfaces over 94 degrees C (201 degrees F).

3.9 INTERIOR FINISHES:

A. Apply following finish coats over prime coats in spaces or on surfaces specified in Construction Documents: FINISH LEGEND.

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) or 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. One (1) coat of MPI 101 primer over two (2) coats of waterborne light industrial coating MPI 163 on exposed surfaces in battery rooms. Steel is to be blast cleaned to SSPC 10/NACE No. 2.
    e. Machinery: One (1) coat MPI 9 (Exterior Alkyd Enamel).
    f. Asphalt Coated Metal: One (1) coat MPI 1 (Aluminum Paint).

C. Gypsum Board:
1. One (1) coat of MPI 45 (Interior Primer Sealer) or 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) or 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) or MPI 46 (Interior Enamel Undercoat) plus one (1) coat of MPI 48 (Interior Alkyd Gloss).

D. Masonry and Concrete Walls:
1. Over MPI 4 (Interior/Exterior Latex Block Filler) on CMU surfaces.
2. Two (2) coats of MPI 53 (Interior Latex, Flat, MPI Gloss Level 1), MPI 52 (Interior Latex, MPI Gloss Level 3) or MPI 54 (Interior Latex, Semi-Gloss, MPI Gloss Level 5).

E. Wood:
1. Sanding:
    a. Use 220-grit sandpaper.
    b. Sand sealers and varnish between coats.
    c. Sand enough to scarify surface to assure good adhesion of subsequent coats, to level roughly applied sealer and varnish, and to knock off "whiskers" of any raised grain as well as dust particles.
2. Sealers:
    a. MPI 31 (gloss) or MPI 71 (flat) thinned as recommended by manufacturer at rate of one (1) part of thinner to four (4) parts of varnish.
    b. Apply sealers specified except sealer may be omitted where pigmented, penetrating, or wiping stains containing resins are used.

c. Allow manufacturer's recommended drying time before sanding, but not less than 24 hours or 36 hours in damp or muggy weather.
d. Sand as specified.

3. Paint Finish:
a. One (1) coat of MPI 45 (Interior Primer Sealer) or MPI 46 (Interior Enamel Undercoat) plus one (1) coat of MPI 47 (Interior Alkyd, Semi-Gloss.
b. One (1) coat of MPI 45 Interior Primer Sealer) or MPI 46 (Interior Enamel Undercoat).
c. Two (2) coats of MPI 51 (Interior Alkyd, Eggshell).

F. Cement Board: One (1) coat of MPI 138 (Interior High Performance Latex, MPI Gloss Level 2) or MPI 139 (Interior High Performance Latex, MPI Gloss Level 3) or MPI 140 (Interior High Performance Latex MPI Gloss Level 4) or MPI 141 (Interior High Performance Latex, MPI Gloss Level 5 or MPI 114 (Interior Latex, Gloss).

G. Miscellaneous:
1. Apply where specified in Construction Documents: FINISH LEGEND.
2. MPI 1 (Aluminum Paint): Two (2) coats of aluminum paint.

3.10 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. In existing rooms and areas where alterations occur, clean existing stained and natural finished wood retouch abraded surfaces and then give entire surface one (1) coat of MPI 31 (Polyurethane, Moisture Cured, Clear Gloss) or MPI 71 (Polyurethane, Moisture Cured, Clear Flat).

G. Refinish areas as specified for new work to match adjoining work unless specified or scheduled otherwise.

H. Coat knots and pitch streaks showing through old finish with MPI 36 (Knot Sealer) before refinishing.

I. Sand or dull glossy surfaces prior to painting.

J. Sand existing coatings to a feather edge so that transition between new and existing finish will not show in finished work.

3.11 PAINT COLOR:

A. Color and gloss of finish coats is specified in Construction Documents: FINISH LEGEND.

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.

3.12 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 disturbed spaces not scheduled to be finish painted 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 Construction Documents: FINISH LEGEND to match surrounding surfaces.
2. Paint colors as specified in Construction Documents: FINISH LEGEND except for following:
   a. White: Exterior unfinished surfaces of enameled plumbing fixtures. Insulation coverings on breeching and uptake inside boiler house, drums and drum-heads, oil heaters, condensate tanks and condensate piping.

b. Gray: Heating, ventilating, air conditioning and refrigeration equipment (except as required to match surrounding surfaces), and water and sewage treatment equipment and sewage ejection equipment.

c. Aluminum Color: Ferrous metal on outside of boilers and in connection with boiler settings including supporting doors and door frames and fuel oil burning equipment, and steam generation system (bare piping, fittings, hangers, supports, valves, traps and miscellaneous iron work in contact with pipe).

d. Federal Safety Red: Exposed fire protection piping, hydrants, post indicators, electrical conducts containing fire alarm control wiring, and fire alarm equipment.

e. Federal Safety Orange: Entire lengths of electrical conduits containing feeders 600 volts or more.

f. Color to match brickwork sheet metal covering on breeching outside of exterior wall of boiler house.

I. Apply paint systems on properly prepared and primed surface as follows:

1. Interior Locations:

a. Apply two (2) coats of MPI 47 (Interior Alkyd, Semi-Gloss) to following items:

Metal under 94 degrees C (201 degrees F) of items such as bare piping, fittings, hangers and supports.

Equipment and systems such as hinged covers and frames for control cabinets and boxes, cast-iron radiators, electric conduits and panel boards.

Heating, ventilating, air conditioning, plumbing equipment, and machinery having shop prime coat and not factory finished.

b. Apply one (1) coat of MPI 50 (Interior Latex Primer Sealer) and one (1) coat of MPI 53 (Interior Latex, Flat, MPI Gloss Level 1), MPI 44 (Interior Low Sheen Latex), MPI 52 (Interior Latex, MPI Gloss Level 3), MPI 54 (Interior Latex, Semi-Gloss, MPI Gloss Level 5), on finish of insulation on boiler breeching and uptakes inside boiler house, drums, drumheads, oil heaters, feed water heaters, tanks and piping.

c. Apply two (2) coats of MPI 22 (High Heat Resistant Coating) to ferrous metal surface over 94 degrees K (290 degrees F) of following items:

Garbage and trash incinerator.

Medical waste incinerator.

Exterior of boilers and ferrous metal in connection with boiler settings including supporting members, doors and door frames and fuel oil burning equipment.

Steam line flanges, bare pipe, fittings, valves, hangers and supports over 94 degrees K (290 degrees F).

Engine generator exhaust piping and muffler.

d. Paint electrical conduits containing cables rated 600 volts or more using two (2) coats of MPI 9 (Exterior Alkyd Enamel) or MPI 8 (Exterior Alkyd, Flat), MPI 94 (Exterior Alkyd, Semi-gloss) in the Federal Safety Orange color in exposed and concealed spaces full length of conduit.

2. 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).

3.13 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 Construction Documents: FINISH LEGEND.
   2. Painting of disturbed, damaged and repaired or patched surfaces when entire space is not scheduled for complete repainting or refinishing.
   3. Painting of ferrous metal and galvanized metal.
   4. Painting of wood with fire retardant paint exposed in attics, when used as mechanical equipment space (except shingles).
   5. Identity painting and safety painting.

B. Building and Structural Work not Painted:
   1. Prefinished items:
      a. Casework, doors, elevator entrances and cabs, metal panels, wall covering, and similar items specified factory finished under other sections.
      b. Factory finished equipment and pre-engineered metal building components such as metal roof and wall panels.
   2. Finished surfaces:
      a. Hardware except ferrous metal.
      b. Anodized aluminum, stainless steel, chromium plating, copper, and brass, except as otherwise specified.
      c. Signs, fixtures, and other similar items integrally finished.
   3. Concealed surfaces:
      a. Inside dumbwaiter, elevator and duct shafts, interstitial spaces, pipe basements, crawl spaces, pipe tunnels, above ceilings, attics, except as otherwise specified.
      b. Inside walls or other spaces behind access doors or panels.
      c. Surfaces concealed behind permanently installed casework and equipment.
   4. Moving and operating parts:

a. Shafts, chains, gears, mechanical and electrical operators, linkages, and sprinkler heads, and sensing devices.
b. Tracks for overhead or coiling doors, shutters, and grilles.

5. Labels:
   a. Code required label, such as Underwriters Laboratories Inc., Intertek Testing Service or Factory Mutual Research Corporation.
   b. Identification plates, instruction plates, performance rating, and nomenclature.
6. Galvanized metal:
   a. Exterior chain link fence and gates, corrugated metal areaways, and gratings.
   b. Gas Storage Racks.
   c. Except where specifically specified to be painted.
7. Metal safety treads and nosings.
8. Gaskets.
9. Concrete curbs, gutters, pavements, retaining walls, exterior exposed foundations walls and interior walls in pipe basements.
10. Face brick.
11. Structural steel encased in concrete, masonry, or other enclosure.
12. Structural steel to receive sprayed-on fire proofing.
13. Ceilings, walls, columns in interstitial spaces.
14. Ceilings, walls, and columns in pipe basements.
15. Wood Shingles.

3.14 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. Electrical Conduits containing feeders over 600 volts, paint legends using 50 mm (2 inch) high black numbers and letters, showing the voltage class rating. Provide legends where conduits pass through walls and floors and at maximum 6096 mm (20 foot) intervals in between. Use

labels with yellow background with black border and words Danger High Voltage Class, 5000, 15000 or 25000.

8. See Sections for methods of identification, legends, and abbreviations of the following:
   a. Regular compressed air lines: Section 22 15 00, GENERAL SERVICE COMPRESSED-AIR SYSTEMS.
   b. Dental compressed air lines: Section 22 61 13.74, DENTAL COMPRESSED-AIR PIPING / Section 22 61 19.74, DENTAL COMPRESSED-AIR EQUIPMENT.
   c. Laboratory gas and vacuum lines: Section 22 62 00, VACUUM SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES / Section 22 63 00, GAS SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES.
   d. Oral evacuation lines: Section 22 62 19.74, DENTAL VACUUM AND EVACUATION EQUIPMENT.
   e. Medical Gases and vacuum lines: Section 22 62 00, VACUUM SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES / Section 22 63 00, GAS SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES.
   f. Conduits containing high voltage feeders over 600 volts: Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS / Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS / Section 28 05 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.

3.15 PROTECTION CLEAN UP, AND TOUCH-UP:

A. Protect work from paint droppings and spattering by use of masking, drop cloths, removal of items or by other approved methods.

B. Upon completion, clean paint from hardware, glass and other surfaces and items not required to be painted of paint drops or smears.

C. Before final inspection, touch-up or refinished in a manner to produce solid even color and finish texture, free from defects in work which was damaged or discolored.

- - - E N D - - -

SECTION 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 interior concrete block exposed to view.
7. Painting gypsum drywall exposed to view.
8. Painting of wood exposed to view, except items which are specified to be painted or finished under other Sections of these specifications. Back painting of all wood in contact with concrete, masonry or other moisture areas.
9. Painting pipes, pipe coverings, conduit, ducts, insulation, hangers, supports and other mechanical and electrical items and equipment exposed to view.
10. Painting surfaces above, behind or below grilles, gratings, diffusers, louvers lighting fixtures, and the like, which are exposed to view through these items.
11. Painting includes shellacs, stains, varnishes, coatings specified, and striping or markers and identity markings.
12. Incidental painting and touching up as required to produce proper finish for painted surfaces, including touching up of factory finished items.
13. 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 CONSTUCTION 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. Division 10 SPECIALTIES: Shop prime painting of steel and ferrous metals.
H. Division 21 FIRE SUPPRESSION: Shop prime painting of steel and ferrous metals.
I. Division 22 PLUMBING: Shop prime painting of steel and ferrous metals.
J. Division 23 HEATING; VENTILATION AND AIR-CONDITIONING: Shop prime painting of steel and ferrous metals.
K. Division 26 ELECTRICAL: Shop prime painting of steel and ferrous metals.
L. Division 27 COMMUNICATIONS: Shop prime painting of steel and ferrous metals.
M. 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 Construction Documents: FINISH LEGEND.
      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.
   5. Plastic floor coating.

1.4 DELIVERY AND STORAGE

A. Deliver materials to site in manufacturer's sealed container marked to show following:
   1. Name of manufacturer.
   2. Product type.
   3. Batch number.
   4. Instructions for use.
   5. Safety precautions.

B. In addition to manufacturer's label, provide a label legibly printed as following:
   1. Federal Specification Number, where applicable, and name of material.
   2. Surface upon which material is to be applied.
   3. 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 COR in writing of any anticipated problems using the coating systems as specified with substrates primed by others.

1.6 MOCK-UP PANEL

A. In addition to the samples specified herein to be submitted for approval, apply in the field, at their final location, each type and color of approved paint materials, applied 3.05 m (10 feet) wide, floor to ceiling of wall surfaces, before proceeding with the remainder of the work, for approval by the COR. Paint mock-ups to include one (1) door and frame assembly.

B. Finish and texture approved by COR will be used as a standard of quality and workmanship for remainder of work.

C. Repaint individual areas which are not approved, as determined by the COR, until approval is received.

1.7 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.

1.8 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.

1.9 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
5 .....Exterior Alkyd Wood Primer
6 .....Exterior, Latex for Exterior Wood Primer
7 .....Exterior Oil Wood Primer
8 .....Exterior Alkyd, Flat MPI Gloss Level 1
9 .....Exterior Alkyd Enamel MPI Gloss Level 6
10 .....Exterior Latex, Flat

11 .....Exterior Latex, Semi-Gloss
15 .....Exterior Latex, Low Sheen (MPI Gloss Level 3-4)
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
40 .....Exterior, Latex High Build
42 .....Textured Coating, Latex, Flat
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:

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.

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. All suction spots or “hot spots” in plaster after the application of the first coat are to be touched up before applying the second coat.
J. 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. Masonry (Clay and CMU's): 12 percent.
    d. Wood: 15 percent.
    e. Gypsum Board: 12 percent.
    f. Plaster: 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. Masonry, Concrete, Cement Board, Cement Plaster and Stucco:
   1. Clean and remove dust, dirt, oil, grease efflorescence, form release agents, laitance, and other deterrents to paint adhesion.
   2. Use emulsion type cleaning agents to remove oil, grease, paint and similar products. Use of solvents, acid, or steam is not permitted.
   3. Remove loose mortar in masonry work.
   4. Replace mortar and fill open joints, holes, cracks and depressions with new mortar specified in Section 04 05 13. Do not fill weep holes. Finish to match adjacent surfaces.
   5. Neutralize Concrete floors to be painted by washing with a solution of 1.4 Kg (3 pounds) of zinc sulfate crystals to 3.8 L (1 gallon) of water, allow to dry three (3) days and brush thoroughly free of crystals.
   6. Repair broken and spalled concrete edges with concrete patching compound to match adjacent surfaces as specified in Division 03, CONCRETE Sections. Remove projections to level of adjacent surface by grinding or similar methods.

E. Gypsum Plaster and Gypsum Board:
   1. Remove efflorescence, loose and chalking plaster or finishing materials.
   2. Remove dust, dirt, and other deterrents to paint adhesion.
   3. Fill holes, cracks, and other depressions with CID-A-A-1272A finished flush with adjacent surface, with texture to match texture of adjacent surface. Patch holes over 25 mm (1-inch) in diameter as specified in Section for plaster or gypsum board.

3.5 PAINT PREPARATION:

A. Thoroughly mix painting materials to ensure uniformity of color, complete dispersion of pigment and uniform composition.

B. Do not thin unless necessary for application and when finish paint is used for body and prime coats. Use materials and quantities for thinning as specified in manufacturer's printed instructions.

C. Remove paint skins, then strain paint through commercial paint strainer to remove lumps and other particles.

D. Mix two (2) component and two (2) part paint and those requiring additives in such a manner as to uniformly blend as specified in manufacturer's printed instructions unless specified otherwise.

E. For tinting required to produce exact shades specified, use color pigment recommended by the paint manufacturer.

3.6 APPLICATION:

A. Start of surface preparation or painting will be construed as acceptance of the surface as satisfactory for the application of materials.

B. Unless otherwise specified, apply paint in three (3) coats; prime, body, and finish. When two (2) coats applied to prime coat are the same, first coat applied over primer is body coat and second coat is finish coat.

C. Apply each coat evenly and cover substrate completely.

D. Allow not less than 48 hours between application of succeeding coats, except as allowed by manufacturer's printed instructions, and approved by COR.

E. Apply by brush or roller. Spray application for new or existing occupied spaces only upon approval by acceptance from COR in writing.

1. Apply painting materials specifically required by manufacturer to be applied by spraying.
2. In new construction and in existing occupied spaces, where paint is applied by spray, mask or enclose with polyethylene, or similar air tight material with edges and seams continuously sealed including items specified in “Building and Structural Work Field Painting”; “Work not Painted”; motors, controls, telephone, and electrical equipment, fronts of sterilizes and other recessed equipment and similar prefinished items.

F. Do not paint in closed position operable items such as access doors and panels, window sashes, overhead doors, and similar items except overhead roll-up doors and shutters.

3.7 PRIME PAINTING:

A. After surface preparation, prime surfaces before application of body and finish coats, except as otherwise specified.

B. Spot prime and apply body coat to damaged and abraded painted surfaces before applying succeeding coats.

C. Additional field applied prime coats over shop or factory applied prime coats are not required except for exterior exposed steel apply an additional prime coat.

D. Prime rabbets for stop and face glazing of wood, and for face glazing of steel.

E. Wood and Wood Particleboard:

1. Use same kind of primer specified for exposed face surface.
   a. Exterior wood: MPI 7 (Exterior Oil Wood Primer) for new construction and MPI 5(Exterior Alkyd Wood Primer) for repainting bare wood primer except where MPI 90 (Interior Wood Stain, Semi-Transparent) is scheduled.
   b. Interior wood except for transparent finish: MPI 45 (Interior Primer Sealer) or MPI 46 (Interior Enamel Undercoat), thinned if recommended by manufacturer.
   c. Transparent finishes as specified under “Transparent Finishes on Wood Except Floors Article”

2. Apply two (2) coats of primer MPI 7 (Exterior Oil Wood Primer) or MPI 5 (Exterior Alkyd Wood Primer) or sealer MPI 45 (Interior Primer Sealer) or MPI 46 (Interior Enamel Undercoat) to surfaces of wood doors, including top and bottom edges, which are cut for fitting or for other reason.
3. Apply one (1) coat of primer MPI 7 (Exterior Oil Wood Primer) or MPI 5 (Exterior Alkyd Wood Primer) or sealer MPI 45 (Interior Primer Sealer) or MPI 46 (Interior Enamel Undercoat) as soon as delivered to site to surfaces of unfinished woodwork, except concealed surfaces of shop fabricated or assembled millwork and surfaces specified to have varnish, stain or natural finish.
4. Back prime and seal ends of exterior woodwork, and edges of exterior plywood specified to be finished.
5. Apply MPI 67 (Interior Latex Fire Retardant, Top-Coat (UL Approved) to wood for fire retardant finish.

F. Metals except boilers, incinerator stacks, and engine exhaust pipes:
1. Steel and iron: MPI 79 (Marine Alkyd Metal Primer) or 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), MPI 108 (High Build Epoxy Marine Coating finish is specified.
2. Aluminum scheduled to be painted: MPI 95 (Fast Drying Metal Primer).
3. Machinery not factory finished: MPI 9 (Exterior Alkyd Enamel).

G. Gypsum Board and Hardboard:
1. Surfaces scheduled to have MPI 10 (Exterior Latex, Flat), MPI 11 (Exterior Latex, Semi-Gloss), MPI 53 (Interior Latex, Flat), MPI 54 (Interior Latex, Semi-Gloss, MPI Gloss Level 5: Use MPI 10 (Exterior Latex, Flat), MPI 11 (Exterior Latex, Semi-Gloss, MPI 53 (Interior Latex, MPI Gloss Level 3), MPI 52 (Interior Latex, MPI Gloss Level 3), MPI 54 (Interior Latex, Semi-Gloss, MPI Gloss Level 5) respectively.
2. Primer: MPI 50 (Interior Latex Primer Sealer) except use MPI 45 (Interior Primer Sealer) or MPI 46 (Interior Enamel Undercoat).

H. Concrete Masonry Units except glazed or integrally colored and decorative units:
1. MPI 4 (Block Filler) on interior surfaces.
2. Prime exterior surface as specified for exterior finishes.

3.8 EXTERIOR FINISHES:

A. Steel and Ferrous Metal Two (2) coats of MPI 94 (Exterior Alkyd, Semi-Gloss)on exposed surfaces, except on surfaces over 94 degrees C (201 degrees F).

3.9 INTERIOR FINISHES:

A. Apply following finish coats over prime coats in spaces or on surfaces specified in Construction Documents: FINISH LEGEND.

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) or 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. One (1) coat of MPI 101 primer over two (2) coats of waterborne light industrial coating MPI 163 on exposed surfaces in battery rooms. Steel is to be blast cleaned to SSPC 10/NACE No. 2.
    e. Machinery: One (1) coat MPI 9 (Exterior Alkyd Enamel).
    f. Asphalt Coated Metal: One (1) coat MPI 1 (Aluminum Paint).

C. Gypsum Board:
1. One (1) coat of MPI 45 (Interior Primer Sealer) or 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) or 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) or MPI 46 (Interior Enamel Undercoat) plus one (1) coat of MPI 48 (Interior Alkyd Gloss).

D. Masonry and Concrete Walls:
1. Over MPI 4 (Interior/Exterior Latex Block Filler) on CMU surfaces.
2. Two (2) coats of MPI 53 (Interior Latex, Flat, MPI Gloss Level 1), MPI 52 (Interior Latex, MPI Gloss Level 3) or MPI 54 (Interior Latex, Semi-Gloss, MPI Gloss Level 5).

E. Wood:
1. Sanding:
    a. Use 220-grit sandpaper.
    b. Sand sealers and varnish between coats.
    c. Sand enough to scarify surface to assure good adhesion of subsequent coats, to level roughly applied sealer and varnish, and to knock off "whiskers" of any raised grain as well as dust particles.
2. Sealers:
    a. MPI 31 (gloss) or MPI 71 (flat) thinned as recommended by manufacturer at rate of one (1) part of thinner to four (4) parts of varnish.
    b. Apply sealers specified except sealer may be omitted where pigmented, penetrating, or wiping stains containing resins are used.

c. Allow manufacturer's recommended drying time before sanding, but not less than 24 hours or 36 hours in damp or muggy weather.
d. Sand as specified.

3. Paint Finish:
   a. One (1) coat of MPI 45 (Interior Primer Sealer) or MPI 46 (Interior Enamel Undercoat) plus one (1) coat of MPI 47 (Interior Alkyd, Semi-Gloss.
   b. One (1) coat of MPI 45 Interior Primer Sealer) or MPI 46 (Interior Enamel Undercoat).
   c. Two (2) coats of MPI 51 (Interior Alkyd, Eggshell).

F. Cement Board: One (1) coat of MPI 138 (Interior High Performance Latex, MPI Gloss Level 2) or MPI 139 (Interior High Performance Latex, MPI Gloss Level 3) or MPI 140 (Interior High Performance Latex MPI Gloss Level 4) or MPI 141 (Interior High Performance Latex, MPI Gloss Level 5 or MPI 114 (Interior Latex, Gloss).

G. Miscellaneous:
   1. Apply where specified in Construction Documents: FINISH LEGEND.
   2. MPI 1 (Aluminum Paint): Two (2) coats of aluminum paint.

3.10 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. In existing rooms and areas where alterations occur, clean existing stained and natural finished wood retouch abraded surfaces and then give entire surface one (1) coat of MPI 31 (Polyurethane, Moisture Cured, Clear Gloss) or MPI 71 (Polyurethane, Moisture Cured, Clear Flat).

G. Refinish areas as specified for new work to match adjoining work unless specified or scheduled otherwise.

H. Coat knots and pitch streaks showing through old finish with MPI 36 (Knot Sealer) before refinishing.

I. Sand or dull glossy surfaces prior to painting.

J. Sand existing coatings to a feather edge so that transition between new and existing finish will not show in finished work.

3.11 PAINT COLOR:

A. Color and gloss of finish coats is specified in Construction Documents: FINISH LEGEND.
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.

3.12 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 disturbed spaces not scheduled to be finish painted 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 Construction Documents: FINISH LEGEND to match surrounding surfaces.
   2. Paint colors as specified in Construction Documents: FINISH LEGEND except for following:
      a. White: Exterior unfinished surfaces of enameled plumbing fixtures. Insulation coverings on breeching and uptake inside boiler house, drums and drum-heads, oil heaters, condensate tanks and condensate piping.

b. Gray: Heating, ventilating, air conditioning and refrigeration equipment (except as required to match surrounding surfaces), and water and sewage treatment equipment and sewage ejection equipment.

c. Aluminum Color: Ferrous metal on outside of boilers and in connection with boiler settings including supporting doors and door frames and fuel oil burning equipment, and steam generation system (bare piping, fittings, hangers, supports, valves, traps and miscellaneous iron work in contact with pipe).

d. Federal Safety Red: Exposed fire protection piping, hydrants, post indicators, electrical conducts containing fire alarm control wiring, and fire alarm equipment.

e. Federal Safety Orange: Entire lengths of electrical conduits containing feeders 600 volts or more.

f. Color to match brickwork sheet metal covering on breeching outside of exterior wall of boiler house.

I. Apply paint systems on properly prepared and primed surface as follows:

1. Interior Locations:

a. Apply two (2) coats of MPI 47 (Interior Alkyd, Semi-Gloss) to following items:

Metal under 94 degrees C (201 degrees F) of items such as bare piping, fittings, hangers and supports.

Equipment and systems such as hinged covers and frames for control cabinets and boxes, cast-iron radiators, electric conduits and panel boards.

Heating, ventilating, air conditioning, plumbing equipment, and machinery having shop prime coat and not factory finished.

b. Apply one (1) coat of MPI 50 (Interior Latex Primer Sealer) and one (1) coat of MPI 53 (Interior Latex, Flat, MPI Gloss Level 1), MPI 44 (Interior Low Sheen Latex), MPI 52 (Interior Latex, MPI Gloss Level 3), MPI 54 (Interior Latex, Semi-Gloss, MPI Gloss Level 5), on finish of insulation on boiler breeching and uptakes inside boiler house, drums, drumheads, oil heaters, feed water heaters, tanks and piping.

c. Apply two (2) coats of MPI 22 (High Heat Resistant Coating) to ferrous metal surface over 94 degrees K (290 degrees F) of following items:

Garbage and trash incinerator.

Medical waste incinerator.

Exterior of boilers and ferrous metal in connection with boiler settings including supporting members, doors and door frames and fuel oil burning equipment.

Steam line flanges, bare pipe, fittings, valves, hangers and supports over 94 degrees K (290 degrees F).

Engine generator exhaust piping and muffler.

d. Paint electrical conduits containing cables rated 600 volts or more using two (2) coats of MPI 9 (Exterior Alkyd Enamel) or MPI 8 (Exterior Alkyd, Flat), MPI 94 (Exterior Alkyd, Semi-gloss) in the Federal Safety Orange color in exposed and concealed spaces full length of conduit.

2. 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).

3.13 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 Construction Documents: FINISH LEGEND.
   2. Painting of disturbed, damaged and repaired or patched surfaces when entire space is not scheduled for complete repainting or refinishing.
   3. Painting of ferrous metal and galvanized metal.
   4. Painting of wood with fire retardant paint exposed in attics, when used as mechanical equipment space (except shingles).
   5. Identity painting and safety painting.

B. Building and Structural Work not Painted:
   1. Prefinished items:
      a. Casework, doors, elevator entrances and cabs, metal panels, wall covering, and similar items specified factory finished under other sections.
      b. Factory finished equipment and pre-engineered metal building components such as metal roof and wall panels.
   2. Finished surfaces:
      a. Hardware except ferrous metal.
      b. Anodized aluminum, stainless steel, chromium plating, copper, and brass, except as otherwise specified.
      c. Signs, fixtures, and other similar items integrally finished.
   3. Concealed surfaces:
      a. Inside dumbwaiter, elevator and duct shafts, interstitial spaces, pipe basements, crawl spaces, pipe tunnels, above ceilings, attics, except as otherwise specified.
      b. Inside walls or other spaces behind access doors or panels.
      c. Surfaces concealed behind permanently installed casework and equipment.
   4. Moving and operating parts:

a. Shafts, chains, gears, mechanical and electrical operators, linkages, and sprinkler heads, and sensing devices.
b. Tracks for overhead or coiling doors, shutters, and grilles.

5. Labels:
   a. Code required label, such as Underwriters Laboratories Inc., Intertek Testing Service or Factory Mutual Research Corporation.
   b. Identification plates, instruction plates, performance rating, and nomenclature.
6. Galvanized metal:
   a. Exterior chain link fence and gates, corrugated metal areaways, and gratings.
   b. Gas Storage Racks.
   c. Except where specifically specified to be painted.
7. Metal safety treads and nosings.
8. Gaskets.
9. Concrete curbs, gutters, pavements, retaining walls, exterior exposed foundations walls and interior walls in pipe basements.
10. Face brick.
11. Structural steel encased in concrete, masonry, or other enclosure.
12. Structural steel to receive sprayed-on fire proofing.
13. Ceilings, walls, columns in interstitial spaces.
14. Ceilings, walls, and columns in pipe basements.
15. Wood Shingles.

3.14 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 (Diesel Fuel included under Fuel Oil)	Brown	White		Fuel Oil-Grade
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. Electrical Conduits containing feeders over 600 volts, paint legends using 50 mm (2 inch) high black numbers and letters, showing the voltage class rating. Provide legends where conduits pass through walls and floors and at maximum 6096 mm (20 foot) intervals in between. Use

labels with yellow background with black border and words Danger High Voltage Class, 5000, 15000 or 25000.

8. See Sections for methods of identification, legends, and abbreviations of the following:
   a. Regular compressed air lines: Section 22 15 00, GENERAL SERVICE COMPRESSED-AIR SYSTEMS.
   b. Dental compressed air lines: Section 22 61 13.74, DENTAL COMPRESSED-AIR PIPING / Section 22 61 19.74, DENTAL COMPRESSED-AIR EQUIPMENT.
   c. Laboratory gas and vacuum lines: Section 22 62 00, VACUUM SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES / Section 22 63 00, GAS SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES.
   d. Oral evacuation lines: Section 22 62 19.74, DENTAL VACUUM AND EVACUATION EQUIPMENT.
   e. Medical Gases and vacuum lines: Section 22 62 00, VACUUM SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES / Section 22 63 00, GAS SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES.
   f. Conduits containing high voltage feeders over 600 volts: Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS / Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS / Section 28 05 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.

3.15 PROTECTION CLEAN UP, AND TOUCH-UP:

A. Protect work from paint droppings and spattering by use of masking, drop cloths, removal of items or by other approved methods.

B. Upon completion, clean paint from hardware, glass and other surfaces and items not required to be painted of paint drops or smears.

C. Before final inspection, touch-up or refinished in a manner to produce solid even color and finish texture, free from defects in work which was damaged or discolored.

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SECTION 09 96 00
HIGH-PERFORMANCE COATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes surface preparation and the application of high-performance coating systems on the following substrates:

1. Interior Substrates:

a. Concrete, horizontal surfaces.

B. Related Requirements:

1. Section 051200 "Structural Steel Framing" for shop priming of structural steel with primers specified in this Section.
2. Section 099100 "Interior Painting" for general field painting.

1.3 DEFINITIONS

A. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D523.

B. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D523.

C. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D523.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
2. Indicate VOC content.

B. Samples for Verification: For each type of coating system and each color and gloss of topcoat indicated.

1. Submit Samples on rigid backing, 8 inches (200 mm) square.
2. Apply coats on Samples in steps to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

C. Product List: Cross-reference to coating system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Coatings: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

1.6 QUALITY ASSURANCE

A. Mockups: Apply mockups of each coating system indicated to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each coating system.

    a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
    b. Other Items: Architect will designate items or areas required.

2. Final approval of color selections will be based on mockups.

    a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

A. Apply coatings only when temperature of surfaces to be coated and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).

B. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

C. Do not apply exterior coatings in snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide product listed in the Exterior High-Performance Coating Schedule or Interior High-Performance Coating Schedule for the coating category indicated.

2.2 HIGH-PERFORMANCE COATINGS, GENERAL

A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."

B. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
3. Products shall be of same manufacturer for each coat in a coating system.

C. Colors: As indicated in Construction Drawings: FINISH LEGEND.

2.3 SOURCE QUALITY CONTROL

A. Testing of Coating Materials: Owner reserves the right to invoke the following procedure:

1. Owner will engage the services of a qualified testing agency to sample coating materials. Contractor will be notified in advance and may be present when samples are taken. If coating materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, the two coatings are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Fiber-Cement Board: 12 percent.
3. Masonry (Clay and CMUs): 12 percent.

4. Wood: 15 percent.
5. Gypsum Board: 12 percent.
6. Plaster: 12 percent.

C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

D. Plaster Substrates: Verify that plaster is fully cured.

E. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.

F. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and coating systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of coatings, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce coating systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
1. Abrasive blast clean surfaces to comply with SSPC-SP 7/NACE No. 4.
2. SSPC-SP 11.
3. SSPC-SP 6/NACE No. 3.
4. SSPC-SP 10/NACE No. 2.

5. SSPC-SP 5/NACE No. 1.

3.3 APPLICATION

A. Apply high-performance coatings according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."

1. Use applicators and techniques suited for coating and substrate indicated.
2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Coat backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
4. Do not apply coatings over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

B. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.

C. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test coatings for dry film thickness.

1. The contractor shall touch up and restore coated surfaces damaged by testing.
2. If test results show that dry film thickness of applied coating does not comply with coating manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with coating manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from coating operation. Correct damage to work of other trades by cleaning, repairing, replacing, and recoating, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

3.6 INTERIOR HIGH-PERFORMANCE COATING SCHEDULE

A. Concrete Substrates, Horizontal Surfaces.

1. Epoxy System MPI INT 3.2C:

a. Prime Coat: Epoxy, matching topcoat.
b. Intermediate Coat: Epoxy, matching topcoat.
c. Topcoat: Epoxy, gloss, MPI #77.

1) Basis of Design: See Construction Drawings: FINISH LEGEND.

2. Epoxy, High-Build System MPI INT 3.2L:

a. Prime Coat: High-build epoxy, matching topcoat (reduced).
b. Intermediate Coat: High-build epoxy, matching topcoat.

c. Topcoat: High-build epoxy, gloss, MPI #98.

3. Pigmented Polyurethane System MPI INT 3.2D:

a. Prime Coat: Epoxy, gloss, MPI #77.

b. Intermediate Coat: Polyurethane, two component, pigmented, gloss, matching topcoat.
c. Topcoat: Polyurethane, two component, pigmented, gloss (MPI Gloss Level 6), MPI #72.

4. Clear (Two-Component) Polyurethane System MPI INT 3.2K:

a. Prime Coat: Two-component polyurethane matching topcoat.

b. Intermediate Coat: Two-component polyurethane, matching topcoat.

c. Topcoat: Varnish, aliphatic polyurethane, two component (MPI Gloss Level 6 or MPI Gloss Level 7), MPI #78.

- - - END - - -

SECTION 10 14 00
SIGNAGE

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies interior signage for room numbers, code required signs and temporary signs.

1.2 RELATED WORK

A. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS: Sustainable Design Requirements.

B. Section 03 30 53, MISCELLANEOUS CAST-IN-PLACE CONCRETE: Concrete Post Footings.

C. Section 05 12 00, STRUCTURAL STEEL FRAMING: Structural Steel Supports.

D. Section 09 06 00, SCHEDULE FOR FINISHES: Color and Finish of Interior Signs.

E. 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.

J. Structural calculations.

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 Construction Drawings: Signage 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 Signage Schedule .

2.3 INTERIOR SIGN TYPES

A. Conform to the VA Signage Design Manual.

B. Provide sliding rail frame. insert and frame ,and/or 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, 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 or 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 or 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. 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 Drawings: Signage on 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 corner guards and high impact wall covering.

1.2 RELATED WORK

A. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS: Sustainable Design Requirements.

B. Section 05 50 00, METAL FABRICATIONS: Structural Steel Corner Guards.

C. Section 08 71 00, DOOR HARDWARE: Armor plates and kick plates not specified in this section.

D. Construction Drawings: FINISH LEGEND: Color and texture of 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. Shop Drawings: show design and installation details.

C. Manufacturer's Literature and Data:

1. Corner Guards.
2. High Impact Wall covering.

D. Test Report: Showing that resilient material complies with specified fire and safety code requirements.

E. Manufacturer’s qualifications.

F. Installer’s qualifications.

G. 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.

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.
    Provide integral color with colored components matched in accordance with SAE J 1545 to within plus or minus 1.0 on the CIE-LCH scales.

2.2 CORNER GUARDS

A. Resilient, Shock-Absorbing Corner Guards: Surface mounted type.

1. snap-on corner guard formed from resilient material, minimum 1.98 mm (0.078-inch) thick, free floating on a continuous 1.52 mm (0.060-inch) thick extruded aluminum retainer. Provide appropriate mounting hardware, cushions and base plates as required.
2. Profile: Minimum 50 mm (2 inch) long leg and 6 mm (1/4 inch) corner radius.
3. Height: 1.22 m (4 feet).
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.
    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 HIGH IMPACT WALL COVERING

A. Provide wall covering/panels consisting of high impact rigid acrylic vinyl or polyvinyl chloride resilient material.
B. Panel sizes to be 0.61 x 1.21 meter (2 x 4 feet).
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. Rigid Vinyl Acrylic Wall Covering: Wall covering thickness to be 1.02 mm (0.040 inch).
F. High Impact Wall Panels: Wall panel face and edge thickness to be 0.56 mm (0.022 inch) or 0.71 mm (0.028 inch). Panel face to be factory banded to a 9.53 mm (0.375 inch) thick fiberboard core. The backside of the panel is to be laminated with a moisture resistant vapor barrier.
G. Provide adhesive as recommended by the wall covering manufacturer.

2.4 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.

2.5 FINISH

A. Resilient Material: Embossed textures and color in accordance with SAE J1545.

PART 3 - INSTALLATION

3.1 RESILIENT CORNER GUARDS

A. Install corner guards on walls in accordance with manufacturer's instructions.

3.2 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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SECTION 21 08 00
COMMISSIONING OF FIRE SUPPRESSION SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. The requirements of this Section apply to all sections of Division 21.

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 Fire Suppression 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 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 21 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 21, is required in cooperation with the VA and the Commissioning Agent.

B. The Fire Suppression 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 fire suppression systems will require inspection of individual elements of the fire suppression 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 21 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~~10 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 21 Sections for additional Contractor training requirements.

END OF SECTION

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. The design and installation of a hydraulically calculated automatic wet-pipe system complete and ready for operation,for new data center buidling and all spaces indicated on the drawings.

C. Modification of the existing sprinkler system as indicated on the drawings and as further required by these specifications.

1.2 RELATED WORK

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

B. Section 07 84 00, FIRESTOPPING.

C. Section 09 91 00, PAINTING.

D. Section 22 05 23, GENERAL-DUTY VALVES FOR PLUMBING PIPING.

E. Section 28 31 00, FIRE DETECTION AND ALARM.

1.3 DESIGN CRITERIA

A. Design Basis Information: Provide design, materials, equipment, installation, inspection, and testing of the automatic sprinkler system in accordance with the requirements of NFPA 13.

1. Perform hydraulic calculations in accordance with NFPA 13 utilizing the Area/Density method. Do not restrict design area reductions permitted for using quick response sprinklers throughout by the required use of standard response sprinklers in the areas identified in this section.
2. Sprinkler Protection: Sprinkler hazard classifications shall be in accordance with NFPA 13. The hazard classification examples of uses and conditions identified in the Annex of NFPA 13 shall be mandatory for areas not listed below. Request clarification from the Government for any hazard classification not identified. To determining spacing and sizing, apply the following coverage classifications:
   a. Light Hazard Occupancies: Patient care, treatment, and customary access areas.
   b. Ordinary Hazard Group 1 Occupancies: Laboratories, Mechanical Equipment Rooms, Transformer Rooms, Electrical Switchgear Rooms, Electric Closets, and Repair Shops.
   c. Ordinary Hazard Group 2 Occupancies: Storage rooms, trash rooms, clean and soiled linen rooms, pharmacy and associated storage, laundry, kitchens, kitchen storage areas, retail stores, retail store storage rooms, storage areas, building management storage, boiler plants, energy centers, warehouse spaces, file storage areas for the entire area of the space up to 140 square meters (1500 square feet) and Supply Processing and Distribution (SPD).
3. Hydraulic Calculations: Calculated demand including hose stream requirements shall fall no less than 10 percent below the available water supply curve.
4. Water Supply: Base water supply on a flow test at each building. the flow test should be performed within one year of the date work is performed.
5. Zoning:
   a. For each sprinkler zone provide a control valve, flow switch, and a test and drain assembly with pressure gauge. For buildings greater than two stories, provide a check valve at each control valve.
   b. Sprinkler zones shall conform to the smoke barrier zones shown on the drawings.

1.4 SUBMITTALS

A. Submit as one package in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. Prepare detailed working drawings that are signed by a NICET Level

III or Level IV Sprinkler Technician or stamped by a Registered Professional Engineer licensed in the field of Fire Protection Engineering. As the Government review is for technical adequacy only, the installer remains responsible for correcting any conflicts with other trades and building construction that arise during installation. Partial submittals will not be accepted. Material submittals shall be approved prior to the purchase or delivery to the job site. Suitably bind submittals in notebooks or binders and provide an index referencing the appropriate specification section. In addition to the hard copies, provide submittal items in Paragraphs 1.4(A)1 through 1.4(A)5 electronically in pdf format on a compact disc or as directed by the COR. Submittals shall include, but not be limited to, the following:

1. Qualifications:
   a. Provide a copy of the installing contractors fire sprinkler contractor's license.
   b. Provide a copy of the NICET certification for the NICET Level III or Level IV Sprinkler Technician who prepared and signed the detailed working drawings unless the drawings are stamped by a Registered Professional Engineer licensed in the field of Fire Protection Engineering.
   c. Provide documentation showing that the installer has been actively and successfully engaged in the installation of commercial automatic sprinkler systems for the past ten years.
2. Drawings: Submit detailed 1:100 (1/8 inch) scale (minimum) working drawings conforming to the Plans and Calculations chapter of NFPA 13. Drawings shall include graphical scales that allow the user to determine lengths when the drawings are reduced in size. Include a plan showing the piping to the water supply test location.
3. Manufacturer's Data Sheets: Provide data sheets for all materials and equipment proposed for use on the system. Include listing information and installation instructions in data sheets. Where data sheets describe items in addition to those proposed to be used for the system, clearly identify the proposed items on the sheet.
4. Calculation Sheets:
   a. Submit hydraulic calculation sheets in tabular form conforming to the requirements and recommendations of the Plans and Calculations chapter of NFPA 13.
5. Valve Charts: Provide a valve chart that identifies the location of each control valve. Coordinate nomenclature and identification of control valves with COR. Where existing nomenclature does not exist, the chart shall include no less than the following: Tag ID No., Valve Size, Service (control valve, main drain, aux. drain, inspectors test valve, etc.), and Location.
6. Final Document Submittals: Provide as-built drawings, testing and maintenance instructions in accordance with the requirements in Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. In addition, submittals shall include, but not be limited to, the following:
   a. A complete set of as-built drawings showing the installed system with the specific interconnections between the system switches and the fire alarm equipment. Provide a complete set in the formats as follows. Submit items 2 and 3 below on a compact disc or as directed by the COR.
      1) One full size (or size as directed by the COR) printed copy.
      2) One complete set in electronic pdf format.
      3) One complete set in AutoCAD format or a format as directed by the COR.
   b. Material and Testing Certificate: Upon completion of the sprinkler system installation or any partial section of the system, including testing and flushing, provide a copy of a completed Material and Testing Certificate as indicated in NFPA 13. Certificates shall be provided to document all parts of the installation.
   c. Operations and Maintenance Manuals that include step-by-step procedures required for system startup, operation, shutdown, and routine maintenance and testing. The manuals shall include the manufacturer's name, model number, parts list, and tools that should be kept in stock by the owner for routine maintenance, including the name of a local supplier, simplified wiring and controls diagrams, troubleshooting guide, and

recommended service organization, including address and telephone number, for each item of equipment.

d. One paper copy of the Material and Testing Certificates and the Operations and Maintenance Manuals above shall be provided in a binder. In addition, these materials shall be provided in pdf format on a compact disc or as directed by the COR.

e. Provide one additional copy of the Operations and Maintenance Manual covering the system in a flexible protective cover and mount in an accessible location adjacent to the riser or as directed by the COR.

1.5 QUALITY ASSURANCE

A. Installer Reliability: The installer shall possess a valid State of Florida 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
25-2020	Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems
101-2021	Life Safety Code
170-2021	Fire Safety Symbols

C. Underwriters Laboratories, Inc. (UL):

Fire Protection Equipment Directory

D. Factory Mutual Engineering Corporation (FM):

Approval Guide

PART 2 - PRODUCTS

2.1 PIPING & FITTINGS

A. Piping and fittings for private underground water mains shall be in accordance with NFPA 13.
   1. Pipe and fittings from inside face of building 300 mm (12 in.) above finished floor to a distance of approximately 1500 mm (5 ft.) outside building: Ductile Iron, flanged fittings and 316 stainless steel bolting.

B. Piping and fittings for sprinkler systems shall be in accordance with NFPA 13.
   1. Plain-end pipe fittings with locking lugs or shear bolts are not permitted.
   2. Piping sizes 50 mm (2 inches) and smaller shall be black steel Schedule 40 with threaded end connections.
   3. Piping sizes 65 mm (2 ½ inches) and larger shall be black steel Schedule 10 with grooved connections. Grooves in Schedule 10 piping shall be rolled grooved only.
   4. Plastic piping shall not be permitted except for drain piping.
   5. Flexible sprinkler hose shall be FM Approved and limited to hose with threaded end fittings with a minimum inside diameter or 1-inch and a maximum length of 6-feet.

2.2 VALVES

A. General:
   1. Valves shall be in accordance with NFPA 13.
   2. Do not use quarter turn ball valves for 50 mm (2 inch) or larger drain valves.

B. Control Valve: The control valves shall be a listed indicating type. Control valves shall be UL Listed or FM Approved for fire protection installations. System control valve shall be rated for normal system pressure but in no case less than 175 PSI.

C. Check Valve: Shall be of the swing type with a flanged cast iron body and flanged inspection plate.

D. Automatic Ball Drips: Cast brass 20 mm (3/4 inch) in-line automatic ball drip with both ends threaded with iron pipe threads.

E. Alarm Check Valve: Alarm check valve shall be UL Listed and Factory Mutual Approved. The alarm check valve shall be listed for installation in the vertical or horizontal position. The alarm check valve shall be equipped with a removable cover assembly, gauge connections on the system side and supply side of the valve clapper, variable pressure trim, and an external bypass to eliminate false water flow alarms. The alarm check valve trim piping shall be galvanized. Maximum water working pressure to 250 PSI.

F. Backflow Preventer: Provide backflow preventer in accordance with Section 22 05 23, GENERAL-DUTY VALVES FOR PLUMBING PIPING. Provide means to forward flow test the backflow preventer in accordance with NFPA 13.

2.3 FIRE DEPARTMENT SIAMESE CONNECTION

A. Brass, exterior fire department connection with brass escutcheon plate, and a minimum of two 65 mm (2-1/2 inch) connections threaded to match those on the local fire protection service, with polished brass caps and chains. Provide escutcheon with integral raised letters "Automatic Sprinkler" Install an automatic ball drip between fire department connection and check valve with drain piping routed to the exterior of the building or a floor drain.

2.4 SPRINKLERS

A. All sprinklers shall be FM approved quick response except “institutional” type sprinklers shall be permitted to be UL Listed quick response. Provide FM approved quick response sprinklers in all areas, except that standard response sprinklers shall be provided in telecommunications rooms, data center, freezers, refrigerators, elevator hoistways, elevator machine rooms, and generator rooms.

B. Temperature Ratings: In accordance with NFPA 13 except that sprinklers in elevator shafts and elevator machine rooms shall be no less than intermediate temperature rated and sprinklers in generator rooms shall be no less than high temperature rated.

C. Provide sprinkler guards in accordance with NFPA 13 and when the elevation of the sprinkler head is less than 7 feet 6 inches above finished floor. The sprinkler guard shall be UL listed or FM approved for use with the corresponding sprinkler.

2.5 SPRINKLER CABINET

A. Provide sprinkler cabinet with the required number of sprinkler heads of all ratings and types installed, and a sprinkler wrench for each type of sprinkler in accordance with NFPA 13. Locate adjacent to the riser.

B. Provide a list of sprinklers installed in the property in the cabinet. The list shall include the following:
   1. Manufacturer, model, orifice, deflector type, thermal sensitivity, and pressure for each type of sprinkler in the cabinet.
   2. General description of where each sprinkler is used.
   3. Quantity of each type present in the cabinet.
   4. Issue or revision date of list.

2.6 SPRINKLER SYSTEM SIGNAGE

A. Rigid plastic, steel or aluminum signs with white lettering on a red background with holes for easy attachment. Sprinkler system signage shall be attached to the valve or piping with chain.

2.7 SWITCHES:

A. OS&Y Valve Supervisory Switches shall be in a weatherproof die cast/red baked enamel, oil resistant, aluminum housing with tamper resistant screws, 13 mm (1/2 inch) conduit entrance and necessary facilities for attachment to the valves. Provide two SPDT switches rated at 2.5 amps at 24 VDC.

B. Water flow Alarm Switches: Mechanical, non-coded, non-accumulative retard and adjustable from 0 to 60 seconds minimum. Set flow switches at an initial setting between 20 and 30 seconds.

C. Alarm Pressure Switches: Activation by any flow of water equal to or in excess of the discharge from one sprinkler. The alarm pressure switch shall be UL Listed or Factory Mutual Approved for the application in which it is used. Activation of the alarm pressure switch shall cause an alarm on the fire alarm system control unit.

D. Valve Supervisory Switches for Ball and Butterfly Valves: May be integral with the valve.

2.8 GAUGES

A. Provide gauges as required by NFPA 13. Provide gauges where the normal pressure of the system is at the midrange of the gauge.

2.9 PIPE HANGERS, SUPPORTS AND RESTRAINT OF SYSTEM PIPING

A. Pipe hangers, supports, and restraint of system piping shall be in accordance with NFPA 13.

2.10 WALL, FLOOR AND CEILING PLATES

A. Provide chrome plated steel escutcheon plates.

2.11 VALVE TAGS

A. Engraved black filled numbers and letters not less than 15 mm (1/2 inch) high for number designation, and not less than 8 mm (1/4 inch) for service designation on 19 gage, 40 mm (1-1/2 inches) round brass disc, attached with brass "S" hook, brass chain, or nylon twist tie.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be accomplished by the licensed contractor. Provide a qualified technician, experienced in the installation and operation of the type of system being installed, to supervise the installation and testing of the system.

B. Installation of Piping: Accurately cut pipe to measurements established by the installer and work into place without springing or forcing. In any situation where bending of the pipe is required, use a standard pipe-bending template. Concealed piping in spaces that have finished ceilings. Where ceiling mounted equipment exists, such as in operating and radiology rooms, install sprinklers so as not to obstruct the movement or operation of the equipment. Sidewall heads may need to be utilized. In stairways, locate piping as near to the ceiling as possible to prevent tampering by unauthorized personnel and to provide a minimum headroom clearance of 2250 mm (seven feet six inches). Piping shall not obstruct the minimum means of egress clearances required by NFPA 101. Pipe hangers, supports, and restraint of system piping shall be installed accordance with NFPA 13.

C. Welding: Conform to the requirements and recommendations of NFPA 13.

D. Drains: Provide drips and drains, including low point drains, in accordance with NFPA 13. Pipe drains to discharge at safe points outside of the building or to sight cones attached to drains of adequate size to readily carry the full flow from each drain under maximum pressure. Do not provide a direct drain connection to sewer system or discharge into sinks. Install drips and

drains where necessary and required by NFPA 13. The drain piping shall not be restricted or reduced and shall be of the same diameter as the drain collector.

E. Supervisory Switches: Provide supervisory switches for sprinkler control valves.

F. Waterflow Alarm Switches: Install waterflow alarm switches and valves in stairwells or other easily accessible locations.

G. Inspector's Test Connection: Install and supply in accordance with NFPA 13, locate in a secured area, and discharge to the exterior of the building.

H. Affix cutout disks, which are created by cutting holes in the walls of pipe for flow switches and non-threaded pipe connections to the respective waterflow switch or pipe connection near to the pipe from where they were cut.

I. Provide escutcheon plates for exposed piping passing through walls, floors or ceilings.

J. Clearances: For systems requiring seismic protection, piping that passes through floors or walls shall have penetrations sized 50 mm (2 inches) nominally larger than the penetrating pipe for pipe sizes 25 mm (1 inch) to 90 mm (3 ½ inches) and 100 mm (4 inches) nominally larger for penetrating pipe sizes 100 mm (4 inches) and larger.

K. Sleeves: Provide for pipes passing through masonry or concrete. Provide space between the pipe and the sleeve in accordance with NFPA 13. Seal this space with a UL Listed through penetration fire stop material in accordance with Section 07 84 00, FIRESTOPPING. Where core drilling is used in lieu of sleeves, also seal space. Seal penetrations of walls, floors and ceilings of other types of construction, in accordance with Section 07 84 00, FIRESTOPPING.

L. Provide pressure gauges at each water flow alarm switch location and at each main drain connection.

M. For each fire department connection, provide the symbolic sign given in NFPA 170 and locate 2400 to 3000 mm (8 to 10 feet) above each connection location. Size the sign to 450 by 450 mm (18 by 18 inches) with the symbol being at least 350 by 350 mm (14 by 14 inches).

N. Firestopping shall be provided for all penetrations of fire resistance rated construction. Firestopping shall comply with Section 07 84 00, FIRESTOPPING.

O. 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.

P. Sprinkler System Signage: Provide rigid sprinkler system signage in accordance with NFPA 13 and NFPA 25. Sprinkler system signage shall include, but not limited to, the following:
   1. Identification Signs:
      a. Provide signage for each control valve, drain valve, sprinkler cabinet, and inspector’s test.
      b. Provide valve tags for each operable valve. Coordinate nomenclature and identification of operable valves with COR. Where existing nomenclature does not exist, the Tag Identification shall include no less than the following: (FP-B-F/SZ-#) Fire Protection, Building Number, Floor Number/Smoke Zone (if applicable), and Valve Number. (E.g., FP-500-1E-001) Fire Protection, Building 500, First Floor East, Number 001.)
   2. Instruction/Information Signs:
      a. Provide signage for each control valve to indicate valve function and to indicate what system is being controlled.
      b. Provide signage indicating the number and location of low point drains.
   3. Hydraulic Placards:
      a. Provide signage indicating hydraulic design information. The placard shall include location of the design area, discharge densities, required flow and residual pressure

at the base of riser, occupancy classification, hose stream allowance, flow test information, and installing contractor. Locate hydraulic placard information signs at each alarm check valve.

Q. 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.

R. 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.

END OF SECTION

SECTION 21 22 00
CLEAN AGENT FIRE SUPRESSION SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Design, installation and testing of a calculated automatic and manual fixed total flooding clean agent fire extinguishing system and releasing system in accordance with NFPA 2001, NFPA 72, NFPA 70, and NFPA 75 and manufacturer's written instructions for the locations shown on the contract drawings. The installation shall include all mechanical, controls and electrical components necessary for a complete and operating clean agent fire suppression system.

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 05 13, CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY

E. Section 28 05 28.33, CONDUIT AND BACKBOXES FOR ELECTRONIC SAFETY AND SECURITY

F. Section 28 31 00, FIRE DETECTION AND ALARM

1.3 DESIGN CRITERIA

A. The clean agent fire extinguishing system shall be a fixed total flooding type utilizing clean agent designed to provide a uniform concentration throughout the protected spaces in accordance with NFPA 2001 for a Class C fire.

1. The system shall provide a minimum design concentration by volume, throughout the protected spaces at the minimum anticipated temperature within the protected space.
2. The design concentration within any protected space shall not exceed by volume the no observable adverse effects level (NOAEL). Special means such as mechanical exhaust, shall not be permitted to be used to achieve this criterion.
3. The clean agent shall have a global warming potential (GWP) of less than 4000 and the clean agent shall be readily available throughout the continental United States.
   Provide the quantity of clean agent as required by NFPA 2001 and manufacturer's written instructions. Such factors as unenclosed openings (if any), "rundown" time of fans, time required for dampers to close, and any other feature of the facility that could affect concentration shall be taken into consideration.

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 IV Special Hazards Suppression Systems Technician. 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 Contracting Officers Representative (COR). Submittals shall include, but not be limited to, the following:

1. Qualifications:
   a. Provide a copy of the installing contractors Special Suppression Systems and state contractors license.

b. Provide a copy of the NICET certification for the NICET Level IV Special Hazards Suppression System Technician who will prepare and sign the detailed working drawings.
c. Provide documentation showing that the installer has been actively and successfully engaged in the installation of clean agent fire suppression systems for the past ten years.

2. Drawings: Submit detailed 1:100 (1/8 inch) scale (minimum) working plans and drawings of the clean agent fire extinguishing system conforming to NFPA 2001. Submit detailed 1:100 (1/8 inch) scale (minimum) working plans and drawings of the releasing system conforming to NFPA 72. Drawings shall include graphical scales that allow the user to determine lengths when the drawings are reduced in size.
3. Manufacturers Data Sheets:
   a. Provide for all materials and equipment proposed for use on the clean agent fire extinguishing system, including the releasing system. Include listing information and installation instructions in data sheets. Where data sheet describes items in addition to that item being submitted, clearly identify proposed item on the sheet.
4. Calculation Sheets:
   a. Submit flow calculation sheets in tabular form conforming to the requirements of NFPA 2001. Calculations shall include total storage capacity, flooding concentrations, enclosure leakage rates, discharge times, flow through distribution network, pipe sizes, and nozzle orifice sizes.
   b. Submit battery calculations sheets in tabular form conforming to the requirements of NFPA 72.
   c. Submit voltage drop calculations in tabular form. Calculations shall indicate circuit amperage draw, wire resistance, circuit length, and voltage drop. The voltage drop shall demonstrate that voltage provided at the each appliance is within its operating voltage range. Voltage drop calculations shall assume an initial voltage of 20.4 volts.
5. Clean Agent Recharging Certification: Provide a letter to the COR or his designated representative certifying that the installer maintains or has access to a clean agent recharging station. The installer shall also provide proof of the ability to recharge the largest clean agent fire extinguishing system capacity within 48 hours.
6. Test Plan: Provide a test plan to the COR or his designated representative. The testing plan shall describe the procedures to be used to test the system. The testing plan shall include a step-by-step procedure of all tests to be performed, including indication of which tests will present a disruption to building occupants. No tests shall be conducted until the testing plan is approved by the COR or his designated representative.
7. Final Document Submittals: Provide as-built drawings, testing and maintenance instructions in accordance with the requirements in Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. Submittals shall include, but not be limited to, the following:
   a. 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.
   b. System Certification: Upon completion of the clean agent fire extinguishing system installation, including testing, the authorized representative of the manufacturer of the major equipment shall certify that the installation complies with all manufacturer's requirements and that satisfactory total system operation has been achieved. Provide a copy of the Record of Completion for the releasing system in accordance with NFPA 72.
   c. Operating and Maintenance Manuals that include step-by-step procedures required for operation, shutdown, and routine maintenance and testing. The manuals shall include the manufacturer's name, model number, parts list, the name of the 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 System Certification and Record of Completion and the Operating and Maintenance Manuals listed 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 for the system in a binder and mount in an accessible location adjacent to the storage cylinder(s).

1.5 QUALITY ASSURANCE

A. Installer Reliability: The installer shall possess a valid State of Florida Special Suppression Systems contractor's license. The installer shall have been actively and successfully engaged in the installation of clean agent special suppression systems for the past ten years. The installer shall maintain or have access to a clean agent recharging station. The installer shall provide proof of the ability to recharge the largest clean agent fire extinguishing system capacity within 48 hours.

B. Materials and Equipment: All equipment and devices shall be UL listed or approved by FM. All materials, devices, and equipment shall be approved by the VA. All materials and equipment shall be free from defect.

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):

70-2023	National Electric Code
72-20 22	National Fire Alarm Code
75-2024	Fire Protection of Information Technology Equipment
170-2024	Fire Safety Symbols
2001-2022	Installation of Clean Agent Fire Extinguishing Systems

C. Underwriters Laboratories, Inc. (UL):

2011	Fire Protection Equipment Directory

D. Factory Mutual Engineering Corporation (FM):

2015	Approval Guide

1.7 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 COR.

PART 2 - PRODUCTS

2.1 GENERAL

A. All equipment and components shall be new and the manufacturer’s current model. All equipment and components shall be UL listed or FM approved for its intended use. The authorized representative of the manufacturer of the major equipment shall certify that the installation complies with all manufacturer’s requirements and that satisfactory total system operation has been achieved.

2.2 CLEAN AGENT FIRE EXTINGUISHING SYSTEM

A. General:

1. The clean agent fire extinguishing system shall be UL listed and shall be in accordance with NFPA 2001.

B. Piping and fittings:
   1. All piping and fittings shall be in compliance with NFPA 2001.
   2. Multi-outlet fittings, other than tees, shall not be permitted.
   3. All piping shall be reamed, blown clear, and swabbed with appropriate solvent to remove mill varnish and cutting oils before assembly.
   4. Ordinary cast iron steel and non-metallic piping and fittings and flexible hoses shall not be used unless specifically required by the manufacturer.

C. Piping Support:
   1. All piping shall be supported in accordance with the manufacturer's written instructions. Piping shall be supported within 12 inches (304 mm) of discharge nozzles. The supports shall prevent the upward movement of the nozzle.

D. Storage Cylinders:
   1. Provide storage cylinders as required by the manufacturer's written instructions and in accordance with NFPA 2001.
   2. Cylinder assemblies shall be of steel construction designed to meet the requirements of the U.S. Department of Transportation.
   3. Filling of the storage cylinders shall be by an authorized systems distributor in conjunction with a factory authorized agent filling station. Initial filling and recharge shall be performed in accordance with manufacturer's written instructions and shall not require replacement components for normal service.
   4. Cylinders shall be securely attached to the wall. Provide factory- or field-fabricated retaining brackets consisting of steel straps and channels; suitable for container support, maintenance, and tank refilling or replacement.
   5. For halocarbon clean agents, storage cylinders shall be provided with a low agent pressure switch.

E. Valve Actuators:
   1. Electric valve actuators shall be of brass construction and stackable design with swivel connections to allow removal of actuators for maintenance or testing.
   2. Operation of actuators shall not require replacement of components. No electro-explosive devices may be used to actuate the valve assembly. Actuators shall include an indication if they are set or actuated.
   3. Electric valve actuators shall be magnetic latch, continuous duty type for 24 VDC operation.
   4. Actuation devices shall be UL listed or FM approved for use with the system.
   5. Removal of the electric valve actuator shall cause a trouble on the clean agent control panel.

F. Discharge Nozzles:
   1. Nozzles shall be permanently marked with the manufacturer's part number. The nozzles shall be threaded directly to the discharge piping without the use of special adaptors.

2.3 RELEASING SYSTEM

A. General
   1. The releasing system shall be an analog addressable intelligent reporting, microprocessor controlled system, capable of remote sensitivity testing of the smoke detectors, and be installed in accordance with NFPA 70, NFPA 72, and NFPA 2001.

B. Clean Agent Control Panel:
   1. General:
      a. The clean agent control panel shall be UL listed or FM approved and include a UL listed or FM approved releasing module.
      b. Each protected space shall be provided with its own clean agent control unit.

c. All circuits shall be monitored for integrity.
d. Visually and audibly annunciate all alarm, supervisory, and trouble signals including, but not limited to main power failure, open circuit, short circuit, ground faults, and system bypass activation.
e. The panel or releasing module shall include a 0-60 second programmable timer.
f. The clean agent control panel shall be provided with separate contacts to provide common supervisory, alarm, and trouble signals to the main building fire alarm system.

2. Enclosure:
   a. The clean agent control unit shall be housed in a cabinet suitable for both recessed and surface mounting. The cabinet and front panel shall be corrosion protected, given a rust-resistant prime coat, and manufacturer's standard finish.
   b. The cabinet shall contain all necessary relays, terminals, lamps, and legend plates to provide control for the system.
3. Power Supply:
   a. The clean agent control unit shall derive its normal power from a 120 volt, 60 Hz dedicated supply connected to the emergency power system. Standby power shall be provided by a 24 volt DC battery as hereinafter specified. The normal power shall be transformed, rectified, coordinated, and interfaced with the standby battery and charger.
   b. The power supply for smoke detection systems shall be taken from the clean agent control unit.
4. Circuit Supervision: Each alarm initiating device circuit, signaling line circuit, and notification appliance circuit, shall be supervised against the occurrence of an open, short circuit, or ground fault condition in the field wiring. These conditions shall cause a trouble signal to sound in the control unit until manually silenced by an off switch.
   a. Initiating device circuits (IDC) shall be wired Class B in accordance with NFPA 72.
   b. Signaling line circuits (SLC) shall be wired Class B in accordance with NFPA 72.
   c. Notification appliance circuits (NAC) shall be wired Class B in accordance with NFPA 72.
5. Supervisory Alarm Devices: The low agent pressure switch and maintenance lock-out switch shall initiate a supervisory signal.
6. Trouble signals:
   a. Arrange the trouble signals for automatic reset (non-latching).
   b. System trouble switch off and on lamps shall be visible through the control unit door.
7. Function Switches: Provide the following switches in addition to any other switches required for the system:
   a. Remote Alarm Transmission By-pass Switch: Shall prevent transmission of all signals to the building fire alarm control unit when in the "off" position. A clean agent control unit system trouble signal shall be energized when switch is in the off position.
   b. Alarm Off Switch: Shall disconnect power to notification appliance circuits on the clean agent control panel. A system trouble signal shall be activated when the switch is in the off position.
   c. Trouble Silence Switch: Shall silence the trouble signal whenever the trouble silence switch is operated. This switch shall not reset the trouble signal.
   d. Reset Switch: Shall reset the system after an alarm, provided the initiating device has been reset. The system shall lock in alarm until reset.
   e. Lamp Test Switch: A test switch or other approved convenient means shall be provided to test the indicator lamps.
   f. AHU By-Pass: Provide a means to disable air handling units shutdown and dampers from closing upon operation of an initiating device designed to interconnect with these devices. A system trouble signal shall be activated when switch is in the off position.

8. Reset Capability: Each clean agent control unit shall be installed and programmed so that each must be reset locally after an alarm, before the main fire alarm control unit can be reset.

C. Conduit, Boxes, and Wire
   1. Conduit shall be in accordance with Section 28 05 28.33 CONDUIT AND BACKBOXES FOR ELECTRONIC SAFETY AND SECURITY and as follows:
      a. All new conduits shall be installed in accordance with NFPA 70.
      b. Conduit fill shall not exceed 40 percent of interior cross sectional area.
      c. All new conduits shall be 3/4 inch (19 mm) minimum.
   2. Wire:
      a. Wiring shall be installed in conduit.
      b. 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 appliance circuits.
      c. c. Signaling line circuits shall be twisted and shielded unless other wiring methods are specifically required by the fire alarm equipment manufacturer in writing.
   3. Terminal Boxes, Junction Boxes, and Cabinets:
      a. These shall be galvanized steel in accordance with UL requirements.
      b. All boxes shall be sized and installed in accordance with NFPA 70.
      c. Covers shall be repainted red in accordance with Section 09 91 00, PAINTING and shall be identified with white markings as "CA FA" or as directed by the COR for junction boxes and as "CLEAN AGENT FIRE ALARM SYSTEM" for cabinets and terminal boxes. Lettering shall be a minimum of 3/4 inch (19 mm) high.
      d. Terminal boxes and cabinets shall have a volume 50 percent greater than required by NFPA 70. Minimum sized wire shall be considered as 14 AWG for calculation purposes.
      e. Terminal boxes and cabinets shall have identified screw type terminal strips and shall be located in an accessible location. Terminal strips shall be labeled as to what circuit it is or as approved by the COR.

D. Standby Power Supply
   1. Batteries:
      a. The batteries shall be of the sealed, maintenance free type, 24-volt nominal.
      b. The batteries shall have sufficient capacity to power the clean agent control panel and its peripherals for not less than 24 hours plus 5 minutes of alarm to an end voltage of 1.14 volts per cell, upon a normal AC power failure.
      c. Battery racks shall be steel with an alkali-resistant finish.
   2. Battery Charger:
      a. The battery charger shall be completely automatic, with constant potential charger maintaining the battery fully charged under all service conditions. Charger shall operate from a 120-volt, 60 hertz emergency power source.
      b. The battery charger shall be rated for fully charging a completely discharged battery within 48 hours while simultaneously supplying any loads connected to the battery.
      c. The battery charger shall have protection to prevent discharge through the charger.
      d. The battery charger shall have protection for overloads and short circuits on both AC and DC sides.
      e. A trouble condition shall actuate the fire alarm trouble signal.
      f. The battery charger shall have automatic AC line voltage regulation, automatic current-limiting features, and adjustable voltage controls.

E. Spot-type Smoke Detectors

1. Smoke detectors shall be photoelectric plug-in type and UL listed for use with the clean agent control panel being furnished. Each detector shall be monitored individually, via an integral, analog addressable element.
2. Photoelectric detectors shall be factory calibrated and readily field adjustable. The sensitivity of any photoelectric detector shall be factory set at 3.0 plus or minus 0.25 percent obscuration per foot.
3. Smoke detectors of the protected spaces shall be spaced in accordance with NFPA 72 for high air movement areas. Air velocities within the protected spaces shall be suitable for the listed detection air velocity range of the smoke detector.
4. Each protected space shall have at least 2 detectors.
5. Provide red stickers with an “A” on the ceiling below the location of the above ceiling smoke detectors when above ceiling detectors are provided. Provide red stickers with a “U” on the ceiling above the location of the under floor smoke detectors. Each sticker shall also include the address of the detector. The address shall be the same as that address that shows on the fire alarm control unit when the detector is activated.
6. For smoke detectors located under the floor, the smoke detectors shall be mounted with a steel angle or channel support independent of the raised floor structure. The smoke detectors shall be mounted in a vertical orientation.

F. Manual Activation Stations:
1. Shall be non-break glass, address reporting type.
2. Station front shall be constructed of durable material such as cast or extruded metal or high impact plastic. Stations shall be semi-flush type.
3. Shall be of dual action pull down type with suitable operating instructions provided on front in raised or depressed letters, and clearly labeled “AGENT RELEASE.”
4. Operating handles shall be constructed of a durable material. On operation, the lever shall lock in alarm position and remain so until physically reset. A key shall be required to gain front access for resetting, or conducting tests and drills.
5. Shall be located at least 3.28 ft (1m) from any fire alarm manual pull station.

G. Notification Appliances:
1. Pre-discharge Bells:
   a. Shall be 24 VDC and be capable of producing an alarm signal of not less than 85 dBa at 10 feet.
   b. Shall be at least 6 inches (150 mm) in diameter.
2. Pre-discharge Strobes:
   a. Be listed in accordance with UL 1971.
   b. Shall be a minimum of 75 candela.
   c. Shall be provided with an amber lens.
   d. Shall be synchronized with other pre-discharge strobes in the protected space.
3. Discharge Strobes:
   a. Be listed in accordance with UL 1971.
   b. Shall be a minimum of 75 candela.
   c. Shall be provided with a red lens.
   d. Shall be synchronized with other discharge strobes outside the protected space.

H. Addressable Interface Module
1. Addressable interface modules shall be installed in individual boxes in accordance with the manufacturer’s product listing. The addressable interface module shall be provided with a protective cover provided by the device manufacturer. The protective cover shall have the provision for viewing the operational LED of the addressable interface module. Addressable interface modules shall not be installed in a back-box with other devices or relays.
2. The installer shall provide, install, and test addressable interface modules as necessary to comply with the sequence of operations, whether shown on the drawings or not.

I. Graphic Floor Plans:

1. Provide readable scaled graphics of the protected area. The graphics shall show the location and address of each the ceiling smoke detectors, above ceiling smoke detectors, and under floor smoke detectors, on separate plans.
2. The graphic shall be framed and shall be located in an area approved by the COR.
3. Where approved by the COR a single graphic floor plan shall be permitted.

J. Abort Switches:
1. The abort switch front shall be constructed of durable material such as cast or extruded metal or high impact plastic. The abort switch shall be semi-flush type.
2. The abort switch shall not be a locking or keyed type.
3. The abort switch shall be of single action dead-man spring loaded type with suitable operating instructions provided on front in raised or depressed letters, and clearly labeled “ABORT.”

2.4 SWITCHES

A. Maintenance Lock-out Switch
1. Shall be key-operated only allowing the removal of the key in the “Normal” position. A red indicator lamp shall be included on the switch assembly to be illuminated when in the “Lock-out” position. The clean agent control panel shall indicate a supervisory alarm condition when in the “Lock-out” position.
2. The terminals shall be of the screw type.
3. Shall be provided adjacent to the clean agent control panel.

2.5 SIGNAGE

A. Signage shall have white lettering on a red plastic background.

B. The letters shall be 1 inch (25 mm) high with a stroke width of 3/8 inches (9.5 mm).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be accomplished by the licensed contractor. Provide a factory trained 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. Install clean agent fire extinguishing system piping and fittings level and plumb, according to manufacturer’s written instructions.

C. Where installing piping adjacent to equipment, allow space for service and maintenance.

D. Identity piping, agent storage cylinders, and control panels with signage in accordance with NFPA 2001.

E. Provide signage for the pre-discharge bells and strobes. The sign shall say “FIRE. [Agent Surname] RELEASE IMMINENT”. The sign shall be permanently affixed to the wall within 12 inches (304 mm) of the pre-discharge strobe.

F. Provide signage for the discharge strobes. The sign shall say “[Agent Surname] DISCHARGE”. The sign shall be permanently affixed to the wall within 12 inches (304 mm) of the discharge strobe.

G. Provide signage on the exterior of the protected space at each entrance. The sign shall say “THIS SPACE IS PROTECTED BY A CLEAN AGENT FIRE EXTINGUISHING SYSTEM. DO NOT ENTER WITHOUT AUTHORIZATION DURING OR AFTER DISCHARGE. THE RED STROBE INDICATES SYSTEM DISCHARGE.” The sign shall be permanently affixed to the wall adjacent to the door.

H. Provide signage adjacent to each manual activation station. The sign shall say “ACTUATION OF THIS DEVICE WILL CAUSE FIRE SUPPRESSION GAS TO DISCHARGE. BEFORE ACTUATING, ENSURE THAT PERSONNEL ARE CLEAR OF THE AREA.” The sign shall be permanently affixed to the wall within 12 inches (304 mm) of the station.

I. Firestopping shall be provided for all penetrations of fire resistance rated construction. Firestopping shall comply with Section 07 84 00, FIRESTOPPING.

J. Repairs: Repair damage to the building or equipment resulting from the installation of the clean agent fire extinguishing system by the installer at no additional expense to the Government.

K. Supervise clean agent control panel for alarm, supervisory, and trouble signals by the building fire alarm system in accordance with Section 28 31 00, FIRE DETECTION AND ALARM.

L. Where duct detectors are provided within computer room air conditioning units, addressable interface modules shall be used to monitor the activation of the duct detector as a supervisory signal on the clean agent control unit.

M. Control emergency power off with addressable interface modules.

3.2 SEQUENCE OF OPERATIONS

A. The clean agent extinguishing fire extinguishing system shall operate as follows:
   1. Activation of any single smoke detector shall:
      a. Energize an alarm LED lamp on the activated detector and clean agent control panel.
      b. Transmit an alarm signal to the building's fire alarm system.
   2. Activation of a second smoke detector shall:
      a. Energize an alarm LED lamp on the activator detector.
      b. Activate pre-discharge bell notification appliance and pre-discharge strobe notification appliance.
      c. Shut down power to electronic equipment within the protected space, close dampers, release door hold open devices, and shut down air handling units serving the protected space.
      d. Initiate a programmable 30-second time delay (agent release) sequence.
   3. Activation of a manual activation station shall:
      a. Energize an alarm LED lamp on the clean agent control panel.
      b. Activate pre-discharge bell notification appliance and pre-discharge strobe notification appliance.
      c. Shut down power to electronic equipment within the protected space, close dampers, release door hold open devices, and shut down air handling units serving the protected space.
      d. Transmit an alarm signal to the building's fire alarm system.
      e. Initiate a programmable 20-second time delay (agent release) sequence.
   4. Activation of the abort switch shall:
      a. Cease the time delay. Once the abort switch is released, the time delay countdown shall resume from where it ceased. The time delay shall not reset.
      b. Transmit a trouble signal to the building's fire alarm system.
   5. Upon completion of the time delay, the system shall:
      a. De-energize the pre-discharge bell and pre-discharge strobe notification appliance.
      b. Activate a discharge strobe notification appliance inside and outside of the protected area.
      c. Energize valve actuator for agent cylinders releasing gaseous agent into the protected area.
   6. Activation of the low agent tank pressure switch and maintenance lock-out switch shall:
      a. Energize a supervisory LED lamp on the clean agent control panel.
      b. Transmit a supervisory alarm signal to the building's fire alarm system.
   7. Presence of any fault, bypass function, or removal of the electric valve actuator shall:
      a. Energize a trouble LED lamp on the clean agent control panel.
      b. Transmit a trouble signal to the building's fire alarm system.
   8. Activation of duct detector within a computer room air condition unit shall energize a supervisory signal LED lamp on the clean agent control panel.

3.3 INSPECTION AND TEST

A. Room Enclosure Test: A room pressurization test shall be conducted for the protected space. The testing shall be done in accordance with NFPA 2001 Annex C. The contractor shall be responsible for sealing the enclosure to ensure the success of the room pressurization test. The test shall be deemed successful if the tested leakage rate is less than or equal to the leakage rate assumed in the calculations.

B. Pressure Test: Pneumatically pressure test piping in a closed circuit in accordance with NFPA 2001.

C. Flow Test: Subject system to a flow test utilizing nitrogen to verify that flow is continuous and that the piping and nozzles are unobstructed.

D. Preliminary Testing: System function operation test system as specified in NFPA 2001 and NFPA 72, in the presence of the COR or his designated representative.

E. Final Inspection and Testing: Subject system to tests in accordance with NFPA 2001 and NFPA 72, 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.

3.4 TRAINING

A. The manufacturer's authorized representative shall provide instruction and training to the VA on the dates requested by the COR as follows:
   1. Six 1-hour sessions to employees working in protected area, engineering staff, security police and VA Fire Department personnel where there is a VA Fire Department present on site for simple operation of the system. Two sessions at the start of installation, 2 sessions at the completion of installation and 2 sessions 3 months after the completion of installation.
   2. Four 2-hour sessions to engineering staff for detailed operation of the system. Two sessions at the completion of installation and 2 sessions 3 months after the completion of installation.
   3. Three 8-hour sessions to electrical technicians for maintaining, programming, modifying, and repairing the system at the completion of installation and one 8-hour refresher session 3 months after the completion of installation.

B. Each initial training session shall be videotaped.

END OF SECTION

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 http//www.cfm.va.gov/til/indes.asp
181. T/P: Temperature and Pressure
182. TYP: Typical
183. USDA: U.S. Department of Agriculture
184. V: Vent
185. V: Volt
186. VA: Veterans Administration
187. VA CFM: VA Construction & Facilities Management
188. VA CFM CSS: VA Construction & Facilities Management, Consulting Support Service
189. VAC: Vacuum
190. VAC: Voltage in Alternating Current
191. VAMC: Veterans Administration Medical Center
192. VHA OCAMES: This has been replaced by HEFP.
193. VSD: Variable Speed Drive
194. VTR: Vent through Roof
195. W: Waste
196. WAGD: Waste Anesthesia Gas Disposal
197. WC: Water Closet

198. WG: Water Gauge
199. WOG: Water, Oil, Gas
200. WPD: Water Pressure Drop
201. WSFU: Water Supply Fixture Units

1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.
B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
C. Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT.
D. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.
E. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.
F. Section 02 82 11, TRADITIONAL ASBESTOS ABATEMENT.
G. Section 03 30 00, CAST-IN-PLACE CONCRETE: Concrete and Grout.
H. Section 05 31 00, STEEL DECKING: Building Components for Attachment of Hangers.
I. Section 05 36 00, COMPOSITE METAL DECKING: Building Components for Attachment of Hangers.
J. Section 05 50 00, METAL FABRICATIONS.
K. Section 07 60 00, FLASHING AND SHEET METAL: Flashing for Wall and Roof Penetrations.
L. Section 07 84 00, FIRESTOPPING.
M. Section 07 92 00, JOINT SEALANTS.
N. Section 09 91 00, PAINTING.

O. Section 22 05 12, GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT.
P. Section 22 07 11, PLUMBING INSULATION.
Q. Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.
R. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.
S. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
T. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES.
U. Section 26 29 11, MOTOR CONTROLLERS.
V. Section 31 20 00, EARTH MOVING: Excavation and Backfill.

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):

B31.1-2020	Power Piping
ASME Boiler and Pressure Vessel Code	
BPVC Section IX-2021	Welding, Brazing, and Fusing Qualifications

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

A36/A36M-2019	Standard Specification for Carbon Structural Steel
A575-2020	Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades

E84-2021a	Standard Test Method for Surface Burning Characteristics of Building Materials
E119-2020	Standard Test Methods for Fire Tests of Building Construction and Materials

D. International Code Council, (ICC):

IBC-2021	International Building Code
IPC-2021	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 1-2019	Motors and Generators

H. National Fire Protection Association (NFPA):

51B-2019	Standard for Fire Prevention During Welding, Cutting and Other Hot Work
54-2021	National Fuel Gas Code
70-2020	National Electrical Code (NEC)
99-2021	Healthcare Facilities Code

I. NSF International (NSF):

5-2019	Water Heaters, Hot Water Supply Boilers, and Heat Recovery Equipment
14-2020	Plastic Piping System Components and Related Materials
61-2020	Drinking Water System Components – Health Effects
372-2020	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. 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.

K. Provide copies of approved plumbing equipment submittals to the TAB and Commissioning Subcontractor.

L. Completed System Readiness Checklist provided by the CxA and completed by the Contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 22 08 00 COMMISSIONING OF PLUMBING SYSTEMS.

M. Submit training plans, trainer qualifications and instructor qualifications in accordance with the requirements of Section 22 08 00 COMMISSIONING OF PLUMBING SYSTEMS.

1.5 QUALITY ASSURANCE

A. Mechanical, electrical, and associated systems 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. As-built drawings are to be provided, with a copy of them on AutoCAD provided on CD or DVD. The CAD drawings will use multiple line layers with a separate individual layer for each system.

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. Building Working Environment: Maintain the architectural and structural integrity of the building and the working environment at all times. Maintain the interior of building at 18 degrees C (65 degrees F) minimum. Limit the opening of doors, windows or other access openings to brief periods as necessary for rigging purposes. Storm water or ground water leakage is prohibited. Provide daily clean-up of construction and demolition debris on all floor surfaces and on all equipment being operated by VA. Maintain all egress routes and safety systems/devices.

D. Acceptance of Work for Government Operation: As new equipment, systems and facilities are made available for operation and these items are deemed of beneficial use to the Government, inspections and tests will be performed. Based on the inspections, a list of contract deficiencies will be issued to the Contractor. After correction of deficiencies as necessary for beneficial use, the Contracting Officer will process necessary acceptance and the equipment will then be under the control and operation of Government personnel.

PART 2 - PRODUCTS

2.1 MATERIALS FOR VARIOUS SERVICES

A. 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 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.

2.5 ELECTRIC MOTORS, MOTOR CONTROL, CONTROL WIRING

A. All material and equipment furnished and installation methods used will conform to the requirements of Section 22 05 12, GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT; Section 26 29 11, MOTOR CONTROLLERS; and, Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES. All electrical wiring, conduit, and devices necessary for the proper connection, protection and operation of the systems 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 in Section 22 05 12, GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT, with no consideration of annual service hours. Motor manufacturers generally define these efficiency requirements as “NEMA premium efficient” and the requirements generally exceed those of the Energy Policy Act (EPACT), revised 2005. Motors not specified as “high efficiency or premium efficient” 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.

2.6 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.

2.7 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.

2.8 GALVANIZED REPAIR COMPOUND

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

2.9 PIPE AND EQUIPMENT SUPPORTS AND RESTRAINTS

A. In lieu of the paragraph which follows, suspended equipment support and restraints may be designed and installed in accordance with the International Building Code (IBC). Submittals based on the International Building Code (IBC)requirements, or the following paragraphs of this Section 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. Refer to Section 05 50 00, METAL FABRICATIONS, for miscellaneous metal support materials and prime coat painting.

C. For Attachment to Concrete Construction:
   1. Concrete insert: Type 18, MSS SP-58.
   2. Self-drilling expansion shields and machine bolt expansion anchors: Permitted in concrete not less than 100 mm (4 inches) thick when approved by the COR for each job condition.
   3. Power-driven fasteners: Permitted in existing concrete or masonry not less than 100 mm (4 inches) thick when approved by the COR for each job condition.

D. For Attachment to Steel Construction: MSS SP-58.
   1. Welded attachment: Type 22.
   2. Beam clamps: Types 20, 21, 28 or 29. Type 23 C-clamp may be used for individual copper tubing up to 23 mm (7/8 inch) outside diameter.

E. Attachment to Metal Pan or Deck: As required for materials specified in Section 05 31 00, STEEL DECKINGOR Section 05 36 00, COMPOSITE METAL DECKING.

F. For Attachment to Wood Construction: Wood screws or lag bolts.

G. Hanger Rods: Hot-rolled steel, ASTM A36/A36M or ASTM A575 for allowable load listed in MSS SP-58. For piping, provide adjustment means for controlling level or slope. Types 13 or 15 turn-buckles will provide 40 mm (1-1/2 inches) minimum of adjustment and incorporate locknuts. All-thread rods are acceptable.

H. Multiple (Trapeze) Hangers: Galvanized, cold formed, lipped steel channel horizontal member, not less than 43 mm by 43 mm (1-5/8 inches by 1-5/8 inches), 2.7 mm (No. 12 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.

I. Pipe Hangers and Supports: (MSS SP-58), use hangers sized to encircle insulation on insulated piping. Refer to Section 22 07 11, PLUMBING INSULATION for insulation thickness. To protect insulation, provide Type 39 saddles for roller type supports or insulated calcium silicate shields. Provide Type 40 insulation shield or insulated calcium silicate shield at all other types of supports and hangers including those for insulated piping.

1. General Types (MSS SP-58):
    a. Standard clevis hanger: Type 1; provide locknut.
    b. Riser clamps: Type 8.
    c. Wall brackets: Types 31, 32 or 33.
    d. Roller supports: Type 41, 43, 44 and 46.
    e. Saddle support: Type 36, 37 or 38.
    f. Turnbuckle: Types 13 or 15.
    g. U-bolt clamp: Type 24.
    h. Copper Tube:
        1) Hangers, clamps and other support material in contact with tubing 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. 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.

J. Pre-insulated Calcium Silicate Shields:
1. Provide 360-degree water resistant high density 965 kPa (140 psig) compressive strength calcium silicate shields encased in galvanized metal.
2. Pre-insulated calcium silicate shields to be installed at the point of support during erection.
3. Shield thickness 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.

2.10 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.

2.11 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.

2.12 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.

2.13 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, specified in Section 03 30 00, CAST-IN-PLACE CONCRETE, 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 bathrooms, restrooms, housekeeping closets: All pipe penetrations behind escutcheons will be sealed with plumbers’ putty.

O. 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.

P. 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 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.

3.3 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.

3.4 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.

E. Asbestos Insulation Removal: Conform to Section 02 82 11, TRADITIONAL ASBESTOS ABATEMENT.

3.5 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.

3.6 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.

3.7 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. Provide a minimum of 3 weeks prior notice.

3.8 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.

3.9 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.

3.10 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

B. Components provided under this section of the specification will be tested as part of a larger system.

3.11 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer’s technical representative for 4 hours to instruct each VA personnel responsible in operation and maintenance of the system.

B. Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

END OF SECTION

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 PPLICABLE 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):

C700-2020	Cold Water Meters, Displacement Type, Bronze Main Case
C701-2019	Cold Water Meters-Turbine Type, for Customer Service
C702-2019	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-2021	International Plumbing Code

F. National Fire Protection Association (NFPA):

70–2020	National Electrical Code (NEC)

G. NSF International (NSF):

61-2020	Drinking Water System Components – Health Effects
372-2020	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

A. Comply with requirements in Paragraph “AS-BUILT DOCUMENTATION” of Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING

PART 2 - PRODUCTS

2.1 DISPLACEMENT WATER METER

A. For pipe sizes 50 mm (2 inches) and smaller, the water meter shall be displacement type, full size nutating disc, magnetic drive, sealed register, and fully conform to AWWA C700. Peak domestic flow shall be 2.2 L/s (34 gpm). 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 meter case, bottom caps, and register box lids shall be constructed from cast bronze.

D. 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 700.

E. The water meter shall conform to NSF 61andNSF 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 61andNSF 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 61andNSF 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.

END OF SECTION

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
1003-2020	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
1020-2020	Performance Requirements for Pressure Vacuum Breaker Assembly
1035-2020	Performance Requirements for Laboratory Faucet Backflow Preventers

1069-2020	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-2021	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):

9th Edition 2019	Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems

H. NSF International (NSF):

61-2020	Drinking Water System Components – Health Effects
372-2020	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.AS BUILT DOCUMENTATION

D. 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, Buna-NorEPDM 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 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.

2.4 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. Water service entrance from loop system.

C. The pipe applied or integral atmospheric vacuum breaker shall be ASSE listed 1001. The main body shall be cast bronze. The seat disc shall be the elastomer type suited for water service. The device shall be accessible for maintenance without removing the device from the service line. The installation shall not be in a concealed or inaccessible location or where the venting of water from the device during normal operation is deemed objectionable. Atmospheric vacuum breakers shall be installed in the following applications.
   1. Hose bibs and sinks with threaded outlets.

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.

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. 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.

F. 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.

G. Install pressure gauges on outlet of backflow preventers.

H. Do not install bypass piping around backflow preventers.

I. 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.

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

K. 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.

END OF SECTION

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, 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, 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/m3 - 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 02 82 11, TRADITIONAL ASBESTOS ABATEMENT: Insulation containing asbestos material.

F. Section 07 84 00, FIRESTOPPING: Mineral fiber and bond breaker behind sealant.

G. 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.

H. Section 22 05 19, METERS AND GAGES FOR PLUMBING PIPING: Hot and cold water piping.

I. Section 22 05 23, GENERAL-DUTY VALVES FOR PLUMBING PIPING: Hot and cold water piping.

J. Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

K. Section 23 21 13, HYDRONIC PIPING: electrical heat tracing systems.

L. Section 26 32 13, ENGINE GENERATORS: Exhaust stacks and muffler.

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
C411-2019	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
C450-2018	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.
C533-2019	Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation
C534/C534M-2020	Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
C547-2019	Standard Specification for Mineral Fiber Pipe Insulation
C552-2021	Standard Specification for Cellular Glass Thermal Insulation
C553-2019	Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
C591-2021	Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
C680-2019	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(R2019)	Standard Specification for Mineral Fiber Block and Board Thermal Insulation
C1126-2019	Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation
C1136-2021	Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation

C1710-2021	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
E84-2021a	Standard Test Method for Surface Burning Characteristics of Building Materials
E2231-2019	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-2021	International Mechanical Code

E. Military Specifications (Mil. Spec.):

MIL-A-3316D - 2020	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-2021	Standard for the Installation of Air-Conditioning and Ventilating Systems

G. Underwriters Laboratories, Inc (UL):

723-2018	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. 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 . 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 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/m3 (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/m3 (nominal 1 pcf), k = 0.045 (0.31) 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/m3 (7.5 pcf) nominal, k = 0.033 (0.29) at 24 degrees C (75 degrees F).

B. Pipe insulation for use at process temperatures below ambient air to 482 degrees C (900 degrees F) with or without all service vapor retarder jacket (ASJ).

C. Pipe insulation for use at process temperatures for pipe and tube below ambient air temperatures or where condensation control is necessary are to be installed with a vapor retarder/barrier system of with or without all service vapor retarder sealed jacket (ASJ) system. Without ASJ shall require all longitudinal and circumferential joints to be vapor sealed with vapor barrier mastic.

D. Cellular glass thermal insulation intended for use on surfaces operating at temperatures between −268 and 482 degrees C (−450 and 900 degrees F). It is possible that special fabrication or techniques for pipe insulation, or both, shall be required for application in the temperature range from 121 to 427 degrees C (250 to 800 degrees F).

2.5 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 INSULATION FACINGS AND JACKETS

A. Vapor Retarder, higher strength with low water permeance = 0.02 or less perm rating, Beach puncture 50 units for insulation facing on pipe insulation jackets. Facings and jackets shall be ASJ or PVDC Vapor Retarder jacketing.

B. ASJ shall be white finish (kraft paper) bonded to 0.025 mm (1 mil) thick aluminum foil, fiberglass reinforced, with pressure sensitive adhesive closure. Comply with ASTM C1136. Beach puncture is 50 units, suitable for painting without sizing. Jackets shall have minimum 40 mm (1-1/2 inch) lap on longitudinal joints and minimum 75 mm (3 inch) butt strip on end joints. Butt strip material shall be same as the jacket. Lap and butt strips shall be self-sealing type with factory-applied pressure sensitive adhesive.

C. Vapor Retarder medium strength with low water vapor permeance of 0.02 or less perm rating), Beach puncture 25 units: FSK or PVDC type for concealed ductwork and equipment.

D. Except for flexible elastomeric cellular thermal insulation (not for high humidity exposures), field applied vapor barrier jackets shall be provided, in addition to the specified facings and jackets, on all exterior piping as well as on interior piping exposed to outdoor air (i.e.; in ventilated attics, piping in ventilated (not air conditioned) spaces, etc.)in high humidity locations conveying fluids below ambient temperature. The vapor barrier jacket shall consist of a multi-layer laminated cladding with a maximum water vapor permeance of 0.001 perms. The minimum puncture resistance shall be 35 cm-kg (30 inch-pounds) for interior locations and 92 cm-kg (80 inch-pounds) for exterior or exposed locations or where the insulation is subject to damage.

E. Except for cellular glass thermal insulation, when all longitudinal and circumferential joints are vapor sealed with a vapor barrier mastic or caulking, vapor barrier jackets may not be provided. For aesthetic and physical abuse applications, exterior jacketing is recommended. Otherwise field applied vapor barrier jackets shall be provided, in addition to the applicable specified facings and jackets, on all exterior piping as well as on interior piping exposed to outdoor air (i.e.; in ventilated attics, piping in ventilated (not air conditioned) spaces, etc.) in high humidity locations conveying fluids below ambient temperature. The vapor barrier jacket shall consist of a multi-layer laminated cladding with a maximum water vapor permeance of 0.001 perms. The minimum puncture resistance shall be 35 cm-kg (30 inch-pounds) for interior locations and 92 cm-kg (80 inch-pounds) for exterior or exposed locations or where the insulation is subject to damage.

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

G. Pipe fitting insulation covering (jackets): Fitting covering shall be premolded to match shape of fitting and shall be PVC conforming to Fed Spec L-P-535E, composition A, Type II Grade GU, and Type III, minimum thickness 0.7 mm (0.03 inches). Provide color matching vapor retarder pressure sensitive tape. Staples, tacks, or any other attachment that penetrates the PVC covering is not allowed on any form of a vapor barrier system in below ambient process temperature applications.

H. Aluminum Jacket-Piping systems and circular breeching and stacks: ASTM B209, 3003 alloy, H-14 temper, 0.6 mm (0.023 inch) minimum thickness with locking longitudinal joints. Jackets for elbows, tees and other fittings shall be factory-fabricated or with cut aluminum gores to match shape of fitting and of 0.6 mm (0.024 inch) minimum thickness aluminum. Aluminum fittings shall be of same construction with an internal moisture barrier as straight run jackets but need not be of the same alloy. Factory-fabricated stainless steel bands with wing seals shall be installed on all circumferential joints. Bands shall be 15 mm (0.5 inch) wide on 450 mm (18 inch) centers. System shall be weatherproof if utilized for outside service.

I. Aluminum jacket-Rectangular breeching: ASTM B209, 3003 alloy, H-14 temper, 0.5 mm (0.020 inches) thick with 32 mm (1-1/4 inch) corrugations or 0.8 mm (0.032 inches) thick with no corrugations. System shall be weatherproof if used for outside service.

2.7 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.

2.8 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.

2.9 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.

2.10 FIRESTOPPING MATERIAL

A. Other than pipe insulation, refer to Section 07 84 00, FIRESTOPPING.

2.11 FLAME AND SMOKE

A. Unless shown otherwise all assembled systems shall meet flame spread 25 and smoke developed 50 rating as developed under ASTM and UL standards and specifications. See paragraph "Quality Assurance".

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. Required pressure tests of piping joints and connections shall be completed and the work approved by the Contracting Officer’s Representative (COR) for application of insulation. Surface shall be clean and dry with all foreign materials, such as dirt, oil, loose scale and rust removed.

B. Except for specific exceptions or as noted, insulate all specified equipment, and piping (pipe, fittings, valves, accessories). Insulate each pipe individually. Do not use scrap pieces of insulation where a full length section will fit.

C. Where removal of insulation of piping and equipment is required to comply with Section 02 82 11, TRADITIONAL ASBESTOS ABATEMENT, such areas shall be reinsulated to comply with this specification.

D. Insulation materials shall be installed with smooth and even surfaces, with jackets and facings drawn tight and smoothly cemented down and sealed at all laps. Insulation shall be continuous through all sleeves and openings, except at fire dampers and duct heaters (NFPA 90A).

E. Vapor retarders shall be continuous and uninterrupted throughout systems with operating temperature 15 degrees C (60 degrees F) and below. Lap and seal vapor barrier over ends and exposed edges of insulation. Anchors, supports and other metal projections through insulation on cold surfaces shall be insulated and vapor sealed for a minimum length of 150 mm (6 inches).

F. Install vapor stops with operating temperature 15 degrees C (60 degrees F) and below at all insulation terminations on either side of valves, pumps, fittings, and equipment and particularly in straight lengths every 4.6 to 6.1 meters (approx. 15 to 20 feet) of pipe insulation. The annular space between the pipe and pipe insulation of approx. 25 mm (1 inch) in length at every vapor stop shall be sealed with appropriate vapor barrier sealant. Bio-based materials shall be utilized when possible.

G. Construct insulation on parts of equipment such as cold water pumps and heat exchangers that must be opened periodically for maintenance or repair, so insulation can be removed and replaced without damage. Install insulation with bolted 1 mm thick (20 gage) galvanized steel or aluminum covers as complete units, or in sections, with all necessary supports, and split to coincide with flange/split of the equipment. Do not insulate over equipment nameplate data.

H. Insulation on hot piping and equipment shall be terminated square at items not to be insulated, access openings and nameplates. Cover all exposed raw insulation with white sealer coating (caution about coating’s maximum temperature limit) or jacket material.

I. Protect all insulations outside of buildings with aluminum jacket using lock joint or other approved system for a continuous weather tight system. Access doors and other items requiring maintenance or access shall be removable and sealable.

J. Plumbing work not to be insulated unless otherwise noted:
   1. Piping and valves of fire protection system.
   2. Chromium plated brass piping.
   3. Water piping in contact with earth.

K. Apply insulation materials subject to the manufacturer's recommended temperature limits. Apply adhesives, mastic and coatings at the manufacturer's recommended minimum wet or dry film thickness. Bio-based materials shall be utilized when possible.

L. Elbows, flanges and other fittings shall be insulated with the same material as is used on the pipe straights. Use of polyurethane or polyisocyanurate spray-foam to fill a PVC elbow jacket is prohibited on cold applications.

M. Firestop Pipe insulation:
   1. Provide firestopping insulation at fire and smoke barriers through penetrations. Firestopping insulation shall be UL listed as defined in Section 07 84 00, FIRESTOPPING.
   2. Pipe penetrations requiring fire stop insulation including, but not limited to the following:
      a. Pipe risers through floors
      b. Pipe chase walls and floors
      c. Smoke partitions
      d. Fire partitions
      e. Hourly rated walls

N. Provide vapor barrier systems as follows:
   1. All piping exposed to outdoor weather.
   2. All interior piping conveying fluids in high humidity locations.

O. 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.

P. 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. Cold water piping, exterior only.

D. Cellular Glass Insulation:
1. Pipe and tubing, covering nominal thickness in millimeters and inches as specified in the schedule at the end of this section.
2. Underground piping other than or in lieu of that specified in Section 22 11 00, FACILITY WATER DISTRIBUTION: Type II, factory jacketed with a 3 mm laminate jacketing consisting of 3000 mm x 3000 mm (10 ft x 10 ft) asphalt impregnated glass fabric, bituminous mastic and outside protective plastic film.
    a. 75 mm (3 inches) thick for hot water piping.
    b. As scheduled at the end of this section for chilled water piping.
    c. Underground piping: Apply insulation with joints tightly butted. Seal longitudinal self-sealing lap. Use field fabricated or factory made fittings. Seal butt joints and fitting with jacketing as recommended by the insulation manufacturer. Use 100 mm (4 inch) wide strips to seal butt joints.
    d. Provide expansion chambers for pipe loops, anchors and wall penetrations as recommended by the insulation manufacturer.
    e. Underground insulation shall be inspected and approved by the COR as follows:
        1) Insulation in place before coating.
        2) After coating.
    f. Sand bed and backfill: Minimum 75 mm (3 inches) all around insulated pipe or tank, applied after coating has dried.
    g. All piping up to 482 degrees C (900 degrees F) requiring protection from physical heavy contact/abuse including in mechanical rooms and exposures to the public.
3. Cold equipment: 50 mm (2 inch) thick insulation faced with ASJ.

E. 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.

3.3 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

B. Components provided under this section of the specification will be tested as part of a larger system.

3.4 PIPE INSULATION SCHEDULE

A. Provide insulation for piping systems as scheduled below:

Insulation Thickness Millimeters (Inches)					
		Nominal Pipe Size Millimeters (Inches)			
Operating Temperature Range/Service	**Insulation Material**	**Less than 25 (1)**	**25 – 32 (1 – 1¼)**	**38 – 75 (1½ - 3)**	**100 (4) and Greater**
38-60 degrees C (100-140 degrees F) (Domestic Hot Water Supply and Return)	Mineral Fiber (Above ground piping only)	38 (1.5)	38 (1.5)	50 (2.0)	50 (2.0)
38-60 degrees C (100-140 degrees F) (Domestic Hot Water Supply and Return)	Rigid Cellular Phenolic Foam (Above ground piping only) (exterior locations only)	38 (1.5)	38 (1.5)	50 (2.0)	50 (2.0)
38-60 degrees C (100-140 degrees F) (Domestic Hot Water Supply and Return)	Polyiso-cyanurate Closed-Cell Rigid (Exterior Locations only)	38 (1.5)	38 (1.5)	50 (2.0)	50 (2.0)
38-60 degrees C (100-140 degrees F) (Domestic Hot Water Supply and Return)	Flexible Elastomeric Cellular Thermal (Above ground piping only)	38 (1.5)	38 (1.5)	50 (2.0)	50 (2.0)
38-60 degrees C (100-140 degrees F) (Domestic Hot Water Supply and Return)	Cellular Glass Thermal	38 (1.5)	38 (1.5)	50 (2.0)	50 (2.0)

END OF SECTION

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~~10 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 OF SECTION

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 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.

B. American Society of Mechanical Engineers (ASME):

A13.1-2020	Scheme for Identification of Piping Systems
B16.3-2016	Malleable Iron Threaded Fittings: Classes 150 and 300
B16.9-2018	Factory-Made Wrought Buttwelding Fittings
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
B16.18-2018	Cast Copper Alloy Solder Joint Pressure Fittings
B16.22-2018	Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings
B16.24-2016	Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 600, 900, 1500, and 2500
B16.51-2018	Copper and Copper Alloy Press-Connect Fittings
ASME Boiler and Pressure Vessel Code -	
BPVC Section IX-2021	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-2020	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
A183-2014 (R2020)	Standard Specification for Carbon Steel Track Bolts and Nuts
A269/A269M-2015a(R2019)	Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service
A312/A312M-2021	Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
A403/A403M-2020	Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings
A536-1984 (R2019)e1	Standard Specification for Ductile Iron Castings
A733-2016	Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
B32-2020	Standard Specification for Solder Metal
B43-2020	Standard Specification for Seamless Red Brass Pipe, Standard Sizes
B61-2015	Standard Specification for Steam or Valve Bronze Castings
B62-2017	Standard Specification for Composition Bronze or Ounce Metal Castings
B75/B75M-2020	Standard Specification for Seamless Copper Tube
B88-2020	Standard Specification for Seamless Copper Water Tube
B584-2014	Standard Specification for Copper Alloy Sand Castings for General Applications
B687-1999 (R2016)	Standard Specification for Brass, Copper, and Chromium-Plated Pipe Nipples
C919-2019	Standard Practice for Use of Sealants in Acoustical Applications
D1785-2021	Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
D2000-2018	Standard Classification System for Rubber Products in Automotive Applications
D2564-2020	Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems

D2657-2007 (R2015)	Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings
D2855-2020	Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings
D4101-2017e1	Standard Specification for Polypropylene Injection and Extrusion Materials
E1120-2016	Standard Specification for Liquid Chlorine
E1229-2016	Standard Specification for Calcium Hypochlorite
F2389-2021	Standard Specification for Pressure-rated Polypropylene (PP) Piping Systems
F2620-2020	Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings
F2769-2018	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
C151-2017	Ductile Iron Pipe, Centrifugally Cast
C153-2019	Ductile-Iron Compact Fittings
C203-2020	Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied
C213-2015	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/A5.8-2019	Specification for Filler Metals for Brazing and Braze Welding

G. International Code Council (ICC):

IPC-2021	International Plumbing Code

H. Manufacturers Specification Society (MSS):

SP-58-2018	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):

14-2020	Plastics Piping System Components and Related Materials
61-2020	Drinking Water System Components – Health Effects

372-2020	Drinking Water System Components – Lead Content

J. Plumbing and Drainage Institute (PDI):

PDI-WH 201-2017	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 SPARE PARTS

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 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's 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 UNDERGROUND WATER SERVICE CONNECTIONS TO BUILDINGS

A. From inside face of exterior wall to approximately 1500 mm (5 feet) outside of building and underground inside building, material to be the same for the size specified inside the building.

B. 75 mm (3 inch) Diameter and Greater: Ductile iron, AWWA C151, 2413 kPa (350 psig) pressure class, exterior bituminous coating, and cement lined. Bio-based materials shall be utilized when possible. Provide flanged and anchored connection to interior piping.

C. Under 75 mm (3 inch) Diameter: Copper tubing, ASTM B88, Type K, seamless, annealed. Fittings are as specified in paragraph "Above Ground (Interior) Water Piping". Use brazing alloys, AWS A5.8M/A5.8, Classification BCuP.

D. Flexible Expansion Joint: Ductile iron with ball joints rated for 1725 kPa (250 psig) working pressure conforming to AWWA C153, capable of deflecting a minimum of 20 degrees in each direction. Flexible expansion joint size shall match the pipe size it is connected to and shall have the expansion capability designed as an integral part of the ductile iron ball castings. Pressure containing parts shall be lined with a minimum of 15 mils of fusion bonded epoxy conforming to the applicable requirements of AWWA C213 and shall be factory tested with a 1500-volt spark test. Flexible expansion joint shall have flanged connections conforming to AWWA C110. Bolts and nuts shall be 316 stainless steel and gaskets shall be neoprene. The flexible expansion fitting shall not expand or exert an axial thrust under internal water pressure. Provide piping joint restraints at each mechanical joint end connection and piping restraints at the penetration of the building wall. The restraints shall be provided to address the developed thrust at the change of piping direction.

2.3 ABOVE GROUND (INTERIOR) WATER PIPING

A. Pipe: Copper tube, ASTM B88, Type K or L, drawn. For pipe 150 mm (6 inches) and larger, stainless steel, ASTM A312, schedule 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 **are prohibited**. 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.

2.4 EXPOSED WATER PIPING

A. Finished Room: Use full iron pipe size chrome plated brass piping for exposed water piping connecting fixtures, casework, cabinets, equipment, and reagent racks when not concealed by apron including those furnished by the Government or specified in other sections.
   1. Pipe: ASTM B43, standard weight.
   2. Fittings: ASME B16.15 cast bronze threaded fittings with chrome finish.
   3. Nipples: ASTM B687, Chromium-plated.
   4. Unions: MSS SP-72, MSS SP-110, brass or bronze with chrome finish. Unions 65 mm (2-1/2 inches) and larger shall be flange type with approved gaskets.

B. Unfinished Rooms, Mechanical Rooms and Kitchens: Chrome-plated brass piping is not required. Paint piping systems as specified in Section 09 91 00, PAINTING.

2.5 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.

2.6 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.

2.7 DIELECTRIC FITTINGS

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

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. All Other Piping Tests: Test new installed piping under 1-1/2 times actual operating conditions and prove tight.

D. 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.

END OF SECTION

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 07 84 00, FIRESTOPPING: Penetrations in rated enclosures.

F. Section 07 92 00, JOINT SEALANTS: Sealant products.

G. Section 09 91 00, PAINTING: Preparation and finish painting and identification of piping systems.

H. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING: Pipe Hangers and Supports, Materials Identification.

I. Section 22 07 11, PLUMBING INSULATION.

J. Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS

K. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

L. 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):

A13.1-2020	Identification of Piping Systems
A112.36.2M-1991 (R2017)	Cleanouts
A112.6.3-2019	Floor and Trench Drains
B1.20.1-2013 (R2018)	Pipe Threads, General Purpose(Inch)
B16.1-2020	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
B16.39-2019	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-2020	Standard Specification for Pipe, Steel, Black And Hot-Dipped, Zinc-coated, Welded and Seamless
A74-2021	Standard Specification for Cast Iron Soil Pipe and Fittings
A888-2021	Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
B32-2020	Standard Specification for Solder Metal
B43-2020	Standard Specification for Seamless Red Brass Pipe, Standard Sizes
B88-2020	Standard Specification for Seamless Copper Water Tube
B306-2020	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
C564-2020a	Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
D2321-2020	Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
D2564-2020	Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
D2665-2020	Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
D2855-2020	Standard Practice for Two-Step (Primer and Solvent Cement) Method of Joining Poly(Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) CPVCP Pipe and Piping Components with Tapered Sockets

D5926-2015 (R2020)	Standard Specification for Poly(Vinyl Chloride) (PVC) Gaskets for Drain, Waste, and Vent (DWV), Sewer, Sanitary, and Storm Plumbing Systems
F402-2018	Standard Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings
F477-2014	Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
F1545-2015a	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
310-2020	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-2021	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):

508-2018	Standard For Industrial Control Equipment

1.4 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

B. Information and material submitted under this section shall be marked “SUBMITTED UNDER SECTION 22 13 00, FACILITY SANITARY AND VENT PIPING”, with applicable paragraph identification.

C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.
   1. Piping.
   2. Floor Drains.
   3. Cleanouts.
   4. Trap Seal Protection.
   5. Penetration Sleeves.
   6. Pipe Fittings.
   7. Traps.
   8. 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. Polyvinyl chloride (PVC) pipe and fittings are permitted where the waste temperature is less than 60 degrees C (140 degrees F).
2. 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, kitchens, 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.
3. Polyvinyl chloride sanitary waste, drain, and vent pipe and fittings shall be solid core sewer piping conforming to ASTM D2665, sewer and drain series with ends for solvent cemented joints.
4. Fittings: PVC fittings shall be solvent welded socket type using solvent cement conforming to ASTM D2564.

2.2 EXPOSED WASTE PIPING

A. Chrome plated brass piping of full iron pipe size shall be used in finished rooms for exposed waste piping connecting fixtures, casework, cabinets, equipment and reagent racks when not concealed by apron including those furnished by the Government or specified in other sections.
   1. The Pipe shall meet ASTM B43, regular weight.
   2. The Fittings shall conform to ASTM D2665.
   3. Nipples shall conform to ASTM B687, Chromium-plated.
   4. Unions shall be brass or bronze with chrome finish. Unions 65 mm (2-1/2 inches) and larger shall be flange type with approved gaskets.

B. In unfinished Rooms such as mechanical Rooms and Kitchens, Chrome-plated brass piping is not required. The pipe materials specified under the paragraph “Sanitary Waste, Drain, and Vent Piping” can be used. The sanitary pipe in unfinished rooms shall be painted as specified in Section 09 91 00, PAINTING.

2.3 SPECIALTY PIPE FITTINGS

A. Transition pipe couplings shall join piping with small differences in outside diameters or different materials. End connections shall be of the same size and compatible with the pipes being joined. The transition coupling shall be elastomeric, sleeve type reducing or transition pattern and include shear and corrosion resistant metal, tension band and tightening mechanism on each end. The transition coupling sleeve coupling shall be of the following material:
   1. For cast iron soil pipes, the sleeve material shall be rubber conforming to ASTM C564.
   2. For PVC soil pipes, the sleeve material shall be elastomeric seal or PVC, conforming to ASTM F477 or ASTM D5926.
   3. For dissimilar pipes, the sleeve material shall be PVC conforming to ASTM D5926, or other material compatible with the pipe materials being joined.

B. The dielectric fittings shall conform to ASSE 1079 with a pressure rating of 861 kPa (125 psig) at a minimum temperature of 82 degrees C (180 degrees F). The end connection shall be solder joint copper alloy and threaded ferrous.

C. Dielectric flange insulating kits shall be of non-conducting materials for field assembly of companion flanges with a pressure rating of 1035 kPa (150 psig). The gasket shall be neoprene or phenolic. The bolt sleeves shall be phenolic or polyethylene. The washers shall be phenolic with steel backing washers.

D. The di-electric nipples shall be electroplated steel nipple complying with ASTM F1545 with a pressure rating of 2070 kPa (300 psig) at 107 degrees C (225 degrees F). The end connection shall be male threaded. The lining shall be inert and noncorrosive propylene.

2.4 CLEANOUTS

A. Cleanouts shall be the same size as the pipe, up to 100 mm (4 inches); and not less than 100 mm (4 inches) for larger pipe. Cleanouts shall be easily accessible and shall be gastight and

watertight. Minimum clearance of 600 mm (24 inches) shall be provided for clearing a clogged sanitary line.

B. Floor cleanouts shall be gray iron housing with clamping device and round, secured, scoriated, gray iron cover conforming to ASME A112.36.2M. A gray iron ferrule with hubless, socket, inside calk or spigot connection and counter sunk, taper-thread, brass or bronze closure plug shall be included. The frame and cover material and finish shall be nickel-bronze copper alloy with a square shape. The cleanout shall be vertically adjustable for a minimum of 50 mm (2 inches). When a waterproof membrane is used in the floor system, clamping collars shall be provided on the cleanouts. Cleanouts shall consist of wye fittings and eighth bends with brass or bronze screw plugs. Cleanouts in the resilient tile floors, quarry tile and ceramic tile floors shall be provided with square top covers recessed for tile insertion. In the carpeted areas, carpet cleanout markers shall be provided. Two way cleanouts shall be provided where indicated in the contract document and at every building exit. The loading classification for cleanouts in sidewalk areas or subject to vehicular traffic shall be heavy duty type.

C. Cleanouts shall be provided at or near the base of the vertical stacks with the cleanout plug located approximately 600 mm (24 inches) above the floor. If there are no fixtures installed on the lowest floor, the cleanout shall be installed at the base of the stack. The cleanouts shall be extended to the wall access cover. Cleanout shall consist of sanitary tees. Nickel-bronze square frame and stainless steel cover with minimum opening of 150 by 150 mm (6 by 6 inches) shall be furnished at each wall cleanout. Where the piping is concealed, a fixture trap or a fixture with integral trap, readily removable without disturbing concealed pipe, shall be accepted as a cleanout equivalent providing the opening to be used as a cleanout opening is the size required.

D. In horizontal runs above grade, cleanouts shall consist of cast brass tapered screw plug in fitting or caulked/hubless cast iron ferrule. Plain end (hubless) piping in interstitial space or above ceiling may use plain end (hubless) blind plug and clamp.

2.5 FLOOR DRAINS

A. General Data: floor drain shall comply with ASME A112.6.3. A caulking flange, inside gasket, or hubless connection shall be provided for connection to cast iron pipe, screwed or no hub outlets for connection to steel pipe. The drain connection shall be bottom outlet. A membrane clamp and extensions shall be provided, if required, where installed in connection with waterproof membrane. Puncturing membrane other than for drain opening shall not be permitted. Double drainage pattern floor drains shall have integral seepage pan for embedding into floor construction, and weep holes to provide adequate drainage from pan to drain pipe. For drains not installed in connection with a waterproof membrane, a /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 C (FD-C) medium duty (non-traffic) floor drain shall comply with ASME A112.6.3. The type C floor drain shall have a cast iron body, double drainage pattern, clamping device, light duty nickel bronze adjustable strainer with round or square grate of 150 mm (6 inches) width or diameter minimum for toilet rooms, showers and kitchens.

2.6 TRAPS

A. Traps shall be provided on all sanitary branch waste connections from fixtures or equipment not provided with traps. Exposed brass shall be polished brass chromium plated with nipple and set screw escutcheons. Concealed traps may be rough cast brass or same material as the piping they are connected to. Slip joints are prohibited on sewer side of trap. Traps shall correspond to fittings on cast iron soil pipe or steel pipe respectively, and size shall be as required by connected service or fixture.

2.7 PRIMER VALVES AND TRAP SEAL PRIMER SYSTEMS

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.

2.8 PENETRATION SLEEVES

A. A sleeve flashing device shall be provided at points where pipes pass through membrane waterproofed floors or walls. The sleeve flashing device shall be manufactured, cast iron fitting with clamping device that forms a sleeve for the pipe floor penetration of the floor membrane. A galvanized steel pipe extension shall be included in the top of the fitting that shall extend 50 mm (2 inches) above finished floor and galvanized steel pipe extension in the bottom of the fitting that shall extend through the floor slab. A waterproof caulked joint shall be provided at the top hub.

PART 3 EXECUTION

3.1 PIPE INSTALLATION

A. The pipe installation shall comply with the requirements of the International Plumbing Code (IPC) and these specifications.

B. Branch piping shall be installed for waste from the respective piping systems and connect to all fixtures, valves, cocks, outlets, casework, cabinets and equipment, including those furnished by the Government or specified in other sections.

C. Pipe shall be round and straight. Cutting shall be done with proper tools. Pipe shall be reamed to full size after cutting.

D. All pipe runs shall be laid out to avoid interference with other work.

E. The piping shall be installed above accessible ceilings where possible.

F. The piping shall be installed to permit valve servicing or operation.

G. The piping shall be installed free of sags and bends.

H. Seismic restraint shall be installed where required by code.

I. Changes in direction for soil and waste drainage and vent piping shall be made using appropriate branches, bends and long sweep bends. Sanitary tees and short sweep quarter bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Long turn double wye branch and eighth bend fittings shall be used if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow greater than 90 degrees. Proper size of standard increaser and reducers shall be used if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

J. Buried soil and waste drainage and vent piping shall be laid beginning at the low point of each system. Piping shall be installed true to grades and alignment indicated with unbroken continuity of invert. Hub ends shall be placed upstream. Required gaskets shall be installed according to manufacturer's written instruction for use of lubricants, cements, and other installation requirements.

K. Cast iron piping shall be installed according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings"

L. Aboveground copper tubing shall be installed according to Copper Development Association's (CDA) "Copper Tube Handbook".

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

3.2 JOINT CONSTRUCTION

A. Hub and spigot, cast iron piping with gasket joints shall be joined in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Hub and spigot, cast iron piping with calked joints shall be joined in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.

C. Hubless or No-hub, cast iron piping shall be joined in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless piping coupling joints.

D. For threaded joints, thread pipe with tapered pipe threads according to ASME B1.20.1. The threads shall be cut full and clean using sharp disc cutters. Threaded pipe ends shall be reamed to remove burrs and restored to full pipe inside diameter. Pipe fittings and valves shall be joined as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is required by the pipe service.
   2. Pipe sections with damaged threads shall be replaced with new sections of pipe.

E. Copper tube and fittings with soldered joints shall be joined according to ASTM B828. A water flushable, lead free flux conforming to ASTM B813 and a lead-free alloy solder conforming to ASTM B32 shall be used.

F. 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 and ASTM D2665 appendices.

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.

END OF SECTION

SECTION 22 14 00
FACILITY STORM DRAINAGE

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section describes the requirements for storm drainage systems, including piping 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: 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: Pipe Hangers and Supports, Materials Identification.

I. Section 22 07 11, PLUMBING INSULATION.

J. Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

1.3 APPLICABLE PUBLICATIONS

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

B. American Society of Mechanical Engineers (ASME):

A112.6.4-2003 (R2012)	Roof, Deck, and Balcony Drains
A13.1-2020	Scheme for Identification of Piping Systems
B1.20.1-2013 (R2018)	Pipe Threads, General Purpose, Inch
B16.3-2016	Malleable Iron Threaded Fittings: Classes 150 and 300
B16.9-2018	Factory-Made Wrought Buttwelding Fittings
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
B16.18-2018	Cast Copper Alloy Solder-Joint Pressure Fittings
B16.22-2018	Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings
B16.23-2016	Cast Copper Alloy Solder Joint Drainage Fittings - DWV
B16.29-2017	Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fittings – DWV

C. American Society of Sanitary Engineering (ASSE)

1079-2012	Performance Requirements for Dielectric Pipe Unions

D. 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
A74-2021	Standard Specification for Cast Iron Soil Pipe and Fittings
A183-2014 (R2020)	Standard Specification for Carbon Steel Track Bolts and Nuts
A312/A312M-2021	Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
A536-1984(R2019)e1	Standard Specification for Ductile Iron Castings
A733-2016	Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
A888-2021	Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
B32-2020	Standard Specification for Solder Metal
B61-2015	Standard Specification for Steam or Valve Bronze Castings
B62-2017	Standard Specification for Composition Bronze or Ounce Metal Castings
B75/B75M-2020	Standard Specification for Seamless Copper Tube
B88-2020	Standard Specification for Seamless Copper Water Tube
B306-2020	Standard Specification for Copper Drainage Tube (DWV)
B584-2014	Standard Specification for Copper Alloy Sand Castings for General Applications
B687-1999 (R2016)	Standard Specification for Brass, Copper, and Chromium-Plated Pipe Nipples
B828-2016	Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings
B813-2016	Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube
C564-2020a	Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
C1173-2018	Standard Specification for Flexible Transition Couplings for Underground Piping Systems

D1785-2021	Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120
D2000-2018	Standard Classification System for Rubber Products in Automotive Applications
D2321-2020	Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
D2564-2020	Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems
D2665-2020	Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
D2855-2020	Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings
D4101-2017e1	Standard Specification for Polypropylene Injection and Extrusion Materials
D5926-2015 (R2020)	Standard for Poly (Vinyl Chloride) (PVC) Gaskets for Drain, Waste, and Vent (DWV), Sewer, Sanitary, and Storm Plumbing Systems
F477-2014	Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
F656-2021	Standard Specification for Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings
F1545-2015a	Standard Specification for Plastic-Lined Ferrous Metal Pipe, Fittings, and Flanges

E. American Welding Society (AWS):

A5.8M/A5.8 AMD1-2019	Specification for Filler Metals for Brazing and Braze Welding

F. Copper Development Association (CDA):

A4015-14/20	Copper Tube Handbook

G. Cast Iron Soil Pipe Institute (CISPI):

301-2021	Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
310-2012	Standard 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

H. International Code Council (ICC):

IPC-2012	International Plumbing Code

I. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (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

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 14 00, FACILITY STORM DRAINAGE”, 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 Fittings.
   2. Specialty Pipe Fittings.
   3. Cleanouts.
   4. Roof Drains.
   5. Expansion Joints.
   6. Downspout Nozzles.
   7. Sleeve Flashing Devices.

D. Detailed shop drawing of clamping device and extensions when required in connection with the waterproofing membrane.

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 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 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 STORM WATER DRAIN PIPING

A. Cast Iron Storm Pipe and Fittings:
   1. Cast iron storm pipe and fittings shall be used for the following applications:
      a. Pipe buried in or in contact with earth.
      b. Extension of pipe to a distance of approximately 1500 mm (5 feet) outside of building walls.
      c. Interior storm piping above grade.
      d. All mechanical equipment rooms or other areas containing mechanical air handling equipment.
   2. The cast iron storm pipe shall be bell and spigot, or hubless (plain end or no-hub) as required by selected jointing method.
   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. 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): May be used for piping above ground.
   1. The copper DWV tube shall be drainage type, drawn temper conforming to ASTM B306.
   2. The copper drainage fittings shall be cast copper or wrought copper conforming to ASME B16.23 or ASME 16.29.
   3. The joints shall be lead free, using a water flushable flux, and conforming to ASTM B32.

C. Polyvinyl Chloride (PVC):
   1. PVC storm sewer pipe and fittings are permitted for single story structures except for mechanical equipment rooms and other areas containing air handling equipment or hot water generation equipment.
   2. PVC storm sewer pipe and fittings shall be schedule 40 solid core piping conforming to ASTM D1785 and ASTM D2665, Sewer and Drain Series, with ends for solvent cemented joints.
   3. PVC joints shall be solvent welded socket type using solvent cement conforming to ASTM D2564 and adhesive primer conforming to ASTM F656. Bio-based materials shall be utilized when possible.

D. Roof drain piping and body of drain in locations where the outdoor conditions are subject to freezing shall be insulated.

2.2 SPECIALTY PIPE FITTINGS

A. Transition pipe couplings shall join piping with small differences in outside diameters or be of different materials. End connections shall be of the same size and compatible with the pipes being joined. The transition coupling shall be unshielded, elastomeric, sleeve type reducing or transition pattern conforming with ASTM C1173 and include shear ring and corrosion resistant metal tension band and tightening mechanism on each end. The transition coupling sleeve coupling shall be of the following material:
   1. For cast iron soil pipes, the sleeve material shall be rubber conforming to ASTM C564.
   2. For PVC soil pipes, the sleeve material shall be elastomeric seal conforming to ASTM F477 or PVC conforming to ASTM D5926.
   3. dissimilar pipes, the sleeve material shall be PVC conforming to ASTM D5926, or other material compatible with the pipe materials being joined.

B. Dielectric fittings shall conform to ASSE 1079 with a pressure rating of 1035 kPa (150 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 flanges shall conform to ASSE 1079 with a pressure rating of 1035 kPa (150 psig). The flange shall be a factory fabricated, bolted, companion flange assembly. The end connection shall be threaded or solder-joint copper alloy and threaded ferrous.

D. 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.

E. Dielectric nipples shall be electroplated steel and shall conform with ASTM F1545 with a pressure ratings 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. Bio-based materials shall be utilized when possible.

2.3 CLEANOUTS

A. Cleanouts shall be the same size as the pipe, up to 100 mm (4 inches); not less than 100 mm (4 inches) for larger pipe. Cleanouts shall be easily accessible and shall be gastight and watertight. A minimum clearance of 600 mm (24 inches) shall be provided for clearing a clogged storm sewer 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 caulk 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 on the drawings and at each building exit. The loading classification for cleanouts in sidewalk areas or subject to vehicular traffic shall be heavy duty.

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. 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 mm by 150 mm (6 inch by 6 inch) shall be provided at each wall cleanout.

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.

2.4 ROOF DRAINS AND CONNECTIONS

A. Roof Drains: Roof Drains (RD) shall be cast iron with clamping device for making watertight connection and shall conform with ASME A112.6.4. Free openings through strainer shall be twice area of drain outlet. For roof drains not installed in connection with a waterproof membrane, a soft copper membrane shall be provided 300 mm (12 inches) in diameter greater than outside diameter of drain collar. An integral gravel stop shall be provided for drains installed on roofs having built up roofing covered with gravel or slag. Integral no-hub, soil pipe gasket or threaded outlet connection shall be provided.

1. Flat Roofs: The roof drain shall have a beehive or dome shaped strainer with integral flange not less than 300 mm (12 inches) in diameter. For an insulated roof, a roof drain with an adjustable drainage collar shall be provided, which can be raised or lowered to meet required insulation heights, sump receiver and deck clamp. The bottom section shall serve as roof drain during construction before insulation is installed.

2. Canopy Roofs: The roof drain shall have a beehive or dome shaped strainer with the integral flange no greater than 200 mm (8 inches) in diameter. For an insulated roof, the roof drain shall be provided with an adjustable drainage collar, which can be raised or lowered to meet the required insulation heights, sump receiver and deck clamp. Bottom section shall serve as roof drain during construction before insulation is installed.
3. Promenade Decks: the roof drain shall be the same as for canopy roofs, except decks shall have flat, round, loose, non-slip, bronze grate set in square, non-slip, bronze frame.
4. Portico Roofs and Gutters: Roof drains shall be horizontal angle type drain with flat bottom and horizontal outlet at the same elevation as the pipe to which it is connected. Strainer shall be removable angle grate type.
5. Protective Roof Membrane Insulation Assembly: The roof drain shall have a perforated stainless steel extension filter, non-puncturing clamp ring, large sump with extra wide roof flange and deck clamp.
    a. Non pedestrian Roofs: The roof drain shall have large polypropylene or aluminum locking dome.
    b. Pedestrian Roof: The roof drain shall have a bronze promenade top 356 mm (14 inches) square, set in square secured frame support collar.
6. Roof Drains, Overflow or Secondary (Emergency): Roof Drains identified as overflow or secondary (emergency) drains shall have a 50 mm (2 inch) water dam integral to the drain body.
7. Roof drains in areas subject to freezing shall have heat tape and shall be insulated.

B. Expansion Joints: Expansions joints shall be heavy cast iron with cast brass or PVC expansion sleeve having smooth bearing surface working freely against a packing ring held in place and under pressure of a bolted gland ring, forming a water and air tight flexible joint. Asbestos packing is prohibited.

C. Interior Downspouts: An expansion joint shall be provided, specified above, at top of run on straight, vertical runs of downspout piping 12 m (40 feet) long or greater.

D. Downspout Nozzle: The downspout nozzle fitting shall be of brass, unfinished, with internal pipe thread for connection to downspout.

2.5 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.

PART 3 - EXECUTION

3.1 PIPE INSTALLATION

A. The pipe installation shall comply with the requirements of the IPC and these specifications.

B. Branch piping shall be installed from the piping system and connect to all drains and outlets.

C. Pipe shall be round and straight. Cutting shall be done with proper tools. Pipe, except for glass, shall be reamed to remove burrs and a clean smooth finish restored to full pipe inside diameter.

D. All pipe runs shall be laid out to avoid interference with other work/trades.

E. The piping shall be installed above accessible ceilings to allow for ceiling panel removal.

F. Unless otherwise stated on the documents, minimum horizontal slope shall be one inch for every 2.44 m (8 feet) (1 percent slope) of pipe length.

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 storm drainage piping shall be made using appropriate branches, bends and long sweep bends. Sanitary tees and short sweep ¼ bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Long turn double wye branch and 1/8 bend fittings shall be used if two drains are installed back to back or side by side with common drain pipe. 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.

J. Buried storm drainage 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. Bio-based materials shall be utilized when possible.

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 CDA A4015.

M. Aboveground PVC piping shall be installed according to ASTM D2665. Underground PVC piping shall be installed according to ASTM D2321.

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 undamaged sections of pipe at no additional time or cost to Government.

E. Copper tube and fittings with soldered joints shall be joined according to ASTM B828. A water flushable, lead free flux conforming to ASTM B813 and a lead free alloy solder conforming to ASTM B32 shall be used.

F. 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 and ASTM D2665 appendices.

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 IPC, Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, and these specifications.

B. 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. 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. NPS 1-1/2 to NPS 2 (DN 40 to DN 50): 1500 mm (60 inches) with 10 mm (3/8 inch) rod.
   2. NPS 3 (DN 80): 1500 mm (60 inches) with 15 mm (1/2 inch) rod.
   3. NPS 4 to NPS 5 (DN 100 to DN 125): 1500 mm (60 inches) with 18 mm (5/8 inch) rod.
   4. NPS 6 to NPS 8 (DN 150 to DN 200): 1500 mm (60 inches) with 20 mm (3/4 inch) rod.
   5. NPS 10 to NPS 12 (DN 250 to DN 300): 1500 mm (60 inches) with 23 mm (7/8 inch) rod.

E. The maximum support spacing for horizontal plastic 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 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. Roller shall be cast iron.
   8. 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 shall be 100 mm (4 inches) in length and be 1.6 mm (16 gage) steel. The shield shall be sized for the insulation.

H. Miscellaneous materials shall be provided 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. All necessary auxiliary steel shall be provided to provide that support.

I. Cast escutcheon with set screw shall be installed 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 around the pipe shall be completely sealed and made watertight with sealant as specified in Section 07 92 00, JOINT SEALANTS. Bio-based materials shall be utilized when possible.

3.5 INSULATION

A. Insulate horizontal sections and 600 mm (2 feet) past changes of direction to vertical sections for interior section of roof drains. Install insulation in accordance with the requirements of Section 22 07 11, PLUMBING INSULATION.

3.6 TESTS

A. Storm sewer system shall be tested either in its entirety or in sections.

B. Storm Water Drain 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 with water, tightly close all openings in pipes except the 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 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) gage shall be maintained for at least 15 minutes without leakage. A force pump and mercury column gage shall be used for the test.
3. Final Tests: While either one of the following tests may be used, Contractor shall check with VA as to which test will be performed.
    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 0.25 kPa (1 inch of water) with a smoke machine. **Chemical smoke is prohibited.**
    b. Peppermint Test: Introduce .06 liters (2 ounces) of peppermint into each line or stack.

C. COR shall witness all tests. Contractor shall coordinate schedules with the COR and CxA. Contractor shall provide a minimum of 10 working days prior to flushing, disinfection/sterilization, startup, and testing.

3.7 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.

3.8 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.

END OF SECTION

SECTION 22 33 00
ELECTRIC DOMESTIC WATER HEATERS

PART 1 GENERAL

1.1 DESCRIPTION

A. This section describes the requirements for installing a complete electric domestic water heater system ready for operation including the water heaters, thermometers, and all necessary accessories, connections, and equipment.

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 03 30 00, CAST-IN-PLACE CONCRETE: Concrete and Grout.

F. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

G. Section 22 05 19, METERS AND GAGES FOR PLUMBING PIPING.

H. Section 22 05 23, GENERAL-DUTY VALVES FOR PLUMBING 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 the basic designation only. Where conflicts occur these specifications and the VHA standards will govern.

B. American National Standard Institute (ANSI):

Z21.22-2015	Relief Valves for Hot Water Supply Systems

C. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):

90.1-2019	Energy Standard for Buildings Except Low-Rise Residential Buildings

D. American Society of Mechanical Engineers (ASME):

ASME BOILER and Pressure Vessel Code	
BPVC Section IV-2021	Rules for Construction of Heating Boilers
BPVC Section VIII-1-2021	Rules for Construction of Pressure Vessels, Division 1
Form U-1	Manufacturer’s Data Report for Pressure Vessels
B1.20.1-2013(R2018)	Pipe Threads, General Purpose (Inch)
B1.20.7-1991	Hose Coupling Screw Threads (Inch)
B16.5-2020	Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard
B16.24-2016	Cast Copper Alloy Pipe Flanges, Flanged Fittings, and Valves: Classes 150, 300, 600, 900, 1500, and 2500

CSD-1-2021	Controls and Safety Devices for Automatically Fired Boilers

E. Federal Energy Management Program (FEMP):

https://www.energy.gov/eere/femp

F. National Fire Protection Association (NFPA)

70-2020	National Electrical Code (NEC)

G. NSF International (NSF):

5-2019	Water Heaters, Hot Water Supply Boilers, and Heat Recovery Equipment
61-2020	Drinking Water System Components – Health Effects
372-2020	Drinking Water System Components – Lead Content

H. Underwriters Laboratories, Inc. (UL):

174-2004(R2019)	Standard for Household Electric Storage Tank Water Heaters
499-2014(R2017)	Standard for Electric Heating Appliances
1453-2016(R2018)	Standard for Electric Booster and Commercial Storage Tank Water Heaters

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 33 00, ELECTRIC DOMESTIC WATER HEATERS”, 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 Heaters.
   2. Pressure and Temperature Relief Valves.
   3. Thermometers.
   4. Pressure Gauges.
   5. Vacuum Breakers.
   6. Expansion Tanks.

D. For each electric domestic hot water heater type and size, the following characteristics shall be submitted:
   1. Rated Capacities.
   2. Operating characteristics.
   3. Electrical characteristics.
   4. Furnished specialties and accessories.
   5. A Form U-1 or other documentation stating compliance with the ASME Boiler and Pressure Vessel Code.

E. Shop drawings shall include wiring diagrams for power, signal and control functions.

F. Submit documentation indicating compliance with applicable requirements with ASHRAE 90.1 for Service Water Heating.

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. For commercial applications, comply with ASHRAE 90.1 for efficiency performance.

B. Electrical components, devices and accessories shall be listed and labeled as defined in NFPA 70 by a qualified testing agency and marked for intended location and application.

C. ASME code construction shall be a vessel fabricated in compliance with the ASME BPVC Section VIII-1.

D. Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 and NSF 372.

E. The domestic water heater shall be certified and labeled by an independent testing agency.

F. Bio-Based Materials: For products designated by the USDA's Bio-Preferred Program, provide products that meet or exceed USDA recommendations for bio-based content, so long as products meet all performance requirements in this specifications section. For more information regarding the product categories covered by the Bio-Preferred Program, visit https://www.biopreferred.gov.

G. 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 ELECTRIC, TANKLESS, DOMESTIC WATER HEATER

A. Electric, Tankless, domestic water heaters shall be constructed with copper piping or tubing complying with NSF 61 and NSF 372 for barrier materials for potable water heaters without storage capacity.

B. The pressure rating shall be 1035 kPa (150 psig).

C. The heating element shall be resistance heating system type.

D. Temperature control shall be made with flow control fittings.

E. The safety control shall be a high temperature limit cutoff device or system.

F. The heater shall have an enameled jacket with an aluminum or steel floor stand or wall bracket for off-floor mounting.

G. Heater capacities and electrical characteristics are scheduled on the drawings.

2.2 DOMESTIC HOT WATER EXPANSION TANKS

A. A steel pressure rated tank constructed with welded joints and factory installed butyl rubber diaphragm shall be installed as scheduled. The air precharge shall be set to minimum system operating pressure at tank.

B. The tappings shall be factory-fabricated steel, welded to the tank and include ASME B1.20.1 pipe thread.

C. The interior finish shall comply with NSF 61 and NSF 372 for barrier materials for potable water tank linings and the liner shall extend into and through the tank fittings and outlets.

D. The air charging valve shall be factory installed.

2.3 ELECTRIC WATER HEATER DRAIN PAN

A. A stainless-steel drain pan shall be provided that is 152 mm (6 inches) larger than the water heater and has a minimum of 152 mm (6 inch) sides. The drain pan shall include a drain outlet not less than 20 mm or DN20 (NPS 3/4 inch) with ASME B1.20.7 garden hose threads.

2.4 COMBINATION TEMPERATURE AND PRESSURE RELIEF VALVES

A. The combination pressure and temperature relief valve shall be ANSI Z21.22 and ASME rated and constructed of all brass or bronze with a self-closing reseating valve. The relief valves shall include a relieving capacity greater than the heat input and include a pressure setting less than the water heater's working pressure rating. Sensing element shall extend into storage tank.

2.5 THERMOMETERS

A. Thermometers shall be rigid stem or remote sensing, scale or dial type with an aluminum, black metal, stainless-steel, or chromium plated brass case. The thermometer shall be back connected, red liquid (alcohol or organic-based) fill, vapor, bi-metal or gas actuated, with 228 mm (9 inches) high scale dial or circular dial 50 to 127 mm (2 to 5 inches) in diameter graduated from 4 to 100 degrees C (40 to 212 degrees F), with two-degree graduations guaranteed accurate within one scale division. The socket shall be separable, double-seat, micrometer-fittings, with extension neck not less than 63 mm (2-1/2 inches) to clear tank or pipe covering. The thermometer shall be suitable for 19 mm (3/4 inch) pipe threads. Thermometers may be console-mounted with sensor installed in separate thermometer well.

2.6 SUPPORTS

A. Water heater stands shall be factory-fabricated steel for floor mounting capable of supporting water heater and water a minimum of 457 mm (18 inches) above the floor.

B. Wall brackets for wall mounted heaters shall be factory-fabricated steel capable of supporting water heater and water.

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. Water heaters shall be installed on concrete bases unless elevated above the floor. Refer to Section 03 30 00, CAST-IN-PLACE CONCRETE and Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

C. The water heaters shall be installed level and plumb and securely anchored.

D. The water heaters shall be installed and connected in accordance with manufacturer's written instructions with manufacturer's recommended clearances.

E. All pressure and temperature relief valves discharge shall be piped to nearby floor drains with air gap.

F. Thermometers shall be installed on the water heater inlet and outlet piping and shall be positioned such that they can be read by an operator or staff standing on floor or walkway.

G. The thermostatic control shall be set for a minimum setting of 60 degrees C (140 degrees F) for storage heaters.

H. Dielectric unions shall be provided if there are dissimilar metals between the water heater connections and the attached piping.

I. Provide vacuum breakers per ANSI Z21.22 on the inlet pipe if the water heater is bottom fed.

J. Shutoff valves shall be installed on the domestic water supply piping to the water heater and on the domestic hot water outlet piping.

K. All manufacturer's required clearances shall be maintained.

L. A combination temperature and pressure relief valve shall be installed at the top portion of the storage tank in accordance with manufacturer's recommendations. The sensing element shall extend into the tank. The relief valve outlet drain piping shall discharge by air gap into a floor drain.

M. Piping type heat traps shall be installed on the inlet and outlet piping of the electric domestic water heater storage tanks if not provided integrally with the tanks.

N. Water heater drain piping shall be installed as indirect waste to spill by air gap into open drains or over floor drains. Hose end drain valves shall be installed at low points in water piping for electric domestic water heaters without integral drains.

3.2 LEAKAGE TEST

A. Before piping connections are made, water heaters shall be tested with hydrostatic pressure of 1380 kPa (200 psig) and 1654 kPa (240 psig) for a unit with a MAWP of 1104 kPa (160 psig). Any domestic water heater leaking water shall be replaced with a new unit at no additional cost or time to the Government.

3.3 PERFORMANCE TEST

A. Ensure that all the remote water outlets are always tested to a minimum of 43 degrees C (110 degrees F) and a maximum of 49 degrees C (120 degrees F) water flow.

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. 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.

3.5 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.

3.6 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.

END OF SECTION

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 (R2017)	Supports for Off-the-Floor Plumbing Fixtures for Public Use
A112.19.1-2018	Enameled Cast Iron and Enameled Steel Plumbing Fixtures
A112.19.2-2018	Ceramic Plumbing Fixtures
A112.19.3-2017	Stainless Steel Plumbing Fixtures

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

A276-2017	Standard Specification for Stainless Steel Bars and Shapes
B584-2014	Standard Specification for Copper Alloy Sand Castings for General Applications

D. CSA Group:

B45.4-2017	Stainless Steel Plumbing Fixtures

E. National Association of Architectural Metal Manufacturers (NAAMM):

AMP 500-2006	Metal Finishes Manual

F. American Society of Sanitary Engineering (ASSE):

1016-2017	Automatic Compensating Valves for Individual Showers and Tub/Shower Combinations

G. NSF International (NSF):

14-2020	Plastics Piping System Components and Related Materials
61-2020	Drinking Water System Components – Health Effects
372-2020	Drinking Water System Components – Lead Content

H. American with Disabilities Act (A.D.A)

I. International Code Council (ICC):

IPC-2021	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 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.

E. Mental Health Area: Provide stainless steel drain guard for all lavatories not installed in casework.

2.4 ESCUTCHEONS

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

2.5 SINKS AND LAUNDRY TUBS

A. Dimensions for sinks and laundry tubs are specified, length by width (distance from wall) and depth.

B. (P-502) Service Sink (Corner, Floor 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.

2.6 HYDRANT, HOSE BIBB AND MISCELLANEOUS DEVICES

A. (P-801) Wall Hydrant: Cast bronze non-freeze hydrant with detachable T-handle. Brass operating rod within casing of bronze pipe of sufficient length to extend through wall and place valve inside building. Brass valve with coupling and union elbow having metal-to-metal seat. Valve rod and seat washer removable through face of hydrant; 19 mm (3/4 inch) hose thread on spout; 19 mm (3/4 inch) pipe thread on inlet. Finish may be rough; exposed surfaces will be chrome plated. Set not less than 457 mm (18 inches) nor more than 914 mm (36 inches) above grade. On porches and platforms, set approximately 762 mm (30 inches) above finished floor. Provide integral vacuum breaker which automatically drains when shut off.

B. (P-802) Hose Bibb (Combination Faucet, Wall Mounted to Concealed Supply Pipes): Cast or wrought copper alloy, combination faucet with replaceable Monel seat, removable replacement unit containing all parts subject to wear, mounted on wall 914 mm (36 inches) above floor to concealed supply pipes. Provide faucet without top or bottom brace and with 19 mm (3/4 inch) hose coupling threads on spout, integral stops and vacuum breaker. Design valves with valve disc arranged to eliminate rotation on seat. 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 bright finish.

C. (P-804) Hose Bibb (Single Faucet, Wall Mounted to Concealed Supply Pipe): Cast or wrought copper alloy, single faucet with replaceable Monel seat, removable replacement unit containing all parts subject to wear, mounted on wall 914 mm (36 inches) above floor to concealed supply pipe. Provide faucet with 19 mm (3/4 inch) hose coupling thread on spout and vacuum breaker. Four-arm handle 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 bright finish.

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. Where water closet waste pipe has to be offset due to beam interference, provide correct and additional piping necessary to eliminate relocation of water closet.

H. Aerators are prohibited on lavatories and sinks.

I. 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.

END OF SECTION

SECTION 23 05 11
COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 DESCRIPTION

A. The requirements of this Section apply to all sections of Division 23, HEATING, VENTILATING, AND AIR CONDITIONING (HVAC).

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 02 82 11, TRADITIONAL ASBESTOS ABATEMENT.

G. Section 03 30 00, CAST-IN-PLACE CONCRETE.

H. Section 05 31 00, STEEL DECKING.

I. Section 05 36 00, COMPOSITE METAL DECKING.

J. Section 05 50 00, METAL FABRICATIONS.

K. Section 07 84 00, FIRESTOPPING.

L. Section 07 92 00, JOINT SEALANTS.

M. Section 09 91 00, PAINTING.

N. Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC and STEAM GENERATION EQUIPMENT.

O. Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT.

P. Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.

Q. Section 23 07 11, HVAC AND BOILER PLANT INSULATION.

R. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

S. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

T. Section 23 36 00, AIR TERMINAL UNITS.

U. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

V. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES.

W. 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. Where conflicts occur these specifications and the VHA standard will govern.

B. Air-Conditioning, Heating, and Refrigeration Institute (AHRI):

430-2020	Performance Rating of Central Station Air Handling Unit Supply Fans

C. Air Movement and Control Association (AMCA):

410-1996	Recommended Safety Practices for Users and Installers of Industrial and Commercial Fans

D. American Society of Mechanical Engineers (ASME):

B31.1-2020	Power Piping
B31.9-2020	Building Services Piping
	ASME Boiler and Pressure Vessel Code:
BPVC Section IX-2021	Welding, Brazing, and Fusing Qualifications

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

A36/A36M-2019	Standard Specification for Carbon Structural Steel
A575-1996(2020)	Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades

F. 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

G. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.(MSS):

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

H. Military Specifications (MIL):

MIL-P-21035B-2021	Paint High Zinc Dust Content, Galvanizing Repair (Metric)

I. National Fire Protection Association (NFPA):

70-2020	National Electrical Code (NEC)
101-2021	Life Safety Code

J. Department of Veterans Affairs (VA):

PG-18-10-2020(R2021)	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. 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 accessible 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.

D. 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.

E. 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.

F. 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.

G. 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.

H. 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. 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.

I. 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.

J. HVAC Maintenance Data and Operating Instructions:
1. Maintenance and operating manuals in accordance with Section 01 00 00, GENERAL REQUIREMENTS, paragraph 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 for belts: Belt manufacturer, model number, size and style, and distinguished whether of multiple belt sets.

K. Provide copies of approved HVAC equipment submittals to the TAB and Commissioning Subcontractor.

L. Completed System Readiness Checklist provided by the 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.

M. Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

1.5 QUALITY ASSURANCE

A. Mechanical, electrical and associated systems shall be safe, reliable, efficient, durable, easily and safely operable and maintainable, easily and safely accessible, and in compliance with applicable codes as specified. The systems shall be comprised of high quality institutional-class and industrial-class products of manufacturers that are experienced specialists in the required product lines. All construction firms and personnel shall be experienced and qualified specialists in industrial and institutional HVAC.

B. Flow Rate Tolerance for HVAC Equipment: Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.

C. Equipment Vibration Tolerance:
1. Refer to Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT. Equipment shall be factory-balanced to this tolerance and re-balanced onsite, 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 23 sections shall conform to the referenced codes and standards as required by the specifications. Local codes and amendments shall be enforced, along with requirements of local utility companies. The most stringent requirements of these specifications, local codes, or utility company requirements shall always apply. Any conflicts shall be brought to the attention of the COR.
5. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be of the same manufacturer and model number, or if different models are required they shall be of the same manufacturer and identical to the greatest extent possible (i.e., same model series).
6. Assembled Units: Performance and warranty of all components that make up an assembled unit shall be the responsibility of the manufacturer of the completed assembly.
7. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.
8. Use of asbestos products or equipment or materials containing asbestos is prohibited.

E. HVAC Equipment Service Providers: Service providers shall be authorized and trained by the manufacturers of the equipment supplied. These providers shall be capable of responding onsite and provide acceptable service to restore equipment operations within 4 hours of receipt of notification by phone, e-mail or fax in event of an emergency, such as the shutdown of equipment; or within 24 hours in a non-emergency. Submit names, mail and e-mail addresses and phone numbers of service personnel and companies providing service under these conditions for (as applicable to the project): fans, air handling units, chillers, cooling towers, control systems, pumps, critical instrumentation, computer workstation and programming.

F. HVAC Mechanical Systems Welding: Before any welding is performed, Contractor shall submit a certificate certifying that welders comply with the following requirements:
1. HVAC mechanical systems welding shall meet 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 paragraph 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.

K. 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.

L. Refer to Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS for additional sustainable design requirements.

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 boilers, chillers, cooling towers, fans, and air handling units 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. Boilers shall be left clean following final internal inspection by Government, insurance representative, or inspector.
5. 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. 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 AutoCADprovided on CD or DVD. The CAD drawings shall use multiple line layers with a separate individual layer for each system.

D. The as-built drawings shall indicate the location and type of all lockout/tagout points for all energy sources for all equipment and pumps to include breaker location and numbers, valve tag numbers, etc. Coordinate lockout/tagout procedures and practices with local VA requirements.

E. Certification documentation shall be provided to COR 21 working days prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and provide documentation/certification that all results of tests were within limits specified. Test results shall contain written sequence of test procedure with written test results annotated at each step along with the expected outcome or setpoint. The results shall include all readings, including but not limited to data on device (make, model and performance characteristics), normal pressures, switch ranges, trip points, amp readings, and calibration data to include equipment serial numbers or individual identifications, etc.

1.8 JOB CONDITIONS – WORK IN EXISTING BUILDING

A. Building Operation: Government employees will be continuously operating and managing all facilities, including temporary facilities that serve the VAMC.

B. Maintenance of Service: Schedule all work to permit continuous service as required by the VAMC.

C. Building Working Environment: Maintain the architectural and structural integrity of the building and the working environment at all times. Maintain the interior of building at 18 degrees C (65 degrees F) minimum. Limit the opening of doors, windows or other access openings to brief periods as necessary for rigging purposes. Storm water or ground water leakage is prohibited. Provide daily clean-up of construction and demolition debris on all floor surfaces and on all equipment being operated by VA. Maintain all egress routes and safety systems/devices.

D. Acceptance of Work for Government Operation: As new equipment, systems and facilities are made available for operation and these items are deemed of beneficial use to the Government, inspections 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, shall 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 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.

2.4 ELECTRIC MOTORS

A. All material and equipment furnished, and installation methods shall conform to the requirements of Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC AND STEAM GENERATION EQUIPMENT; Section 26 29 11, MOTOR CONTROLLERS; and, Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES. Provide all electrical wiring, conduit, and devices necessary for the proper connection, protection and operation of the systems. Provide special energy efficient premium efficiency type motors as scheduled.

2.5 VARIABLE SPEED MOTOR CONTROLLERS

A. Refer to Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS and Section 26 29 11, MOTOR CONTROLLERS 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 the contract documents.

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.

2.6 EQUIPMENT AND MATERIALS IDENTIFICATION

A. Use symbols, nomenclature and equipment numbers specified, shown in the contract documents, and shown in the maintenance manuals. Identification for piping is specified in Section 09 91 00, PAINTING.

B. Interior (Indoor) Equipment: Engraved nameplates, with letters not less than 5 mm (3/16 inch) high of brass with black-filled letters, or rigid black plastic with white letters specified in Section 09 91 00, PAINTING permanently fastened to the equipment. Identify unit components such as coils, filters, fans, etc.

C. Exterior (Outdoor) Equipment: Brass nameplates, with engraved black filled letters, not less than 5 mm (3/16 inch) high riveted or bolted to the equipment.

D. Control Items: Label all instrumentation, temperature and humidity sensors, controllers and control dampers. Identify and label each item as they appear on the control diagrams.

E. Valve Tags and Lists:
   1. HVAC and Mechanical Rooms: Provide for all valves other than for equipment in Section 23 36 00, AIR TERMNAL UNITS.
   2. Valve Tags: Engraved black filled numbers and letters not less than 13 mm (1/2 inch) high for number designation, and not less than 6 mm (1/4 inch) for service designation on 19-gauge 38 mm (1-1/2 inches) round brass disc, attached with brass "S" hook or brass chain.
   3. Valve Lists: Typed or printed plastic coated card(s), sized 216 mm (8-1/2 inches) by 279 mm (11 inches) showing tag number, valve function and area of control, for each service or system. Punch sheets for a 3-ring notebook.
   4. Provide detailed plan for each floor of the building indicating the location and valve number for each valve. Identify location of each valve with a color-coded thumb tack in ceiling.

F. Ceiling Grid Labels:
   1. 50 mm (2 inch) long by 13 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.

2.7 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.

2.8 GALVANIZED REPAIR COMPOUND

A. Mil-P-21035B, paint form.

2.9 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 279 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. Refer to Section 05 50 00, METAL FABRICATIONS, for miscellaneous metal support materials and prime coat painting requirements.

D. Attachment to Concrete Building Construction:
   1. Concrete Insert: MSS SP-58, Type 18.
   2. Self-Drilling Expansion Shields and Machine Bolt Expansion Anchors: Permitted in concrete not less than 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 shall be used for individual copper tubing up to 22 mm (7/8 inch) outside diameter.

F. Attachment to Metal Pan or Deck: As required for materials specified in Section 05 31 00, STEEL DECKING orSection 05 36 00, COMPOSITE METAL DECKING.

G. Attachment to Existing Structure: Support from existing floor/roof frame.

H. Attachment to Wood Construction: Wood screws or lag bolts.

I. 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 38 mm (1-1/2 inches) minimum of adjustment and incorporate locknuts. All-thread rods are acceptable.

J. Hangers Supporting Multiple Pipes (Trapeze Hangers): Galvanized, cold formed, lipped steel channel horizontal member, not less than 41 by 41 mm (1-5/8 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 13 mm (1/2 inch) galvanized steel bands, or preinsulated calcium silicate shield for insulated piping at each hanger.

2.10 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 38 mm (1-1/2 inch) angle set in silicone adhesive around opening.
3. For Drilled Penetrations: Provide 38 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 shall 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.

2.11 DUCT PENETRATIONS

A. Provide curbs for roof mounted piping, ductwork and equipment. Curbs shall be 457 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.

2.12 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.

2.13 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. Provide a watertight joint in spaces where brass or steel pipe sleeves are specified.

2.14 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 in 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 shall be provided.

G. Electrical Interconnection of Instrumentation or Controls: This generally not shown but shall be provided. This includes interconnections of sensors, transmitters, transducers, control devices, control and instrumentation panels, instruments and computer workstations. Devices shall be located so they are easily accessible for testing, maintenance, calibration, etc. The COR has the final determination on what is accessible and what is not. Comply with NFPA 70.

H. Protection and Cleaning:
   1. Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations and as approved by the COR. Damaged or defective items in the opinion of the COR, shall be replaced.

2. Protect all finished parts of equipment, such as shafts and bearings where accessible, from rust prior to operation by means of protective grease coating and wrapping. Close pipe openings with caps or plugs during installation. Tightly cover and protect fixtures and equipment against dirt, water chemical, or mechanical injury. At completion of all work thoroughly clean fixtures, exposed materials and equipment.

I. Concrete and Grout: Use concrete and non-shrink grout 20 MPa (3000 psig) minimum, specified in Section 03 30 00, CAST-IN-PLACE CONCRETE.

J. Install gauges, thermometers, valves and other devices with due regard for ease in reading or operating and maintaining said devices. Locate and position thermometers and gauges to be easily read by operator or staff standing on floor or walkway provided. Servicing shall not require dismantling adjacent equipment or pipe work.

K. Install steam piping expansion joints as per manufacturer’s recommendations.

L. Work in Existing Building:
1. Perform as specified in paragraphs OPERATIONS AND STORAGE AREAS, paragraph ALTERATIONS, and paragraph 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, paragraph OPERATIONS AND STORAGE AREAS, make alterations to existing service piping at times that will least interfere with normal operation of the facility.

M. Switchgear/Electrical Equipment Drip Protection: Every effort shall be made to eliminate the installation of pipe above electrical and data/telephone switchgear. If this is not possible, encase pipe in a second pipe with a minimum of joints. Installation of piping, ductwork, leak protection apparatus or other installations foreign to the electrical installation shall not be located in the space equal to the width and depth of the equipment and extending from to a height of 1.8 m (6 feet) above the equipment or to ceiling structure, whichever is lower (NFPA 70).

N. Inaccessible Equipment:
1. Where the Government determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance or inspections, equipment shall be removed and reinstalled or remedial action performed as directed at no additional cost or time to the Government.
2. The term "conveniently accessible" is defined as capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to motors, fans, pumps, belt guards, transformers, high voltage lines, conduit and raceways, piping, hot surfaces, and ductwork. The COR has final determination on whether an installation meets this requirement or not.

3.3 TEMPORARY PIPING AND EQUIPMENT

A. Continuity of operation of existing facilities will generally require temporary installation or relocation of equipment, ducts, and piping.

B. The Contractor shall provide all required facilities in accordance with the requirements of phased construction and maintenance of service. All piping and equipment shall be properly supported, sloped to drain, operate without excessive stress, and shall be insulated where injury can occur to personnel by contact with operating facilities. The requirements of paragraph 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 13 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, inline pumps and other heavy components. Provide a support within one foot of each elbow.

E. HVAC Vertical Pipe Supports:
   1. Up to 152 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. 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.
   2. 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 152 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.

3.6 MECHANICAL DEMOLITION

A. Rigging access, other than indicated in 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.

E. Asbestos Insulation Removal: Conform to Section 02 82 11, TRADITIONAL ASBESTOS ABATEMENT.

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, fans, 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 and fan 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. 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 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. 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, paragraph 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 paragraph TESTS, and in individual Division 23 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 shall 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.

END OF SECTION

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.

H. Section 26 24 19, MOTOR CONTROL CENTERS.

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. 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
841-2021	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 29 11, MOTOR CONTROLLERS; and Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES. Provide all electrical wiring, conduit, and devices necessary for the proper connection, protection and operation of the

systems. Provide 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 hour 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.

END OF SECTION

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.
   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 23 05 11, COMMON WORK RESULTS FOR HVAC.

E. Section 23 07 11, HVAC AND BOILER PLANT INSULATION.

F. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

G. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

H. Section 23 31 00, HVAC DUCTS AND CASINGS.

I. 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):

ASHRAE Handbook – HVAC 2019	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 XX XX XX, SECTION TITLE”, 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 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, Section 23 05 10, COMMON WORK RESULTS

FOR BOILER PLANT and STEAM GENERATION, and Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

B. Qualifications:
   1. TAB Agency: The TAB agency shall be a subcontractor of the General Contractor and shall report to and be paid by the General Contractor.
   2. The TAB agency shall be either a certified member of AABC, NEBB, or TABB to perform TAB service for HVAC, water balancing 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. 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.
3. 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 l0 percent.
   b. Air Terminal Units (maximum values): Minus 5 percent to plus l0 percent

   c. Minimum Outside Air: 0 percent to plus 10 percent.
   d. Individual room air outlets and inlets, and air flow rates not mentioned above: Minus 5 percent to plus l0 percent except if the air to air space is 100 CFM or less the tolerance will be minus 5 to plus 5 percent.
4. Systems shall be adjusted for energy efficient operation as described in PART 3.
5. 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 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 each phase of the project prior to partial final inspections of each phase of the project. Return existing areas outside the work area to pre-constructed conditions.

D. Allow 14 days' time in construction schedule for TAB and submission of all reports for an organized and timely correction of deficiencies.

E. Air Balance and Equipment Test: Include air-handling units, fans, terminal units, fan coil units, room diffusers/outlets/inlets, and computer room AC units.

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:
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.

3.8 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.

3.9 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.

3.10 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.

3.11 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.

3.12 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.

END OF SECTION

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.
   2. Re-insulation of HVAC piping, ductwork and equipment after asbestos abatement.

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, unfinished attics, crawl spaces and pipe basements are not considered finished areas.
   6. FSK: Foil-scrim-kraft facing.
   7. Hot: HVAC Ductwork handling air at design temperature above 16 degrees C (60 degrees F);HVAC equipment or piping handling media above 41 degrees C (105 degrees F).
   8. Density: kg/m3 - 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.
   22. GH: Hot glycol-water heating supply.
   23. GHR: Hot glycol-water heating return.
   24. FWPD: Feedwater pump discharge.
   25. FWPS: Feedwater pump suction.
   26. CTPD: Condensate transfer pump discharge.
   27. CTPS: Condensate transfer pump suction.
   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.
38. GC: Chilled glycol-water supply.
39. GCR: Chilled glycol-water return.
40. RS: Refrigerant suction.
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 02 82 11, TRADITIONAL ASBESTOS ABATEMENT.

C. Section 07 84 00, FIRESTOPPING.

D. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

E. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

F. Section 23 21 13, HYDRONIC 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.

4.3.10.2.6.4 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):

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 2020a	Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
C547-2019	Standard Specification for Mineral Fiber pipe Insulation
C552 2021	Standard Specification for Cellular Glass Thermal Insulation
C553-2019	Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
C585-2010(R2016)	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- 2021	Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation
D1668/D1668M-97a (R2014)e1	Standard Specification for Glass Fabrics (Woven and Treated) for Roofing and Waterproofing
E84-2021a	Standard Test Method for Surface Burning Characteristics of Building Materials
E1192020	Standard Test Method for Fire Tests of Building Construction and Materials
E136-2019a	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-2021	Standard for the Installation of Air Conditioning and Ventilating Systems
96-2021	Standards for Ventilation Control and Fire Protection of Commercial Cooking Operations
101-2021	Life Safety Code
251-2006	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/m3 (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-3, Density 16 kg/m3 (1 pcf), k = 0.045 (0.31) 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/m3 (7.5 pcf) nominal, k = 0.033 (0.29) at 240 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.

2.7 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 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 areasconveying 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: 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.

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 or high density Polyisocyanurate insulation of the same thickness as adjacent insulation. Density of Polyisocyanurate insulation shall be a minimum of 48 kg/m3 (3.0 pcf).

Nominal Pipe Size and Accessories Material (Insert Blocks)

Nominal Pipe Size mm (inches)	Insert Blocks mm (inches)
Up through 125 (5)	150 (6) long
150 (6)	150 (6) long

200 (8), 250 (10), 300 (12)	225 (9) long
350 (14), 400 (16)	300 (12) long
450 through 600 (18 through 24)	350 (14) long

B. Warm or hot pipe supports: Premolded pipe insulation (180 degree half-shells) on bottom half of pipe at supports. Material shall be high density Polyisocyanurate (for temperatures up to 149 degrees C [300 degrees F]), cellular glass or calcium silicate. Insulation at supports shall have same thickness as adjacent insulation. Density of Polyisocyanurate insulation shall be a minimum of 48 kg/m3 (3.0 pcf).

2.9 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-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.

2.10 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.

2.11 REINFORCEMENT AND FINISHES

A. Glass fabric, open weave: ASTM D1668, Type III (resin treated) and Type I (asphalt treated).

B. Glass fiber fitting tape: Mil. Spec MIL-C-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.

2.12 FIRESTOPPING MATERIAL

A. Other than pipe and duct insulation, refer to Section 07 84 00 FIRESTOPPING.

2.13 FLAME AND SMOKE

A. Unless shown otherwise all assembled systems shall meet flame spread 25 and smoke developed 50 rating as developed under ASTM, NFPA and UL standards and specifications. See paragraph 1.3 "Quality Assurance".

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. Required pressure tests of duct and piping joints and connections shall be completed and the work approved by the 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. Where removal of insulation of piping, ductwork and equipment is required to comply with Section 02 82 11, TRADITIONAL ASBESTOS ABATEMENT, such areas shall be reinsulated to comply with this specification.

D. 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).

E. Install vapor stops at all insulation terminations on either side of valves, pumps and equipment and particularly in straight lengths of pipe insulation.

F. 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.

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 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. 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.

J. Apply insulation materials subject to the manufacturer's recommended temperature limits. Apply adhesives, mastic and coatings at the manufacturer's recommended minimum coverage.

K. Elbows, flanges and other fittings shall be insulated with the same material as is used on the pipe straights. The elbow/ fitting insulation shall be field-fabricated, mitered or factory prefabricated to the necessary size and shape to fit on the elbow/ fitting. Use of polyurethane spray-foam to fill a PVC elbow jacket is prohibited on cold applications.

L. Firestop Pipe and Duct insulation:
   1. Provide firestopping insulation at fire and smoke barriers through penetrations. Fire stopping insulation shall be UL listed as defines in Section 07 84 00, FIRESTOPPING.
   2. Pipe and duct penetrations requiring fire stop insulation including, but not limited to the following:
      a. Pipe risers through floors
      b. Pipe or duct chase walls and floors
      c. Smoke partitions

d. Fire partitions

M. Provide 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.

N. 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.
3. Exposed, unlined ductwork and equipment in unfinished areas, mechanical and electrical equipment rooms and attics, and duct work exposed to outdoor weather:
a. 40 mm (1-1/2 inch) thick insulation faced with ASJ (white all service jacket): Supply air duct and after filter housing.
b. 40 mm (1-1/2 inch) thick insulation faced with ASJ: Return air duct, mixed air plenums and prefilter housing.
c. Outside air intake ducts: 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.

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. 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, HYDRONIC PIPING: 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, COMMON WORK RESULTS FOR HVAC.
   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. 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.

3.3 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.

3.4 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)	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)	Rigid Cellular Phenolic Foam	50 (2.0)	50 (2.0)	75 (3.0)	75 (3.0)
38-94 degrees C (100-200 degrees F) (LPR, PC, HWH, HWHR, GH and GHR)	Mineral Fiber (Above ground piping only)	38 (1.5)	38 (1.5)	50 (2.0)	50 (2.0)
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)	Cellular Glass Closed-Cell	50 (2.0)	50 (2.0)	75 (3.0)	75 (3.0)

(CH and CHR within chiller room and pipe chase and underground)					
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)

END OF SECTION

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) will manage the commissioning process. The General Contractor must contract directly and provide a commissioning agent approved by the VA, in accordance with Section 10 91 00.

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 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC.

E. Section 23 09 23 DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

1.3 SUMMARY

A. This Section includes requirements for commissioning the HVAC systems of the related subsystems and equipment. This Section supplements the general requirements specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

B. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for more details regarding processes and procedures as well as roles and responsibilities for all Commissioning Team members.

1.4 DEFINITIONS

A. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for definitions.

1.5 COMMISSIONED SYSTEMS

A. Commissioning of a system or systems specified in Division 23 is part of the construction process. Documentation and testing of these systems, as well as training of the VA's Operation and Maintenance personnel in accordance with the requirements of Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS and of Division 23, is required in cooperation with the VA and the Commissioning Agent.

B. The Facility HVAC systems commissioning will include the systems listed in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

1.6 SUBMITTALS

A. The commissioning process requires review of selected Submittals that pertain to the systems to be commissioned. The Commissioning Agent will provide a list of submittals that will be reviewed by the Commissioning Agent. This list will be reviewed and approved by the VA prior to forwarding to the Contractor. Refer to Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, and SAMPLES for further details.

B. The commissioning process requires Submittal review simultaneously with engineering review. Specific submittal requirements related to the commissioning process are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

1.7 APPLICABLE PUBLICATIONS

A. The following publications form a part of this specification to the extent indicated by the reference thereto. In text the publications are referenced to by the acronym of the organization.

B. Department of Veterans Affairs (VA):

PG 18-10 2007	Mission Critical Facilities - DRAFT
PG 18-10 2007	Life-Safety Protected Facilities - DRAFT

C. American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE):

HANDBOOK 2019	HVAC Applications ASHRAE Handbook, Chapter 39, Testing, Adjusting, and Balancing, Chapter 44, HVAC Commissioning and Chapter 49, Sound and Vibration Control
HANDBOOK 2017	HVAC Fundamentals ASHRAE Handbook, Chapter 8, Sound and Vibration

D. Associated Air Balance Council (AABC):

7th Edition 2016	AABC National Standards for Total System Balance

E. National Environmental Balancing Bureau (NEBB):

9th Edition 2019	Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems
3rd Edition 2015	Procedural Standards for the Measurement of Sound and Vibration
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 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 Contracting Officer's Representative. 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 Contracting Officer's Representative 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.

END OF SECTION

SECTION 23 09 23
DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 - GENERAL

1.1 DESCRIPTION

A. General Contractor shall provide direct-digital control system(s) for new equipment 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.
   1. The direct-digital control system(s) shall consist of high-speed, peer-to-peer network of DDC controllers, a control system server, all configuration and setup software and hardware devices, and integration with the existing Engineering Control Center.
   2. All new building controllers shall be native BACnet. All new BACnet workstations, controllers, devices and components shall be listed by BACnet Testing Laboratories. All new BACnet workstations, controllers, devices and components shall be accessible using a HTML5 Web browser interface. Browsers shall not require the use of an extension or add on software in order to access aforementioned workstations, controllers, devices, and components.
      a. If used, gateways shall be BTL listed.
      b. If used, gateways shall provide all object properties and read/write services shown on VA-approved interoperability schedules.
   3. The work administered by this Section of the technical specifications shall include all labor, materials, special tools, equipment, enclosures, power supplies, software, software licenses, Project specific software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, submittals, testing, verification, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, Warranty, specified services and any other items required for a complete and fully functional Controls System.
   4. The control systems shall be designed such that each mechanical system shall operate under stand-alone mode. The A/E shall designate what each “mechanical systems” is composed of. The contractor administered by this Section of the technical specifications shall provide controllers for each mechanical system. In the event of a network communication failure, or the loss of any other controller, the control system shall continue to operate independently. Failure of the ECC shall have no effect on the field controllers, including those involved with global strategies.

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. Unitary HVAC equipment (split systems) controls. These include:
      a. Discharge temperature control.
      b. Flowrate control.
      c. Setpoint reset.
      d. Time of day indexing.
      e. Status alarm.
   4. Variable frequency drives. These controls, if not native BACnet, will require a BACnet Gateway.
   5. 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. Emergency generators: status alarms.
      c. Domestic water heating systems: low temperature, high temperature 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

Interface with chiller/boiler controls	23 09 23	23 09 23	23 09 23	26
Chiller/boiler controls interface with control system	23	23	23 09 23	26
All control system nodes, equipment, housings, enclosures and panels.	23 09 23	23 09 23	23 09 23	26
Smoke detectors	28 31 00	28 31 00	28 31 00	28 31 00
Fire/Smoke Dampers	23	23	28 31 00	28 31 00
Smoke Dampers	23	23	28 31 00	28 31 00
Fire Dampers	23	23	N/A	N/A
Chiller/starter interlock wiring	N/A	N/A	26	26
Chiller Flow Switches	23	23	23	N/A
Boiler interlock wiring	23	23	23	26
Boiler Flow Switches	23	23	23	N/A
Water treatment system	23	23	23	26
VFDs	23	26	23 09 23	26
Refrigerant monitors	23	23 09 23	23 09 23	26
Laboratory Environmental Controls	23 09 23	23 09 23	23 09 23	26
Fume hood controls	23 09 23	23 09 23	23 09 23	26
Medical gas panels	23	23	26	26
Laboratory Air Valves	23	23	23 09 23	N/A
Computer Room A/C Unit field-mounted controls	23	23	26	26
Control system interface with CRU A/C controls	23 09 23	23 09 23	23 09 23	26
CRU A/C unit controls interface with control system	23	23 09 23	23 09 23	26
Fire Alarm shutdown relay interlock wiring	28	28	28	26
Control system monitoring of fire alarm smoke control relay	28	28	23 09 23	28
Fire-fighter’s smoke control station (FSCS	28	28	28	28
Fan Coil Unit controls (not furnished with equipment)	23 09 23	23 09 23	23 09 23	26
Unit Heater controls (not furnished with equipment)	23 09 23	23 09 23	23 09 23	26

Packaged RTU space-mounted controls (not furnished with equipment)	23 09 23	23 09 23	23 09 23	26
Packaged RTU unit-mounted controls (not furnished with equipment)	23 09 23	23 09 23	23 09 23	26
Cooling Tower Vibration Switches	23	23	23 09 23	23 09 23
Cooling Tower Level Control Devices	23	23	23 09 23	23 09 23
Cooling Tower makeup water control devices	23	23	23 09 23	23 09 23
Starters, HOA switches	23	23	N/A	26
Steam Trap Monitoring in Boiler Plant	23 21 11	23 21 11	26	26
Steam Trap Monitoring not in Boiler Plant	23 22 13	23 22 13	26	26

F. 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.

G. This campus has standardized on an existing standard ASHRAE Standard 135, BACnet/IP Control System supported by a preselected controls service company. This entity is referred to as the “Control System Integrator” in this Section of the technical specifications. The Control system integrator is responsible for ECC system graphics and expansion. It also prescribes control system-specific commissioning/ verification procedures to the contractor administered by this Section of the technical specification. It lastly provides limited assistance to the contractor administered by this Section of the technical specification in its commissioning/verification work.

1. The General Contractor of this project shall directly hire the Control System Integrator in a contract separate from the contract procuring the controls contractor administered by this Section of the technical specifications.
2. The contractor administered by this Section of the technical specifications shall coordinate all work with the Control System Integrator. The contractor administered by this Section of the technical specifications shall integrate the ASHRAE Standard 135, BACnet/IP control network(s) with the Control System Integrator’s B-AWS through an Ethernet connection provided by either the Control System Integrator or VA.
3. Responsibility Table:

Item/Task	Section 23 09 23 contactor	Control system integrator	VA
ECC expansion		X	
ECC programming		X	
Devices, controllers, control panels and equipment	X		
Point addressing: all hardware and software points including setpoint, calculated point, data point(analog/ binary), and reset schedule point	X		

Point mapping		X	
Network Programming	X		
ECC Graphics		X	
Controller programming and sequences	X		
Integrity of LAN communications			X
Electrical wiring	X		
Operator system training		X	
LAN connections to devices			X
LAN connections to ECC			X
IP addresses			X
Overall system verification (Cx)		X	
Controller and system verification	X		

H. Unitary standalone systems including Unit Heaters, Cabinet Unit Heaters, Fan Coil Units, Base Board Heaters, thermal comfort ventilation fans, and similar units for control of room environment conditions may be equipped with integral controls furnished and installed by the equipment manufacturer or field mounted. Refer to equipment specifications and as indicated in project documents. Application of standalone unitary controls is limited to at least those systems wherein remote monitoring, alarm and startup are not necessary. Examples of such systems include:
   1. Mechanical or electrical room heating and ventilation.

I. The direct-digital control system shall start and stop equipment, move (position) damper actuators and valve actuators, and vary speed of equipment to execute the mission of the control system. Use electricity as the motive force for all damper and valve actuators, unless use of pneumatics as motive force is specifically granted in writing by the VA.

1.2 RELATED WORK

A. Section 23 21 13, Hydronic Piping.
B. Section 23 31 00, HVAC Ducts and Casings.
C. Section 23 36 00, Air Terminal Units.
D. Section 23 81 00, Decentralized Unitary HVAC Equipment.
E. Section 23 81 23, Computer-Room Air-Conditioners.
F. Section 23 84 00, Humidity Control Equipment.
G. Section 26 05 11, Requirements for Electrical Installations.
H. Section 26 05 21, Low-Voltage Electrical Power Conductors and Cables (600 Volts and Below).
I. Section 26 05 26, Grounding and Bonding for Electrical Systems.
J. Section 26 05 33, Raceway and Boxes for Electrical Systems.
K. Section 26 09 23, Lighting Controls.
L. Section 26 22 21, Specialty Transformers.
M. Section 26 27 26, Wiring Devices.
N. Section 26 29 11, Motor Starters.
O. Section 26 32 13, Engine Generators.
P. Section 27 15 00, Communications Horizontal Cabling
Q. 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, chillers, pumps, and building spaces. These images can be animated and/or color-coded to indicate operation of the equipment.

GG. Graphic Sequence of Operation: It is a graphical representation of the sequence of operation, showing all inputs and output logical blocks.

HH. I/O Unit: The section of a digital control system through which information is received and transmitted. I/O refers to analog input (AI, digital input (DI), analog output (AO) and digital output (DO). Analog signals are continuous and represent temperature, pressure, flow rate etc., whereas digital signals convert electronic signals to digital pulses (values), represent motor status, filter status, on-off equipment etc.

II. I/P: a method for conveying and routing packets of information over LAN paths. User Datagram Protocol (UDP) conveys information to “sockets” without confirmation of receipt. Transmission Control Protocol (TCP) establishes "sessions", which have end-to-end confirmation and guaranteed sequence of delivery.

JJ. JPEG: A standardized image compression mechanism stands for Joint Photographic Experts Group, the original name of the committee that wrote the standard.

KK. Local Area Network (LAN): A communication bus that interconnects operator workstation and digital controllers for peer-to-peer communications, sharing resources and exchanging information.

LL. Network Repeater: A device that receives data packet from one network and rebroadcasts to another network. No routing information is added to the protocol.

MM. MS/TP: Master-slave/token-passing (ISO/IEC 8802, Part 3). It uses twisted-pair wiring for relatively low speed and low cost communication.

NN. Native BACnet Device: A device that uses BACnet as its primary method of communication with other BACnet devices without intermediary gateways. A system that uses native BACnet devices at all levels is a native BACnet system.

OO. Network Number: A site-specific number assigned to each network segment to identify for routing. This network number must be unique throughout the BACnet internetwork.

PP. Object: The concept of organizing BACnet information into standard components with various associated properties. Examples include analog input objects and binary output objects.

QQ. Object Identifier: An object property used to identify the object, including object type and instance. Object Identifiers must be unique within a device.

RR. Object Properties: Attributes of an object. Examples include present value and high limit properties of an analog input object. Properties are defined in ASHRAE 135; some are optional and some are required. Objects are controlled by reading from and writing to object properties.

SS. Operating system (OS): Software, which controls the execution of computer application programs.

TT. PCX: File type for an image file. When photographs are scanned onto a personal computer they can be saved as PCX files and viewed or changed by a special application program as Photo Shop.

UU. Peripheral: Different components that make the control system function as one unit. Peripherals include monitor, printer, and I/O unit.

VV. Peer-to-Peer: A networking architecture that treats all network stations as equal partners- any device can initiate and respond to communication with other devices.

WW. PICS: Protocol Implementation Conformance Statement, describing the BACnet capabilities of a device. All BACnet devices have published PICS.

XX. PID: Proportional, integral, and derivative control, used to control modulating equipment to maintain a setpoint.

YY. Repeater: A network component that connects two or more physical segments at the physical layer.

ZZ. Router: a component that joins together two or more networks using different LAN technologies. Examples include joining a BACnet Ethernet LAN to a BACnet MS/TP LAN.

AAA. Sensors: devices measuring state points or flows, which are then transmitted back to the DDC system.

BBB. Thermostats : devices measuring temperatures, which are used in control of standalone or unitary systems and equipment not attached to the DDC system.

1.4 QUALITY ASSURANCE

A. Criteria:

1. Single Source Responsibility of subcontractor: Either the DDC Contractor or the System Integrator shall obtain hardware and software supplied under this Section and delegate the responsibility to a single source controls installation subcontractor. The Integration subcontractor shall be responsible for the complete design, installation, integration, and commissioning of the system. The controls subcontractor shall be in the business of design, installation and service of such building automation control systems similar in size and complexity.
2. Equipment and Materials: Equipment and materials shall be cataloged products of manufacturers regularly engaged in production and installation of HVAC control systems. Products shall be manufacturer's latest standard design and have been tested and proven in actual use.
3. The controls subcontractor shall provide a list of no less than five similar projects which have building control systems as specified in this Section. These projects must be on-line and functional such that the Department of Veterans Affairs (VA) representative could observe the control systems in full operation.
4. The controls subcontractor shall have an in-place facility within 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.
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 (CO2)	±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

   1) 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	±1.0ºC (±2.0 degrees F)	
Duct Temperature	±1.5ºC (±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 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 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.

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.
1. First Phase: Formal instructions to the VA facilities personnel for a total of \16 hours, given in multiple training sessions (each no longer than four hours in length), conducted sometime between the completed installation and prior to the performance test period of the 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 16 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.
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.

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.

B. Each controller shall have a communication port for connection to an operator interface.

C. 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 BACNET PROTOCOL ANALYZER

A. For ease of troubleshooting and maintenance, provide a BACnet protocol analyzer. Provide its associated fittings, cables and appurtenances, for connection to the communications network. The BACnet protocol analyzer shall be able to, at a minimum: capture and store to a file all data traffic on all network levels; measure bandwidth usage; filter out (ignore) selected traffic.

2.5 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. 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. 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.

2.6 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.

2.7 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 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 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. 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.
    b. 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.

c. 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.

d. 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.

e. 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.

2.8 SENSORS (AIR, WATER)

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.
   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. 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.

E. 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.

F. 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 as specified in Section 26 05 21.

C. Copper digital communication cable between the ECC and the B-BC and B-AAC controllers shall be 100BASE-TX Ethernet, Category 5e or 6, not less than minimum 24 American Wire Gauge (AWG) solid, Shielded Twisted Pair (STP) or Unshielded Twisted Pair (UTP), with thermoplastic insulated conductors, enclosed in a thermoplastic outer jacket, as specified in Section 27 15 00.
1. Other types of media commonly used within IEEE Std 802.3 LANs (e.g., 10Base-T and 10Base-2) shall be used only in cases to interconnect with existing media.

D. All MS/TP communications cables for devices utilizing the EIA-485 standard must be listed for use on EIA-485 networks by the manufacturer of the cable. This requirement overrides any cable recommendation by the controller manufacturer. The use of EIA-485 communication cables shall not affect the warranty from the installing DDC contractor. Cables shall have the following characteristic:
1. Nominal Impedance: 100-130 Ohms
2. Twisted/shielded construction of 1, 1.5, or 2 pairs depending on controller requirements.
3. Be plenum rated when required
4. Cables designated for use by the cable manufacturer for use in PA or Speaker systems shall not be allowed, regardless of recommendations by the controller manufacturer.

E. Optical digital communication fiber, if used, shall be Multimode or 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 and shall be as specified in Section 27 15 00. Fiber-optic cable shall be suitable for use with the 100Base-FX or the 100Base-SX standard (as applicable) as defined in IEEE Std 802.3.

2.10 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 or satin chrome 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 reset.

C. Freezestats shall have a minimum of 300 mm (one linear foot) of sensing element for each 0.093 square meter (one square foot) of coil area. A freezing condition at any increment of 300 mm (one foot) anywhere along the sensing element shall be sufficient to operate the thermostatic element. Freezestats shall be manually-reset.

D. Room Humidistats: Provide fully proportioning humidistat with adjustable throttling range for accuracy of settings and conservation. The humidistat shall have set point scales shown in percent of relative humidity located on the instrument. Systems showing moist/dry or high/low are 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. 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.
2. 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.
3. 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 inletand the number of sensors shall be adequate to

accommodate the expected velocity profile and variation in flow and temperature. The airflow station shall be of the insertion type in which sensor support structures are inserted from the outside of the ducts to make up the complete electronic velocity array.

b. Thermal flow sensor shall be constructed of hermetically sealed thermistors or nickel chromium or reference grade platinum wire, wound over an epoxy, stainless steel or ceramic mandrel and coated with a material suitable for the conditions to be encountered. Each dual sensor shall be mounted in an extruded aluminum alloy strut.

2. Air Flow Sensor Grid Array:
   a. Each sensor grid shall consist of a lattice network of temperature sensors and linear integral controllers (ICs) situated inside an aluminum casing suitable for mounting in a duct or fan inlet. Each sensor shall be mounted within a strut facing downstream of the airflow and located so that it is protected on the upstream side. All wiring shall be encased (out of the air stream) to protect against mechanical damage.
   b. The casing shall be made of welded aluminum of sufficient strength to prevent structural bending and bowing. Steel or iron composite shall not be acceptable in the casing material.
   c. Pressure drop through the flow station shall not exceed 4 Pascal (0.015 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 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 and temperature in degrees F . 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. 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:
   a. 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

b. 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 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 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.

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 and in accordance with Specification Section 27 15 00, COMMINICATIONS STRUCTURED CABLING.
   3. Install conduit and wiring between operator workstation(s), digital controllers, electrical panels, indicating devices, instrumentation, miscellaneous alarm points, thermostats, and relays as shown on the drawings or as required under this section.
   4. Install all electrical work required for a fully functional system and not shown on electrical plans or required by electrical specifications. Where low voltage (less than 50 volt) power is required, provide suitable Class B transformers.
   5. Install all system components in accordance with local Building Code and National Electric Code.
      a. Splices: Splices in shielded and coaxial cables shall consist of terminations and the use of shielded cable couplers. Terminations shall be in accessible locations. Cables shall be harnessed with cable ties.
      b. Equipment: Fit all equipment contained in cabinets or panels with service loops, each loop being at least 300 mm (12 inches) long. Equipment for fiber optics system shall be rack mounted, as applicable, in ventilated, self-supporting, code gauge steel enclosure. Cables shall be supported for minimum sag.
      c. Cable Runs: Keep cable runs as short as possible. Allow extra length for connecting to the terminal board. Do not bend flexible coaxial cables in a radius less than ten times the cable outside diameter.
      d. Use vinyl tape, sleeves, or grommets to protect cables from vibration at points where they pass around sharp corners, through walls, panel cabinets, etc.
   6. Conceal cables, except in mechanical rooms and areas where other conduits and piping are exposed.
   7. Permanently label or code each point of all field terminal strips to show the instrument or item served. Color-coded cable with cable diagrams may be used to accomplish cable identification.
   8. Grounding: ground electrical systems per manufacturer’s written requirements for proper and safe operation.

C. Install Sensors and Controls:
   1. Temperature Sensors:
      a. Install all sensors and instrumentation according to manufacturer’s written instructions. Temperature sensor locations shall be readily accessible, permitting quick replacement and servicing of them without special skills and tools.
      b. Calibrate sensors to accuracy specified, if not factory calibrated.
      c. Use of sensors shall be limited to its duty, e.g., duct sensor shall not be used in lieu of room sensor.
      d. Install room sensors permanently supported on wall frame. They shall be mounted at 1.5 meter (5.0 feet) above the finished floor unless otherwise noted on the plans or drawings.
      e. Mount sensors rigidly and adequately for the environment within which the sensor operates. Separate extended-bulb sensors form contact with metal casings and coils using insulated standoffs.
      f. Sensors used in mixing plenum, and hot and cold decks shall be of the averaging of type. Averaging sensors shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip.

g. All pipe mounted temperature sensors shall be installed in wells.
h. All wires attached to sensors shall be air sealed in their conduits or in the wall to stop air transmitted from other areas affecting sensor reading.
i. Permanently mark terminal blocks for identification. Protect all circuits to avoid interruption of service due to short-circuiting or other conditions. Line-protect all wiring that comes from external sources to the site from lightning and static electricity.

2. Pressure Sensors:
   a. Install duct static pressure sensor tips facing directly downstream of airflow.
   b. Install high-pressure side of the differential switch between the pump discharge and the check valve.
   c. Install snubbers and isolation valves on steam pressure sensing devices.
3. Actuators:
   a. Mount and link damper and valve actuators according to manufacturer's written instructions.
   b. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed position.
   c. Check operation of valve/actuator combination to confirm that actuator modulates valve smoothly in both open and closed position.
4. Flow Switches:
   a. Install flow switch according to manufacturer's written instructions.
   b. Mount flow switch a minimum of 5 pipe diameters up stream and 10 pipe diameters downstream or 600 mm (2 feet) whichever is greater, from fittings and other obstructions.
   c. Assure correct flow direction and alignment.
   d. Mount in horizontal piping-flow switch on top of the pipe.

D. Installation of network:
1. Ethernet:
   a. The network shall employ Ethernet LAN architecture, as defined by IEEE 802.3. The Network Interface shall be fully Internet Protocol (IP) compliant allowing connection to currently installed IEEE 802.3, Compliant Ethernet Networks.
   b. The network shall directly support connectivity to a variety of cabling types. As a minimum provide the following connectivity: 100 Base TX (Category 5e cabling) for the communications between the ECC and the B-BC and the B-AAC controllers.
2. Third party interfaces: Contractor shall integrate real-time data from building systems by other trades and databases originating from other manufacturers as specified and required to make the system work as one system.

E. Installation of digital controllers and programming:
1. Provide a separate digital control panel for each major piece of equipment, such as air handling unit, chiller, pumping unit etc. Points used for control loop reset such as outdoor air, outdoor humidity, or space temperature could be located on any of the remote control units.
2. Provide sufficient internal memory for the specified control sequences and trend logging. There shall be a minimum of 25 percent of available memory free for future use.
3. System point names shall be human readable, permitting easy operator interface without the use of a written point index.
4. Provide software programming for the applications intended for the systems specified, and adhere to the strategy algorithms provided.
5. Provide graphics for each piece of equipment and floor plan in the building. This includes each chiller, cooling tower, air handling unit, fan, terminal unit, boiler, pumping unit etc. These graphics shall show all points dynamically as specified in the point list.

3.2 SYSTEM VALIDATION AND DEMONSTRATION

A. As part of final system acceptance, a system demonstration is required (see below). Prior to start of this demonstration, the contractor is to perform a complete validation of all aspects of

the controls and instrumentation system. 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) minute. Control loop trend data shall be instantaneous and the time between data points shall not be greater than one (1) minute.

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.

END OF SECTION

SECTION 23 10 00
FACILITY FUEL OIL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Diesel fuel oil and unheated burner fuel oil tanks, piping, and accessories located outside, underground or aboveground as shown on contract drawings. Refer to contract drawings for type of fuel and for tank capacities.

B. Tank fluid level monitoring and alarm systems.

C. Leak detection system for tanks and underground piping.

D. Fuel oil quality maintenance system (water and particulate removal).

E. 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 03 30 00, CAST-IN-PLACE CONCRETE.

F. Section 05 50 00, METAL FABRICATIONS.

G. Section 09 91 00, PAINTING.

H. Section 23 05 11, COMMON WORK RESULTS 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 11, INSTRUMENTATION AND CONTROL FOR BOILER PLANT.

L. Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION.

M. Section 26 42 00, CATHODIC PROTECTION.

N. Section 31 20 00, EARTHWORK.

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 Petroleum Institute (API):

RP 1631-2001	Interior Lining and Periodic Inspection of Underground Storage Tanks

C. American Society of Mechanical Engineers (ASME):

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
B31.1-2020	Power Piping

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

A36/A36M-2019	Standard Specification for Carbon Structural Steel
A53/A53M-2021	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
A105/A105M-2021	Standard Specification for Carbon Steel Forgings for Piping Applications
A106/A106M-2021	Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
A126-2019	Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
A234/A234M-2019	Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
B62-2017	Standard Specification for Composition Bronze or Ounce Metal Castings
D2996-2020	Standard Specification for Filament-Wound “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe

E. Federal Specifications (Fed. Spec.):

A-A-60005-1998	Frames, Covers, Grating, Steps, Sump and Catch Basin, Manhole

F. NACE International (NACE):

SP0169-2013	Control of External Corrosion on Underground or Submerged Metallic Piping Systems
3/SSPC–SP6-2013	Commercial Blast Cleaning
4/SSPC-SP7-2007	Brush-off Blast Cleaning

G. National Electrical Manufacturers Association (NEMA):

250-2021	Enclosures for Electrical Equipment (1000 Volts Maximum)

H. National Fire Protection Association (NFPA):

30-2021	Flammable and Combustible Liquids Code
31-2020	Standard for the Installation of Oil-Burning Equipment
70-2021	National Electrical Code (NEC)

I. Steel Tank Institute (STI):

F001-2017	Flameshield® Standard for Fire Tested Tanks
F841-2010	Standard for Dual Wall Underground Steel Storage Tanks
F894-2018	ACT-100® Specification for External Corrosion Protection of FRP Composite Steel Underground Storage Tanks

F941-2016	Fireguard: Specification for Fireguard Protected Aboveground Storage Tanks
F961-2017	ACT-100U Specification for External Corrosion Protection of Composite Steel Underground Storage Tanks
P3-2015	Specification and Manual for External Corrosion Protection of Underground Steel Storage Tanks
R891-2006	Recommended Practice for Hold Down Strap Isolation

J. Underwriters Laboratories Inc. (UL):

58-2018	Standard for Steel Underground Tanks for Flammable and Combustible Liquids
142-2019	Standard for Steel Aboveground Tanks for Flammable and Combustible Liquids
971-2021	Standard for Nonmetallic Underground Piping for Flammable Liquids
1316-2018	Glass-Fiber-Reinforced Plastic Underground Storage Tanks for Petroleum Products, Alcohols, and Alcohol-Gasoline Mixtures
1746-2007(R2014)	Standard for External Corrosion Protection Systems for Steel Underground Storage Tanks
2085-2012	Standard for Protected Aboveground Tanks for Flammable and Combustible Liquids

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 10 00, FACILITY FUEL OIL SYSTEMS”, 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. Aboveground Steel Tanks, Including Vault-type Tanks:
   1. Drawings of tanks, supports, ladders, platforms, heating coils, tank manholes, emergency relief vents and all accessories. Include overall dimensions and dimensional locations and sizes of pipe connections, and access openings.
   2. Recommended tank support locations.
   3. Weight of entire tank assembly, empty and flooded.
   4. Design and construction of primary tanks, insulation, secondary containment, supports, pipe connections, platforms.
   5. Application and performance data on coatings from manufacturer of coatings.
   6. Data certifying tanks are designed for surcharge loads of platforms shown.
   7. Certification of compliance with specified standards.
   8. Certification that steel tank manufacturer participates in Steel Tank Institute (STI) Quality Assurance Program.
   9. Design, construction, performance, dimensions of emergency relief vents.

E. Fuel Piping:

1. ASTM and UL compliance.
2. Grade, class or type, schedule number.
3. Manufacturer.

F. Pipe Fittings, Unions, Flanges:
1. ASTM and UL compliance.
2. ASTM standards number.
3. Catalog cuts.
4. Pressure and temperature rating.

G. Foot Valves, Check Valves, Overfill Prevention Valves:
1. Catalog cuts showing design and construction.
2. Pressure and temperature ratings.
3. Pressure loss and flow rate data.
4. Materials of construction.
5. Accessories.

H. Secondary Containment System for Fuel Piping:
1. Sizes, materials, construction of containment system including end seals, sumps, coatings and pipe supports.
2. Layout of system.
3. Installation instructions.
4. Design of cathodic protection system (steel casing).

I. Leak Detection System:
1. Drawings, description and performance data on sensors, control units.
2. Description of operation.
3. Layout of system.
4. Installation and operating instructions.
5. Data on interconnecting wiring systems to be furnished.

J. Tank Fluid Level Monitoring Instrumentation System:
1. Drawings showing instruments and in-tank sensing units, with dimensions.
2. Design and construction of all elements of system.
3. Installation instructions.

K. Tank and Piping Accessories: Design, construction, and dimensions of vent caps, fill boxes, fill caps, spill containers and other accessories.

L. Fuel Quality Maintenance System:
1. Drawings and description of all components and arrangement of system.
2. Design and performance of pumps, filters.
3. Catalog data and operation of control system.
4. Installation instructions.

M. 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.

N. 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.

O. 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. Approval by Contracting Officer is required of products or services of proposed manufacturers, suppliers and installers, and will be based on Contractor's certification that:
   1. Manufacturers regularly and currently manufacture tanks, tank and piping accessories, tank fluid level monitoring and leak detection systems, and fuel quality management systems.
   2. Manufacturers of steel tanks participate in the Quality Assurance Program of the Steel Tank Institute (STI).
   3. The design and size of each item of equipment provided for this project is of current production and has been in satisfactory operation on at least three installations for approximately three years. Current models of fluid level and leak detection systems with less than three years' service experience are acceptable if similar previous models from the same manufacturer have at least three years' service experience.

B. Apply and install materials, equipment and specialties in accordance with manufacturer's written instructions. Conflicts between the manufacturer's instructions and the contract drawings and specifications shall be referred to the COR for resolution. Provide copies of installation instructions to the COR two weeks prior to commencing installation of any item.

C. All equipment shall be free from defects that would adversely affect the performance, maintainability and appearance of individual components or overall assembly.

D. Tanks, Secondary Containment Systems for Piping, Plastic Piping and Containment Systems, Tank Level Monitoring Systems, Leak Detection Systems, Fuel Quality Management Systems, Cathodic Protection Systems: Authorized manufacturer's representatives shall provide onsite training of installers and supervision of the installation and testing of the equipment and systems to assure conformance to written instructions of manufacturers.

E. Tank and piping installation contractor shall be certified as acceptable by local and state pollution control authorities.

F. Entire installation shall conform to requirements of local and state pollution control authorities.

G. Pipe Welding: Conform to requirements of ASME B31.1. Welders shall show evidence of qualification. Welders shall utilize a stamp to identify their work. Unqualified personnel will be rejected.

H. Assembly of Glass Fiber Reinforced Plastic Piping: Installation personnel shall have been trained, tested and certified under a procedure approved by the manufacturer of the piping. Proof of certification, in writing, shall be provided to the COR.

I. Where specified codes or standards conflict, consult the COR.

J. Label of Conformance (definition): Labels of accredited testing laboratories showing conformance to the standards specified.

K. 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 safe, complete and fully operational system which conforms to contract requirements and in which no item is subject to conditions beyond its design capabilities.

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. 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 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.

1.7 PERMITS

A. Contractor shall obtain and complete all tank permit and registration forms required by governmental authorities.

PART 2 - PRODUCTS

2.1 ABOVEGROUND STEEL TANKS

A. Type: Factory-fabricated all welded steel, horizontal cylindrical configuration, atmospheric pressure, internal and external corrosion protection as specified. In addition to specified requirements, tanks shall be fabricated in accordance with Steel Tank Institute (STI) design standards by manufacturer that participates in STI Quality Assurance Program.

B. Construction:
   1. ASTM A36/A36M steel, conform to UL 142. Inner and outer tanks of double wall tanks shall both conform. Provide label of conformance.
   2. Conform to NFPA 30 or NFPA 31 as applicable.
   3. Double-wall, un-insulated, conforming to STI F001 "Flameshield" construction. Provide label of conformance.
   4. Design for surcharge load produced by tank-mounted platforms and platform loadings shown. Design tanks for saddle supports furnished by tank manufacturer.
   5. Leaks and abrasions are prohibited. Maximum permissible out-of-roundness of cylindrical shells is one percent of the diameter.
   6. Provide lifting lugs for rigging tanks.
   7. Make provisions for leak detectors to be installed at lowest part of interstitial space between walls of double-wall tanks.

C. Platforms, Stairs, Ladders and Handrails: Provide welded steel assemblies as shown, conforming to OSHA requirements. Provide welded steel tank attachments designed to support platform framing, stairs, ladders and live and dead loadings. Clean and coat all surfaces as specified for tank and steel dike exterior. Galvanizing is an acceptable alternative.

D. Factory Cleaning: Clean interior and exterior of tanks and steel dikes (if furnished). Remove mill scale, dirt, rust, oil, welding debris, loose coatings and coatings incompatible with fuel stored or protective coating. Sandblast exterior in accordance with NACE 3.

E. Factory Coating: Provide tanks and steel dikes (if furnished) with exterior coat of rust resistant metal primer, specified under Section 09 91 00, PAINTING. Coat interior from bottom of tank to 1 m (3 feet) above bottom in compliance with API RP 1631.

F. Field Painting: Clean and coat all surfaces as specified in Section 09 91 00, PAINTING.

G. Pipe Connections to Tanks:
   1. Conform to UL 142.
   2. Pipe sizes 50 mm (2 inches) and smaller, threaded. Pipe sizes 65 mm (2-1/2 inches) and larger, flanged, 1034 kPa (150 psig) ASME rating.
   3. Welded joints required on steel piping located inside tanks.
   4. Provide and coordinate tank connection quantities, sizes and types with requirements of tank level gauge unit; sounding rod; vent, fill, supply and return pipes; and other pipes as shown.
   5. On double-wall tanks, provide valved drain of interstitial space.

H. Wear (Striker) Plates: Provide 300 mm (12 inch) square, 6 mm (1/4 inch) thick steel plates welded to tank bottom directly under the sounding opening, the fuel return discharge, and the fill discharge.

I. Lifting Lugs: Provide for rigging tanks.

J. Emergency Relief Vents for Fire Exposure: Venting capacity shall conform to NFPA 30 or NFPA 31 as applicable. Standard product of a manufacturer, designed to automatically open at tank pressure of 17 kPa (2.5 psig) gauge. Aluminum or cast-iron construction with Teflon seating surface. Provide separate vents for primary and secondary tanks.

K. Provide fittings for grounding per NFPA 70.

2.2 TANK AND PIPING ACCESSORIES

A. Vent Caps: Galvanized cast iron or cast aluminum with brass or bronze screens, arranged to permit full venting and to prevent entry of foreign material into the vent line. Same pipe size as vent pipe.

B. Fill Boxes:
   1. Spill-container type enclosing a fill cap assembly with camlock hose connector with closure coordinated with fittings used by fuel supplier.
   2. Watertight assembly, cylindrical body, quick-opening corrosion-resistant watertight sealable cover, polyethylene spill containment compartment with minimum 15 gallon capacity. Integral drain valve and hand pump with discharge to fill pipe. Underground fill box shall be Preferred Utilities Model 3BG with integral overfill alarm light and horn.
   3. Fill cap shall be lockable, tight-fill design with provision for padlock on the top of the cap. Fill cap shall screw onto threaded adapter that can be removed without removing fill box. Entire assembly shall seal tight with no leakage during filling and when cap is in place.
   4. Provide special tools necessary for opening fill boxes and fill caps.
   5. Protect spill container from traffic by ramped, drain-slotted cast iron body ring and cover. Design shall prevent transmission of traffic loads to the underground tank. Spill-container type not required at locations designated only for sounding tanks.

C. Fill caps located above grade without fill boxes shall be lockable, tight-fill design, operated by special wrench that shall be furnished. Entire assembly shall seal tight with no leakage during fill and when cap is in place. Aboveground fill box shall be Preferred Model 2 Horizontal Spill Container with integral overfill alarm light and horn.

D. Refer to Section 05 50 00, METAL FABRICATIONS, for access platforms shown for aboveground tanks.

E. Support horizontal portion of pipes located inside tank every 2100 mm (7 feet) maximum.

F. Furnish gauging chart, liters versus mm and gallons versus inches depth.

G. Furnish sounding rod for each tank size. Mark rods in increments representing five percent of tank capacity. Provide length of rod suitable for tank burial depth (if applicable). Rods shall be graduated in gallons.

H. Fill Point Identification:
   1. Fill Boxes at Grade Level: Aluminum, brass or bronze plate, anchored to concrete fill box pad with stamped or engraved letters 20 mm (3/4 inch) high.
   2. Fill Caps above Grade: Aluminum, brass or bronze plate, clamped to fill pipe, with stamped or engraved letters 20 mm (3/4 inch) high.
   3. Legend: "BURNER FUEL OIL FILL" "DIESEL FUEL FILL" or "SOUNDING" as appropriate.

2.3 PIPING, VALVES, FITTINGS

A. Fuel supply and return, tank fill, vents, sounding, and pump out.

B. Steel Pipe and Fittings:
   1. Piping: Steel, seamless or electric resistance welded (ERW), ASTM A53/A53M Grade B or ASTM A106/A106M Grade B, Schedule 40. Aboveground piping shall be painted. Refer to Section 09 91 00, PAINTING.
   2. Joints: Socket or butt-welded. Threaded joints are prohibited except at valves, unions and tank connections.
   3. Fittings:
      a. Butt-welded joints: Steel, ASTM A234/A234M, Grade B, ASME B16.9, same schedule as adjoining pipe.
      b. Socket-welded joints: Forged steel, ASME B16.11, 13,790 kPa (2000 psig) class.
   4. Unions: Malleable iron, 2070 kPa (300 psig) class.
   5. Companion flanges: Flanges and bolting, ASME B16.5.
   6. Welding flanges: Weld neck, ASME B16.5, forged steel ASTM A105/A105M, 1034 kPa (150 psig).

C. Glass Fiber Reinforced Plastic (FRP) Pipe and Fittings:
   1. Conform to UL 971 and ASTM D2996 using a filament-winding process and epoxy or vinyl ester resins.
   2. Design pipe, fittings and joining system for required fuel service, 65 degrees C (150 degrees F), 1034 kPa (150 psig) pressure, 68 kPa (20 inches Hg) vacuum.
   3. Provide an integral resin-rich liner, 0.5 mm (0.020 inches) minimum thickness to enhance the corrosion resistance. Outer layer shall include ultra-violet inhibitors. Joining adhesive shall be designed for the pipe furnished and shall be supplied by the pipe manufacturer.
   4. Plastic piping allowed in underground use only.

D. Check Valves - Fuel Pump Suction.
   1. Pipe Sizes 50 mm (2 inches) and under: Rated for 1375 kPa (200 psig) water-oil-gas, swing-type, threaded ends, ASTM B62 bronze body. Provide union adjacent to valve.
   2. Pipe Sizes 65 mm (2-1/2 inches) and above: Rated for 1380 kPa (200 psig) water-oil-gas, swing-type, 861 kPa (125 pounds) ASME flanged ends, ASTM A126 class B cast iron body.

E. Foot Valves - Fuel Pump Suction: Double poppet, lapped-in metal-to-metal seats, double-guided stems, 20 mesh inlet screen, same size as fuel suction piping. Foot valve shall be removable to above grade through the tank manhole enclosure or through extractor fitting. Foot valves to be Preferred Model 22BG double poppet style.

F. Extractor Fittings: Arranged to permit removal of foot valves, overfill prevention valves, and other devices that are located below grade. Access point shall be through a cast iron fill box-type manhole located at grade. Provide extractor wrench.

G. Overfill Prevention Valve: Aluminum automatic valve designed for underground or aboveground tanks, as applicable. Removable through the extractor fitting on underground tanks. Locate valve near the top of the tank in the fill pipe. On underground tanks with gravity fill, provide two

stage automatic float-operated valve. First stage operation at 92 percent tank capacity shall reduce flow to 0.3 L/s (5 gpm) or less. Second stage operation shall stop flow completely when tank is no more than 95 percent full. Overfill Prevention Valves for underground storage tanks to be Preferred Model 71. On aboveground tanks, or tanks pressure-filled, provide single stage valve, rated for fill flow and pressure, which stops flow completely at 95 percent of tank capacity. Valve shall include method for draining oil trapped above the valve into the tank. Overfill Prevention Valves for aboveground storage tanks to be Preferred Model 61F.

2.4 LEAK DETECTION SYSTEMS

A. Automatic digital continuous monitoring systems responsive to the presence of water and hydrocarbons in the interstitial space of the double-wall tanks, in the tank manhole access enclosures, and in the secondary containment of fuel piping systems. System shall distinguish between hydrocarbon and water and identify location of leak as to individual tank and piping system. Leak detection shall be by Preferred Fuel Sentry tank gauge and leak detection system.

B. Functions and Arrangement:
   1. Single control station to monitor all sensing probes.
   2. Visual indicator to monitor and identify leaks as water or hydrocarbon and location.
   3. Indicators showing system status including faults and alarms.
   4. On board printer that provides complete reports of all system functions upon command.
   5. Panel circuit test button.
   6. 95 dB audible alarm with silencing control to sound when leak is detected.
   7. EEPROM non-volatile memory.
   8. NEMA 250 Type 4 cabinet.
   9. UL or other accredited testing laboratory listing.
   10. RS232 Modbus and Ethernet communications with engineering control system to indicate system in service and alarm conditions.

C. Sensors:
   1. Designed for required locations including: Insertion between walls of double-wall tanks, in sumps in double-wall piping systems and in tank manhole enclosures. Sensing points shall be at lowest point of each tank or sump. Intrinsically safe design, Preferred Model HD-A2-C.
   2. Sensing units shall detect presence of water and a minimum 3.2 mm (1/8 inch) thick layer of hydrocarbon on surface of water and minimum 50 mm (2 inch) thickness of hydrocarbon in area that has no water present.
   3. Sensors shall be arranged to allow replacement of individual sensors without disturbing other portions of leak detection system or fuel storage and piping system. Underground sensors shall be accessed through caps as grade.
   4. Materials of construction shall be non-corroding.
   5. Transmit status signal to control unit via standard 4-20 mA signal.

D. Components:
   1. Provide manholes at grade for each sensor cap similar in construction to fill boxes. Manholes shall be cast iron, quick-opening cover, watertight, minimum size necessary to accommodate sensor caps. Provide identification plates, similar to those specified for fill points, labeled “MONITORING/OBSERVATION WELL-DO NOT FILL”. Provide special tools if necessary for opening covers.
   2. Sensor housings from tank and piping to grade shall be Schedule 40 PVC, or stainless steel.
   3. Underground wiring between probes and control unit: Place in water-tight corrosion-resistant conduit system conforming to Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION.

2.5 TANK FLUID LEVEL MONITOR AND ALARM SYSTEMS

A. Digital systems for central monitoring of fuel and water levels in all fuel oil storage tanks in the project. High and low level visual and audible alarms on 4” bar graph display. Volumetric tank-tightness testing. Complete with all transducing, transmitting, and receiving devices. On board printer to provide complete report of all system functions upon command. Tank gauge to be Preferred Fuel Sentry.

B. Fluid Level Monitor:
   1. Digital continuous readout, showing tank oil and water levels in gallons, smallest reading one gallon. Provide identification of product measured, measuring units, and the tank number.
   2. Tank and fuel characteristics contained in preprogrammed non-volatile field-replaceable databases. Protected power supply. Preferred Model TG-EL-MS.

C. High and Low Fluid Level Alarm System:
   1. Automatic continuous on-line monitoring of all tanks.
   2. Visual and audible indicators combined with fluid level monitor. Identify the tank that is in alarm condition.
   3. Manual alarm test and silencing controls.
   4. Low level alarm actuation adjustable 0-25 percent of tank capacity. High level alarm actuation adjustable 75-100 percent of tank capacity.

D. Locate all indicators, selector switches, alarms on face of wall-mounted NEMA 250, Type 4 panel.

E. Remote Alarm Annunciator:
   1. Visual and audible high-level alarms adjacent to tank fill box locations. Locate in NEMA 250 Type 4X weatherproof exterior wall or pole-mounted panels. Preferred Utilities Model FA-AV-BG1
   2. Alarm shall include flashing red light with 180-degree visibility for each tank and 95 dB horn or 100 mm (4 inch) diameter bell. Provide alarm silence control.
   3. Provide identification sign: "WHEN ALARM SOUNDS - FUEL TANK FILLED TO CAPACITY - DO NOT OVERFILL".

F. Modbus communication to engineering control system to indicate tank fluid level and alarm conditions. Telephone modem communication capability.

G. System Performance: Accuracy plus or minus 2.5 mm (0.10 inch) of fluid height in inventory mode and 0.25 mm (0.01 inch) in leak detection mode. Automatic compensation for fluid temperature changes. Volumetric tank tightness sensitivity of 0.4 lph (0.1 gph).

H. Sensors:
   1. Provide magnetostrictive, dual-float sensor.
   2. Apply in accordance with manufacturer’s instructions with provisions for easy future replacement without need for excavation.

I. Code Conformance: NFPA 70.

2.6 FUEL OIL QUALITY MAINTENANCE SYSTEMS

A. Complete factory-assembled automatic particulate filtration and dewatering and fuel additive injection system to maintain the purity of No. 2 fuel oil in storage. The system shall circulate the oil from the storage tank, through the system, and back to the storage tank. Provide quantity and capacity of systems to serve tanks as shown, connected to the tank suction and return pipes. Drawings may show multiple tanks served by one system. Smaller systems without large water storage tanks and without fuel additive injection shall be wall-mounted. Units with water storage tanks and/or additive injection shall be floor-mounted on steel skids on concrete foundations. Digital controls. Filtration system shall be Preferred Utilities Model PF1333-5XX series.

B. Performance: Design for nearly 100 percent water removal. Provide 2-micron particulate filtration. Each system shall have capacity to turn over the largest connected full tank one time within 11 hours maximum. System shall be designed to allow continuous operation with brief interruptions to manually change filters and clean strainers.

C. Components:
   1. Strainer: 100 mesh perforated stainless steel basket. Clamped covers. 861 kPa (125 psig) design pressure.
   2. Water Separation Unit: Two stage, designed to reduce water content of fuel to less than 10 ppm. Centrifugal separator for removal of large droplets and renewable resin-impregnated cellulose water coalescing elements. Water removed shall flow to water holding sump in the unit. Water sensing probe to alert the operator when water level in bowl has reached capacity. Automatic pumped drain to holding tank actuated by electronic water level sensing devices in the separation unit.
   3. Filter: 2-micron filtration with 96 percent removal efficiency, valved manual drain. Replaceable elements.
   4. Filtration Pump: Positive displacement base-mounted pump with cast iron or bronze housing, for circulating the oil from the storage tank, through the water separation and filter units and back to the storage tank. Pump shall have carbon bushings, stainless steel shaft and Teflon mechanical seal, ODP motor.
   5. Controls:
      a. The control strategy shall be microprocessor-based. RELAY LOGIC SHALL NOT BE ACCEPTABLE. The control strategy shall be factory configured and stored on an EEPROM, and shall be safeguarded against re-configuration by un-authorized or un-qualified personnel. Control hardware shall include combination magnetic motor starter with overload protection and circuit breaker.
      b. Operator interface shall be cabinet front door mounted and be presented by a 4.3” touch screen. Touch screen shall have a bright TFT display with full 256-color support. Image resolution shall be a minimum of 480 x 272 pixel display. As a minimum, the following indications, alarms, control switches and pushbuttons shall be provided. The control cabinet shall have the ability of simultaneously communicating to a Data Acquisition System (DAS), Building Automation System (BAS) or Building Management System (BMS) via RS485 Modbus protocol and to a Personal Computer.
      c. Controls shall include:
         1) Control power “on-off”.
         2) “Cycle Start”.
         3) “Cycle Cancel”.
         4) “Hand-off-Auto” for filtration pump.
         5) Pump cycle timer set function.
         6) Cycle duration selector.
      d. Indications shall include:
         1) “Control Power On”.
         2) “Pump Run”.
         3) “Pump Failure”.
         4) “Rupture Basin Leak” alarm.
         5) “High Pressure Drop in Strainer” alarm.
         6) “High Pressure Drop in Filters” alarm.
         7) “High Pressure” alarm and automatic shutdown.
      e. Filter and strainer differential pressure gauges, differential pressure switches and control. Provide indication when filters should be changed.
      f. Over pressure switch and control to shut down pump if filter inlet pressure exceeds limits.
      g. All primary wiring exiting the enclosure shall be encased in conduit.
      h. Magnetic motor starters with overload protection.

i. Circuit breakers.
j. Control enclosure shall be NEMA 4, fully gasketed doors with 3 point lockable latching. Interior shall have white gloss finish; exterior shall be chemical-resistant gray enamel. All controls and indicating devices shall be mounted on front of enclosure and labeled with black Phenolic labels with white lettering.
k. Modbus communication to engineering control systemfor alarms and system status.

D. Enclosure – Wall Mounted Units: 14-gauge steel, NEMA Type 4 enclosure, continuously welded, framed cabinet. Provide doors for complete access to all equipment. Doors shall have a turned edge, piano hinges, three-point locking mechanisms. Corrosion-resistant prime and finish coatings on all interior and exterior surfaces.

E. Waste Water Holding and Removal System. A gear pump shall automatically pump water from the secondary filter housing to a 15 gallon galvanized steel holding tank based on an integral filter water detector signal. Automatic isolating valves prevent water leakage into the fuel or fuel into the water holding tank when the system is idle. The holding tank is equipped with a high level switch to alarm and shutdown the fuel maintenance system until the tank is emptied. A hand pump is provided for periodic removal of waste water from the holding tank. Requires mounting skid. Preferred part number suffix-WR-01.

F. Chemical Additive Holding Tank & Injection System: Chemical treatment helps to prevent fuel degradation and improves cetane rating. Higher cetane rating improves cold starting, reduces white smoke, and maximizes engine efficiency. A gear metering pump injects additives into the oil while the oil is circulating in order to ensure complete mixing. The additive feed pump operating cycle runs biannually, or it can be activated when new fuel is delivered. A 15 gallon welded steel chemical additive holding tank is provided. Separate skid is ordered in conjunction with standard PF series. Preferred part number suffix CA-01.

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 INSTALLATION AND TESTING, ABOVEGROUND TANKS

A. Conform to NFPA 30 or NFPA 31 as applicable.

B. Support tanks on steel saddles welded to the tanks. Anchor to concrete foundations. Provide molded neoprene isolation pads between the steel supports and the concrete foundation.

C. After tanks are installed, test steel tanks with air pressure of 21 kPa to 34 kPa (3 to 5 psig), using soapsuds to locate leaks. Repair leaks by chipping to bare metal and rewelding. Retest until all leaks are repaired. Repair all damaged areas of prime coat on tanks and steel dikes (if furnished). Test interstitial area between steel tank walls with air at pressure recommended by tank manufacturer. Tests shall be witnessed by the COR.

D. For steel tanks storing heated oil, field-applied insulation requirements are specified under Section 23 07 11, HVAC AND BOILER PLANT INSULATION.

E. Surface finish coating for tanks and steel dikes (if furnished) is specified under Section 09 91 00, PAINTING.

F. Provide electrical grounding in accordance with NFPA 70.

3.3 INSTALLATION AND TESTING, LEAK DETECTOR SYSTEMS FOR TANKS AND PIPING

A. Wiring shall conform to NFPA 70.

B. Locate control monitor panels 1500 mm (5 feet) above the floor on inside wall of boiler room, generator room or garage, depending on type of fuel tank served, unless shown otherwise.

C. Test operation of each probe, and monitoring system with fuel and water. If type of probe utilized is damaged by exposure to fuel, provide temporary probe for testing monitoring system.

3.4 INSTALLATION, TANK FLUID LEVEL INDICATOR AND ALARM SYSTEM

A. Wiring shall conform to NFPA 70.

B. Locate level indicator and alarm panel 1500 mm (5 feet) above the floor on inside wall of boiler room, generator room or garage, depending on type of fuel tank served, unless shown otherwise.

C. Locate remote high-level alarm on exterior wall or pole in view of tank fill point, 2400 mm (8 feet) above grade.

3.5 INSTALLATION, FUEL OIL QUALITY MAINTENANCE SYSTEMS

A. Locate systems within easy reach of persons standing on floor, with sufficient elevation to allow gravity flow of water from system to water storage tank sitting on the floor.

B. Connect to tank suction and return piping systems with isolation valves. Provide compound pressure gauges at suction and discharge piping connections. Refer to Section 23 09 11, INSTRUMENTATION AND CONTROL FOR BOILER PLANT for gauge requirements.

3.6 STARTUP AND TESTING

A. Perform tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.

B. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.

C. The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with COR and Commissioning Agent. Provide a minimum notice of 10 working days prior to startup and testing.

3.7 INSTALLATION, CATHODIC PROTECTION TEST STATIONS

A. Provide separate station for each tank and each piping system, anchor firmly, locate so that terminal board is 600 mm (2 feet) minimum above grade. Connect wiring from all anodes and protected structures to the test stations.

3.8 TESTING, CATHODIC PROTECTION

A. Testing performed by NACE-certified corrosion specialist; witnessed by COR.

B. Test Instruments:
   1. Volt-Ammeter.
   2. Saturated copper-copper sulfate reference electrode.
   3. Other instruments as required.

C. Procedures: Conform to NACE SP0169.

D. Test Results Required for Acceptance:
   1. Potential of minus 0.85 volt between protected structure and reference electrode.
   2. Minimum shift of minus 300 millivolts upon application of protective current. Voltage measured between protected structure and reference electrode.
   3. Minimum shift of minus 100 millivolts upon interruption of protective current. Voltage measured between protected structure and reference electrode.

E. Test Report: Provide complete report to COR showing all test measurements, calculations, list of instruments used.

3.9 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.

3.10 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.

END OF SECTION

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 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 07 11, HVAC AND BOILER PLANT INSULATION.

G. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

H. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

I. Section 31 20 00, EARTHWORK: Excavation and backfill.

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(R18)	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 Gray Iron Castings for Valves, Flanges, and Pipe Fittings
A307-2021	Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength
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-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 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.
   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. All specified hydronic system components.

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. 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. 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.

H. 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, Condenser Water, Heating Hot Water, and Glycol-Water other than solar, 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 Fan Coil or Other 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: Carbon steel machine bolts or studs and nuts, ASTM A307, Grade B.

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:
   1. Solder Joints: Joints shall be made up in accordance with recommended practices of the materials applied. Apply 95/5 tin and antimony on all copper piping.
   2. Mechanically Formed Tee Connection In Water and Drain Piping: Form mechanically extracted collars in a continuous operation by drilling pilot hole and drawing out tube surface to form collar, having a height of not less than 3 times the thickness of tube wall. Adjustable collaring device shall ensure proper tolerance and complete uniformity of the joint. Notch and dimple joining branch tube in a single process to provide free flow where the branch tube penetrates the fitting.

B. Bronze Flanges and Flanged Fittings: ASME B16.24.

C. Fittings: ASME B16.18 cast copper or ASME B16.22 solder wrought copper.

2.5 FITTINGS FOR PLASTIC PIPING

A. Schedule 40, socket type for solvent welding.

B. Schedule 40 PVC Drain Piping: Drainage pattern.

C. Chemical Feed Piping for Condenser Water Treatment: CPVC, Schedule 80, ASTM F439.

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. Gate Valves:
      a. 50 mm (2 inches) and Smaller: MSS SP-80, Bronze, 1034 kPa (150 psig), wedge disc, rising stem, union bonnet.
      b. 63 mm (2-1/2 inches) and Larger: Flanged, outside screw and yoke. MSS SP-70, iron body, bronze mounted, 860 kPa (125 psig) wedge disc.
   4. 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. Ballor 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.
4. Provide a readout kit including flow meter, probes, hoses, flow charts and carrying case.

I. Manual Radiator/Convector Valves: Brass, packless, with position indicator.

2.9 STRAINERS

A. Basket orY 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.

2.10 FLEXIBLE CONNECTORS FOR WATER SERVICE

A. Flanged Spool Connector:
1. Single arch or multiple arch type. Tube and cover shall be constructed of chlorobutyl elastomer with full faced integral flanges to provide a tight seal without gaskets. Connectors shall be internally reinforced with high strength synthetic fibers impregnated with rubber or synthetic compounds as recommended by connector manufacturer, and steel reinforcing rings.
2. Working pressures and temperatures shall be as follows:
a. Connector sizes 50 mm to 100 mm (2 inches to 4 inches), 1137 kPa (165 psig) at 121 degrees C (250 degrees F).
b. Connector sizes 127 mm to 305 mm (5 inches to 12 inches), 965 kPa (140 psig) at 121 degrees C (250 degrees F).
3. Provide ductile iron retaining rings and control units.

B. Braided Hose: Corrugated-metal inner hose and braided outer shell.
1. Piping Up To 50 mm (2 inches): Bronze hoses and single-braid bronze sheaths with 3102 kPa at 21 degrees C (450 psig at 70 degrees F) and 2344 kPa at 232 degrees C (340 psig at 450 degrees F) ratings.
2. Piping From 65 mm (2-1/2 inches) To 100 mm (4 inches): Stainless-steel hoses and single-braid, stainless-steel sheaths with 2070 kPa at 21 degrees C (300 psig at 70 degrees F) and 1550 kPa at 232 degrees C (225 psig at 450 degrees F) ratings.

3. Piping From 150 mm (6 inches) and Above: Stainless-steel hoses and single-braid, stainless-steel sheaths with 1380 kPa at 21 degrees C (200 psig at 70 degrees F) and 1000 kPa at 315 degrees C (145 psig at 600 degrees F) ratings.

2.11 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.

2.12 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 and Glycol-Water: 0 to 38 degrees C (32 to 100 degrees F).
   2. Hot Water and Glycol-Water: 38 to 93 degrees C (100 to 200 degrees F).

2.13 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 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.

3.4 FLUSHING AND CLEANING PIPING SYSTEMS

A. Water Piping: Clean systems as recommended by the suppliers of chemicals specified in Section 23 25 00, HVAC WATER TREATMENT.

B. Initial Flushing: Remove loose dirt, mill scale, metal chips, weld beads, rust, and like deleterious substances without damage to any system component. Provide temporary piping or hose to bypass coils, control valves, exchangers and other factory cleaned equipment unless acceptable means of protection are provided and subsequent inspection of hide-out areas takes place. Isolate or protect clean system components, including pumps and pressure vessels, and remove any component which may be damaged. Open all valves, drains, vents and strainers at all system levels. Remove plugs, caps, spool pieces, and components to facilitate early debris discharge from system. Sectionalize system to obtain debris carrying velocity of 1.8 m/s (5.9 f/s), if possible. Connect dead-end supply and return headers as necessary. Flush bottoms of risers. Install temporary strainers where necessary to protect down-stream equipment. Supply and remove flushing water and drainage by various type hose, temporary and permanent piping and Contractor's booster pumps. Flush until clean as approved by the COR.

C. Cleaning: Using products supplied in Section 23 25 00, HVAC WATER TREATMENT, circulate systems at normal temperature to remove adherent organic soil, hydrocarbons, flux, pipe mill varnish, pipe joint compounds, iron oxide, and like deleterious substances not removed by flushing, without chemical or mechanical damage to any system component. Removal of tightly adherent mill scale is not required. Keep isolated equipment which is "clean" and where dead-end debris accumulation cannot occur. Sectionalize system if possible, to circulate at velocities not less than 1.8 m/s (5.9 f/s). Circulate each section for not less than 4 hours. Blow-down all strainers or remove and clean as frequently as necessary. Drain and prepare for final flushing.

D. Final Flushing: Return systems to conditions required by initial flushing after all cleaning solution has been displaced by clean make-up. Flush all dead ends and isolated clean equipment. Gently operate all valves to dislodge any debris in valve body by throttling velocity. Flush for not less than one hour.

3.5 STARTUP AND TESTING

A. Perform tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.

B. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.

C. The 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.

3.6 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

B. Components provided under this section of the specification will be tested as part of a larger system.

3.7 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer’s technical representative for 4hours 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.

END OF SECTION

SECTION 23 23 00
REFRIGERANT PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Field refrigerant piping for direct expansion HVAC systems.

B. Refrigerant piping shall be sized, selected, and designed either by the equipment manufacturer or in strict accordance with the manufacturer's published instructions. The schematic piping diagram shall show all accessories such as, stop valves, level indicators, liquid receivers, oil separator, gauges, thermostatic expansion valves, solenoid valves, moisture separators and driers to make a complete installation.

C. A complete listing of common acronyms and abbreviations are included in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

D. Definitions:
   1. Refrigerating system: Combination of interconnected refrigerant-containing parts constituting one closed refrigeration circuit in which a refrigerant is circulated for the purpose of extracting heat.
      a. Low side means the parts of a refrigerating system subjected to evaporator pressure.
      b. High side means the parts of a refrigerating system subjected to condenser pressure.
   2. Brazed joint: A gas-tight joint obtained by the joining of metal parts with alloys which melt at temperatures higher than 449 degrees C (840 degrees F) but less than the melting temperatures of the joined parts.

1.2 RELATED WORK

A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

B. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

C. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

D. Section 23 07 11, HVAC, and BOILER PLANT INSULATION.

E. Section 23 21 13, HYDRONIC PIPING.

F. Section 23 81 00, DECENTRALIZED UNITARY HVAC EQUIPMENT

G. Section 23 81 23, COMPUTER-ROOM AIR-CONDITIONERS

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 (ARI/AHRI):

495-2005	Standard for Refrigerant Liquid Receivers
730-2013	Flow Capacity Rating of Suction-Line Filters and Suction-Line Filter-Driers
750-2016	Thermostatic Refrigerant Expansion Valves
760-2014	Performance Rating of Solenoid Valves for Use with Volatile Refrigerants

C. American Society of Heating Refrigerating and Air Conditioning Engineers (ASHRAE):

15-2019	Safety Standard for Refrigeration Systems (ANSI)
17-2015	Method of Testing Capacity of Thermostatic Refrigerant Expansion Valves (ANSI)

63.2-2017	Method of Testing Liquid Line Filter Drier Filtration Capability (ANSI)

D. American National Standards Institute (ANSI):

A13.1-2020	Scheme for Identification of Piping Systems
Z535.1-2017	Safety Color Code

E. American Society of Mechanical Engineers (ASME):

B16.22-2018	Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings (ANSI)
B16.24-20016	Cast Copper Alloy Pipe Flanges and Flanged Fittings, Class 150, 300, 400, 600, 900, 1500 and 2500 (ANSI)
B31.5-2019	Refrigeration Piping and Heat Transfer Components (ANSI)
B40.100-2013	Pressure Gauges and Gauge Attachments
B40.200-2008	Thermometers, Direct Reading and Remote Reading

F. American Society for Testing and Materials (ASTM)

A126-2019	Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
B32-2020	Standard Specification for Solder Metal
B88-2020	Standard Specification for Seamless Copper Water Tube
B88M-2020	Standard Specification for Seamless Copper Water Tube (Metric)
B280-2020	Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service

G. American Welding Society, Inc. (AWS): Brazing Handbook

A5.8/A5.8M-2019	Standard Specification for Filler Metals for Brazing and Braze Welding

H. Underwriters Laboratories (UL):

207-2020	Standard for Refrigerant-Containing Components and Accessories, Nonelectrical
429-2021	Standard for Electrically Operated Valves

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 23 00, REFRIGERAN PIPING”, with applicable paragraph identification.

C. Shop Drawings:
   1. Complete information for components noted, including valves and refrigerant piping accessories, clearly presented, shall be included to determine compliance with in the contract documents for components noted below:
      a. Tubing and fittings
      b. Valves

c. Strainers
d. Moisture-liquid indicators
e. Filter-driers
f. Flexible metal hose
g. Liquid-suction interchanges
h. Oil separators (when specified)
i. Gauges
j. Pipe and equipment supports
k. Refrigerant and oil
l. Pipe/conduit roof penetration cover
m. Soldering and brazing materials

2. Layout of refrigerant piping and accessories, including flow capacities, valves locations, and oil traps slopes of horizontal runs, floor/wall penetrations, and equipment connection details.

D. Certification: Copies of certificates for welding procedure, performance qualification record and list of welders' names and symbols.

E. Design Manual: Furnish two copies of design manual of refrigerant valves and accessories.

1.5 QUALITY ASSURANCE

A. Refer to specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. Comply with ASHRAE Standard 15, Safety Code for Mechanical Refrigeration. The application of this Code is intended to assure the safe design, construction, installation, operation, and inspection of every refrigerating system employing a fluid which normally is vaporized and liquefied in its refrigerating cycle.

C. Comply with ASME B31.5: Refrigerant Piping and Heat Transfer Components.

D. Products shall comply with UL 207 "Refrigerant–Containing Components and Accessories, "Nonelectrical"; or UL 429 "Electrical Operated Valves."

1.6 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 PIPING AND FITTINGS

A. Refrigerant Piping: For piping up to 100 mm (4 inch) use Copper refrigerant tube, ASTM B280, cleaned, dehydrated and sealed, marked ACR on hard temper straight lengths. Coils shall be tagged ASTM B280 by the manufacturer. For piping over 100 mm (4 inch) use A53 Black SML steel.

B. Water and Drain Piping: Copper water tube, ASTM B88M, Type B or C (ASTM B88, Type M or L). Optional drain piping material: Schedule 80 flame retardant Polypropylene plastic.

C. Fittings, Valves and Accessories:
1. Copper fittings: Wrought copper fittings, ASME B16.22.
a. Brazed Joints, refrigerant tubing: Cadmium free, AWS A5.8/A5.8M, 45 percent silver brazing alloy, Class BAg-5.
b. Solder Joints, water and drain: 95-5 tin-antimony, ASTM B32 (95TA).
2. Steel fittings: ASTM wrought steel fittings.
a. Refrigerant piping – Welded Joints.
3. Flanges and flanged fittings: ASME B16.24.
4. Refrigeration Valves:
a. Stop Valves: Brass or bronze alloy, packless, or packed type with gas tight cap, frost proof, back seating.

b. Pressure Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; UL listed. Forged brass with nonferrous, corrosion resistant internal working parts of high strength, cast iron bodies conforming to ASTM A126, Grade B. Set valves in accordance with ASHRAE Standard 15.
c. Solenoid Valves: Comply with ARI 760 and UL 429, UL-listed, two-position, direct acting or pilot-operated, moisture and vapor-proof type of corrosion resisting materials, designed for intended service, and solder-end connections. Fitted with suitable NEMA 250 enclosure of type required by location and holding coil.
d. Thermostatic Expansion Valves: Comply with ARI 750. Brass body with stainless-steel or non-corrosive nonferrous internal parts, diaphragm and spring-loaded (direct-operated) type with sensing bulb and distributor having side connection for hot-gas bypass and external equalizer. Size and operating characteristics as recommended by manufacturer of evaporator and factory set for superheat requirements. Solder-end connections. Testing and rating in accordance with ASHRAE Standard 17.
e. Electronic Thermostatic Expansion Valves: Electronic thermal expansion valves shall be stepper motor high resolution drive assembly type for precision control. Valve shall not exceed 6 watts max consumption. Compatibility tested with most CFC, HCFC, and HFC refrigerants and oils. Valve pistons and ports to be characterized to provide improved flow resolution and performance. Valves to be interfaced with microprocessor-based controllers by devise manufacturer with temperature feedback loop. Electric expansion valves to be sized with nominal steps of stroke for tonnage application as recommended by valve manufacture ranging from 500 steps on small tonnage (under 5 tons per circuit) to 6300 on large tonnage circuits (over 100 tons per circuit)
f. Check Valves: Brass or bronze alloy with swing or lift type, with tight closing resilient seals for silent operation; designed for low pressure drop, and with solder-end connections. Direction of flow shall be legibly and permanently indicated on the valve body.

5. Strainers: Designed to permit removing screen without removing strainer from piping system, and provided with screens 80 to 100 mesh in liquid lines DN 25 (NPS 1) and smaller, 60 mesh in liquid lines greater than DN 25 (NPS 1), and 40 mesh in suction lines. Provide strainers in liquid line serving each thermostatic expansion valve, and in suction line serving each refrigerant compressor not equipped with integral strainer.
6. Refrigerant Moisture/Liquid Indicators: Double-ported type having heavy sight glasses sealed into forged bronze body and incorporating means of indicating refrigerant charge and moisture indication. Provide screwed brass seal caps.
7. Refrigerant Filter-Dryers: UL listed, angle or in-line type, as shown in the contract documents. Conform to ARI Standard 730. Heavy gauge steel shell protected with corrosion-resistant paint; perforated baffle plates to prevent desiccant bypass. Size as recommended by manufacturer for service and capacity of system with connection not less than the line size in which installed. Filter driers with replaceable filters shall be furnished with one spare element of each type and size.
8. Flexible Metal Hose: Seamless bronze corrugated hose, covered with bronze wire braid, with standard copper tube ends. Provide in suction and discharge piping of each compressor.

2.2 PIPE SUPPORTS

A. Refer to specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

2.3 REFRIGERANTS AND OIL

A. Provide EPA approved refrigerant and oil for proper system operation.

2.4 PIPE INSULATION FOR DX HVAC SYSTEMS

A. Refer to specification Section 23 07 11, HVAC, PLUMBING, and BOILER PLANT INSULATION.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install refrigerant piping and refrigerant containing parts in accordance with ASHRAE Standard 15 and ASME B31.5
   1. Install piping as short as possible, with a minimum number of joints, elbow and fittings.
   2. Install piping with adequate clearance between pipe and adjacent walls and hangers to allow for service and inspection. Space piping, including insulation, to provide 25 mm (1 inch) minimum clearance between adjacent piping or other surface. Use pipe sleeves through walls, floors, and ceilings, sized to permit installation of pipes with full thickness insulation.
   3. Locate and orient valves to permit proper operation and access for maintenance of packing, seat and disc. Generally locate valve stems in overhead piping in horizontal position. Provide a union adjacent to one end of all threaded end valves. Control valves usually require reducers to connect to pipe sizes shown in the contract documents.
   4. Use copper tubing in protective conduit when installed below ground.
   5. Install hangers and supports per ASME B31.5 and the refrigerant piping manufacturer's recommendations.

B. Joint Construction:
   1. Brazed Joints: Comply with AWS "Brazing Handbook" and with filler materials complying with AWS A5.8/A5.8M.
      a. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper tubing.
      b. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.
      c. Swab fittings and valves with manufacturer's recommended cleaning fluid to remove oil and other compounds prior to installation.
      d. Pass nitrogen gas through the pipe or tubing to prevent oxidation as each joint is brazed. Cap the system with a reusable plug after each brazing operation to retain the nitrogen and prevent entrance of air and moisture.

C. Protect refrigerant system during construction against entrance of foreign matter, dirt and moisture; have open ends of piping and connections to compressors, condensers, evaporators and other equipment tightly capped until assembly.

D. Pipe relief valve discharge to outdoors for systems containing greater than 45 kg (100 lbs) of refrigerant.

E. Firestopping: Fill openings around uninsulated piping penetrating floors or fire walls, with firestop material. For firestopping insulated piping refer to Section 23 07 11, HVAC, and BOILER PLANT INSULATION.

F. 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 PIPE AND TUBING INSULATION

A. Refer to specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. Apply two coats of weather-resistant finish as recommended by the manufacturer to insulation exposed to outdoor weather.

3.3 SIGNS AND IDENTIFICATION

A. Each refrigerating system erected on the premises shall be provided with an easily legible permanent sign securely attached and easily accessible, indicating thereon the name and address of the installer, the kind and total number of pounds of refrigerant required in the system for normal operations, and the field test pressure applied.

B. Systems containing greater than 50 kg (110 lb) of refrigerant shall be provided with durable signs, in accordance with ANSI A13.1 and ANSI Z535.1, having letters not less than 13 mm (1/2 inch) in height designating:
   1. Valves and switches for controlling refrigerant flow, the ventilation and the refrigerant compressor(s).
   2. Signs on all exposed high pressure and low pressure piping installed outside the machinery room, with name of the refrigerant and the letters "HP" or "LP."

3.4 FIELD QUALITY CONTROL

A. Prior to initial operation examine and inspect piping system for conformance to plans and specifications and ASME B31.5. Correct equipment, material, or work rejected because of defects or nonconformance with plans and specifications, and ANSI codes for pressure piping.

B. After completion of piping installation and prior to initial operation, conduct test on piping system according to ASME B31.5. Furnish materials and equipment required for tests. Perform tests in the presence of COR. If the test fails, correct defects and perform the test again until it is satisfactorily done and all joints are proved tight.
   1. Every refrigerant-containing parts of the system that is erected on the premises, except compressors, condensers, evaporators, safety devices, pressure gauges, control mechanisms and systems that are factory tested, shall be tested and proved tight after complete installation, and before operation.
   2. The high and low side of each system shall be tested and proved tight at not less than the lower of the design pressure or the setting of the pressure-relief device protecting the high or low side of the system, respectively, except systems erected on the premises using non-toxic and non-flammable Group A1 refrigerants with copper tubing not exceeding DN 18 (NPS 5/8). This may be tested by means of the refrigerant charged into the system at the saturated vapor pressure of the refrigerant at 20 degrees C (68 degrees F) minimum.

C. Test Medium: A suitable dry gas such as nitrogen or shall be used for pressure testing. The means used to build up test pressure shall have either a pressure-limiting device or pressure-reducing device with a pressure-relief device and a gauge on the outlet side. The pressure relief device shall be set above the test pressure but low enough to prevent permanent deformation of the system components.

3.5 SYSTEM TEST AND CHARGING

A. System Test and Charging: As recommended by the equipment manufacturer or as follows:
   1. Connect a drum of refrigerant to charging connection and introduce enough refrigerant into system to raise the pressure to 70 kPa (10 psig) gauge. Close valves and disconnect refrigerant drum. Test system for leaks with halide test torch or other approved method suitable for the test gas used. Repair all leaking joints and retest.
   2. Connect a drum of dry nitrogen to charging valve and bring test pressure to design pressure for low side and for high side. Test entire system again for leaks.
   3. Evacuate the entire refrigerant system by the triplicate evacuation method with a vacuum pump equipped with an electronic gauge reading in mPa (microns). Pull the system down to 665 mPa (500 microns) 665 mPa (2245.6 inches of mercury at 60 degrees F) and hold for 8 hours then break the vacuum with dry nitrogen (or refrigerant). Repeat the evacuation two more times breaking the third vacuum with the refrigeration to be charged and charge with the proper volume of refrigerant.

3.6 STARTUP AND TESTING

A. 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 7 days prior notice.

B. Provide services of manufacturer’s technical representative for four hours to instruct VA personnel in operation and maintenance of computer room air conditioning equipment.

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 CxA.

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 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer’s technical representative for 4 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 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

END OF SECTION

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.

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 08 90 00, LOUVERS and VENTS.

F. Section 22 11 00, FACILITY WATER DISTRIBUTION.

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 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

K. Section 23 34 00, HVAC FANS.

L. Section 23 36 00, AIR TERMINAL UNITS.

M. Section 23 40 00, HVAC AIR CLEANING DEVICES.

N. Section 23 73 00, INDOOR CENTRAL-STATION AIR-HANDLING UNITS.

O. 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. 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.

E. 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.

F. 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.

G. Duct Hangers and Supports: Refer to SMACNA Standards. Avoid use of trapeze hangers for round duct.

2.3 DUCT ACCESS DOORS, PANELS AND SECTIONS

A. Provide access doors, sized and located for maintenance work, upstream, in the following locations:
   1. Each duct mounted coil and humidifier.
   2. Each fire damper (for link service), smoke damper and automatic control damper.
   3. Each duct mounted smoke detector.
   4. For cleaning operating room supply air duct and kitchen hood exhaust duct, locate access doors at 6.1 m (20 feet) intervals and at each change in duct direction.

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.

2.4 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.

2.5 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.

2.6 FLEXIBLE AIR DUCT

A. General: Factory-fabricated, complying with NFPA 90A for connectors not passing through floors of buildings. Flexible ducts shall not penetrate any fire or smoke barrier which is required to have a fire resistance rating of one hour or more. Flexible duct length shall not exceed 1.5 m (5 feet). Provide insulated acoustical air duct connectors in supply air duct systems and elsewhere as shown.

B. Flexible ducts shall be listed by Underwriters Laboratories, Inc., complying with UL 181. Ducts greater than 203 mm (8 inches) in diameter shall be Class 1. Ducts less than 203 mm (8 inches) in diameter shall be Class 1 or Class 2.

C. Insulated Flexible Air Duct: Factory-fabricated including mineral fiber insulation with maximum C factor of 0.25 at 24 degrees C (75 degrees F) mean temperature, encased with a low permeability moisture barrier outer jacket, having a puncture resistance of not less than 50 Beach Units. Acoustic insertion loss shall not be less than 3 dB per 300 mm (foot) of straight duct, at 500 Hz, based on 152 mm (6 inch) duct, of 762 m/min (2500 fpm).

D. Application Criteria:
1. Temperature Range: -18 to 93 degrees C (0 to 200 degrees F) internal.
2. Maximum Working Velocity: 1219 m/min (4000 fpm).
3. Minimum Working Pressure, Inches of Water Gauge: 2500 Pa (10 inches WG) positive, 500 Pa (2 inches WG) negative.

E. Duct Clamps: 100 percent nylon strap, 80 kg (176 pounds) minimum loop tensile strength manufactured for this purpose or stainless-steel strap with cadmium plated worm gear tightening device. Apply clamps with sealant and as approved for UL 181, Class 1 installation.

F. 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.

2.7 9 FLEXIBLE DUCT CONNECTIONS

A. Where duct connections are made to fans, air terminal units, 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.

2.8 FIRESTOPPING MATERIAL

A. Refer to Section 07 84 00, FIRESTOPPING.

2.9 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.

2.10 DUCT MOUNTED TEMPERATURE SENSOR (AIR)

A. Refer to Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

2.11 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.

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 TESTING, ADJUSTING, AND BALANCING (TAB)

A. Refer to Section 23 05 93, TESTING, ADJUSTING, and BALANCING FOR HVAC.

3.3 OPERATING AND PERFORMANCE TESTS

A. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

END OF SECTION

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 23 05 11, COMMON WORK RESULTS FOR HVAC.

F. Section 23 05 93, TESTING, ADJUSTING, and BALANCING 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 73 00, INDOOR CENTRAL-STATION AIR-HANDLING UNITS.

J. 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. 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):

181-2017	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 ceiling fans.

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 PLENUM FAN

Plenum Fans – Single and/or Multiple Fans in an Array:

General: Fans shall be Class II (minimum) construction with single inlet, aluminum wheel and stamped air-foil aluminum bladed. The fan wheel shall be mounted on the directly-driven motor shaft in AMCA Arrangement 4. Fans shall be dynamically balanced and internally isolated to minimize the vibrations. Provide a steel inlet cone for each wheel to match with the fan inlet. Locate fan in the air stream to assure proper flow. The fan performance shall be rated in accordance with AMCA 210 or ASHRAE 51.

Allowable vibration tolerances for fan shall not exceed a self-excited vibration maximum velocity of 0.005 m/s (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. After field installation, compliance to this requirement shall be demonstrated with field test in accordance with Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC. Following fan assembly, the complete fan assembly balance shall be tested using an electronic balance analyzer with a tunable filter and stroboscope. Vibration measurements shall be taken on each motor bearing housing in the vertical, horizontal, and axial planes (5 total measurements, 2 each motor bearing and 1 axial).

The plenum fans shall be driven by variable speed drives with at least one back-up drive as shown in the design documents. Use of a drive with bypass is not permitted.

Multiple fans shall be installed in a pre-engineered structural frame to facilitate fan stacking. All fans shall modulate in unison, above or below the synchronous speed within the limits specified by the manufacturer, by a common control sequence. Staging of the fans is not permitted. Redundancy requirement shall be met by all operating fans in an array and without the provision of an idle standby fan.

Fan Accessories

Fan Isolation: Provide an automatic back draft damper to isolate the fan not in operation due to failure.

Fan Airflow Measurement: Provide an airflow measuring device integral to the fan to measure air volume within +/- 5 percent accuracy. The probing device shall not be placed in the airflow path to stay clear of turbulence and avoid loss of performance.

2.2 CENTRIFUGAL CEILING FANS

A. Steel housing, baked enamel finish, direct connected fan assembly, attached grille. Provide gravity back draft assembly, aluminum wall cap and bird or insect screen. Provide electric motor operated damper where indicated.

B. Acoustical Lining: 13 mm (1/2 inch) thick mineral fiber, dark finish. Comply with UL 181 for erosion.

C. Motor: Shaded pole or permanent split capacitor, sleeve bearings, supported by steel brackets in combination with rubber isolators.

D. Ceiling Grille, (Where indicated): White plastic egg crate design, 80 percent free area.

E. Control: Provide solid state speed control (located at unit) for final air balancing.

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.

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. 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.

3.4 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

B. Components provided under this section of the specification will be tested as part of a larger system.

3.5 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer's technical representative for 4 hours to instruct each VA personnel responsible in 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.

END OF SECTION

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 23 05 11, COMMON WORK RESULTS FOR HVAC.

F. Section 23 05 93, TESTING, ADJUSTING, and BALANCING 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 31 00, HVAC DUCTS and CASINGS.

J. Section 23 34 00, HVAC FANS

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. Samples: Provide one typical air terminal unit for approval by the COR. This unit will be returned to the Contractor after all similar units have been shipped and deemed acceptable at the job site.

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 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. 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. 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.
   2. Electric Heating Coils:
      a. AHRI certified, spiral fin type.
      b. Capacity: As indicated, based on scheduled data.
      c. Coil: Enclosed copper tube, aluminum finned element of coiled nickel-chrome resistance wire centered in tubes and embedded in refractory material. Exposed helical coil of nickel-chrome resistance wire with refractory ceramic support bushings will not be allowed.

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.

2.2 AIR TERMINAL UNITS (BOXES)

A. General: Factory-built, pressure independent units, factory set-field adjustable air flow rate, suitable for single duct applications. Use of dual-duct air terminal units is prohibited. Clearly show on each unit the unit number and factory set air volumes corresponding to the contract drawings. Section 23 05 93, TESTING, ADJUSTING, and BALANCING FOR HVAC work assumes factory set air volumes. Coordinate flow controller sequence and damper operation details with the contract drawings and Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC. All air terminal units shall be brand new products of the same manufacturer.

B. Capacity and Performance: The maximum capacity of a single terminal unit shall not exceed 566 Liters/second (1,200 cfm) with the exception of operating rooms and Cystoscopy rooms, which shall be served by a single air terminal unit at a maximum of 1,250 Liters/second (2,649 CFM).

C. Sound Power Levels: Acoustic performance of the air terminal units shall be based on the design noise levels for the spaces stipulated in Section 23 05 41, Noise and Vibration Control for HVAC Piping and Equipment. Equipment schedule shall show the sound power levels in all octave bands. Terminal sound attenuators shall be provided, as required, to meet the intent of the design.

D. Casing: Unit casing shall be constructed of galvanized steel no lighter than 0.85 mm (22 Gauge). Air terminal units serving the operating rooms and Cystoscopy rooms shall be fabricated without lining. Provide hanger brackets for attachment of supports.

1. Lining Material: Suitable to provide required acoustic performance, thermal insulation and prevent sweating. Meet the requirements of NFPA 90A and comply with UL 181 for erosion as well as ASTM C665 antimicrobial requirements. Insulation shall consist of 13 mm (1/2 inch) thick non-porous foil faced rigid fiberglass insulation of 4-lb/cu.ft, secured by full length galvanized steel z-strips which enclose and seal all edges. Tape and adhesives shall not be used. Materials shall be non-friable and with surfaces, including all edges, fully encapsulated and faced with perforated metal or coated so that the air stream will not detach material. No lining material is permitted in the boxes serving operating rooms and Cystoscopy rooms.
2. Access Panels (or doors): Provide panels large enough for inspection, adjustment and maintenance without disconnecting ducts, and for cleaning heating coils attached to unit, even if there are no moving parts. Panels shall be insulated to same standards as the rest of the casing and shall be secured and gasketed airtight. It shall require no tool other than a screwdriver to remove.
3. Total leakage from casing, not to exceed 2 percent of the nominal capacity of the unit when subjected to a static pressure of 750 Pa (3 inches WG), with all outlets sealed shut and inlets fully open.

E. Construct dampers and other internal devices of corrosion resisting materials which do not require lubrication or other periodic maintenance.

1. Damper Leakage: Not greater than 2 percent of maximum rated capacity, when closed against inlet static pressure of 1 kPa (4 inches WG).

F. Provide multi-point velocity pressure sensors with external pressure taps. Provide direct reading air flow rate table pasted to box.

G. Provide static pressure tubes.

H. Externally powered DDC variable air volume controller and damper actuator to be furnished under Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC for factory mounting on air terminal units. The DDC controller shall be electrically actuated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. 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.

END OF SECTION

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 08 90 00, LOUVERS and VENTS.

E. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

F. 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. Steel or aluminum except that all supply air outlets installed in operating rooms and Cystoscopy rooms shall be stainless-steel (see paragraph Operating Room Air Distribution Devices in this section). Use aluminum air outlets and inlets for facilities located in high-humidity areas. Exhaust air registers located in combination toilets and shower stalls shall be constructed from aluminum.. 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)
   2. 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.
   3. Supply Grilles: Same as registers but without the opposed blade damper.

D. Return and Exhaust Registers and Grilles: Provide opposed blade damper without removable key operator for registers.

1. Finish: Off-white baked enamel for ceiling mounted units. Wall units shall have a prime coat for field painting or shall be extruded aluminum with manufacturer's standard aluminum finish.
2. Standard Type: Fixed horizontal face bars set at 30 to 45 degrees, approximately 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. 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 (90 mph) or, in coastal areas.

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.

END OF SECTION

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 23 05 11, COMMON WORK RESULTS FOR HVAC.

E. 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.

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.

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, and rated efficiency.

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

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)	1.0
Maximum Recommended Change-Out Resistance (Inches WG)	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)	197	197	197
Dust Holding Capacity (Grams)	486	430	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)	2.0	2.0	2.0
Maximum Recommended Change-Out Resistance (Inches WG)	0.74	0.68	0.54

Rated Initial Resistance (Inches WG)	0.37	0.34	0.27

2.5 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. 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. Equipment Identification: Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

2.6 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. 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.

2.7 HVAC EQUIPMENT FACTORY FILTERS

A. Manufacturer standard filters within fabricated packaged equipment should be specified with the equipment and should adhere to industry standard.

B. Cleanable filters are prohibited.

C. Automatic roll type filters are prohibited.

2.8 FILTER RETURN GRILLES

A. Refer to Section 23 37 00, AIR OUTLETS AND INLETS.

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.

END OF SECTION

SECTION 23 73 00
INDOOR CENTRAL-STATION AIR-HANDLING 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 handling units including integral components specified herein.

C. Definition of Air Handling Unit (AHU): A factory-fabricated and tested assembly of modular sections consisting ofsingle or multiple plenum fans with direct-drive, coils, filters, and other necessary equipment to perform one or more of the following functions of circulating, cleaning, heating, cooling, humidifying, dehumidifying, and mixing of air. Design capacities of units shall be as scheduled 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 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 12, GENERAL MOTOR REQUIREMENTS FOR HVAC AND STEAM GENERATION 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 08 00, COMMISSIONING OF HVAC SYSTEMS.

L. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

M. Section 23 21 13, HYDRONIC PIPING.

N. Section 23 31 00, HVAC DUCTS and CASINGS.

O. Section 23 34 00, HVAC FANS.

P. Section 23 40 00, HVAC AIR CLEANING DEVICES.

Q. 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. Where conflicts occur these specifications and the VHA standards will govern.

B. Air-Conditioning, Heating, and Refrigeration Institute (AHRI):

260-2017	Sound Rating of Ducted Air Moving and Conditioning Equipment
410-2001	Forced-Circulation Air-Cooling and Air-Heating Coils with Addenda 1, 2 and 3
430-2020	Performance Rating of Central Station Air Handling Unit Supply Fans

C. Air Movement and Control Association International, Inc. (AMCA):

99-2016	Standards Handbook
210-2016	Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating

D. American Bearing Manufacturers Association (ABMA):

9-2015(R2020)	Load Ratings and Fatigue Life for Ball Bearings

E. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE):

51-2016	Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating
170-2021	Ventilation of Health Care Facilities

F. 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
B117-2019	Standard Practice for Operating Salt Spray (Fog) Apparatus
D1654-2008(R2016)e1	Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
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

G. Energy Policy Act of 2005 (P.L.109-58)

H. Military Specifications (Mil. Spec.):

P-21035B-2021	Paint, High Zinc Dust Content, Galvanizing Repair (Metric)

I. National Fire Protection Association (NFPA):

70-2020	National Electrical Code
90A-2021	Standard for Installation of Air Conditioning and Ventilating Systems

J. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):

016-2012	HVAC Air Duct Leakage Test Manual, 2nd 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 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. Submittals for AHUs shall include fans, drives, motors, coils, mixing box with outside/return air dampers, filter housings, and all other related accessories. The contractor shall provide custom drawings showing total air handling unit assembly including dimensions, operating weight, access sections, flexible connections, door swings, controls penetrations, electrical disconnect, lights, duplex receptacles, switches, wiring, utility connection points, unit support system, vibration isolators, drain pan, pressure drops through each component (filter, coil etc).
   2. Submittal drawings of section or component only will not be acceptable. Contractor shall also submit performance data including performance test results, charts, curves, or certified computer selection data; data sheets; fabrication and insulation details. If the unit cannot be shipped in one piece, the contractor shall indicate the number of pieces that each unit will have to be broken into to meet shipping and job site rigging requirements.
   3. Submit sound power levels in each octave band for the inlet and discharge of the fan and at entrance and discharge of AHUs at scheduled conditions. In absence of sound power ratings refer to Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.
   4. Provide fan curves showing Liters/Second (cubic feet per minute), static pressure, efficiency, and horsepower for design point of operation and at maximum design Liters/Second (cubic feet per minute).
   5. Submit total fan static pressure, external static pressure, for AHU including total, inlet and discharge pressures, and itemized specified internal losses and unspecified internal losses. Refer to air handling unit schedule in the contract documents.

D. Submit written test procedures two weeks prior to factory testing. Submit written results of factory tests for approval prior to shipping.

E. Submit shipping information that clearly indicates how the units will be shipped in compliance with the descriptions below.
   1. Units shall be shipped in one (1) piece where possible and in shrink wrapping to protect the unit from dirt, moisture and/or road salt.
   2. If not shipped in one (1) piece, provide manufacturer approved shipping splits where required for installation or to meet shipping and/or job site rigging requirements in modular sections. Indicate clearly that the shipping splits shown in the submittals have been verified to accommodate the construction constraints for rigging as required to complete installation and removal of any section for replacement through available access without adversely affecting other sections.
   3. If shipping splits are provided, each component shall be individually shrink wrapped to protect the unit and all necessary hardware (e.g., bolts, gaskets etc.) will be included to assemble unit onsite.
   4. Lifting lugs will be provided to facilitate rigging on shipping splits and joining of segments. If the unit cannot be shipped in one piece, the contractor shall indicate the number of pieces that each unit will have to be broken into to meet shipping and job site rigging requirements.

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 instructions for lubrication, filter replacement, motor and drive replacement, and spare parts list.
   3. Include complete diagrams of the internal wiring for each item of equipment.
   4. Diagrams shall have their terminals identified to facilitate installation, operation, and maintenance.

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 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

H. 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. Comply with requirements in paragraph QUALITY ASSURANCE of Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. Air Handling Units Certification:
   1. Air Handling Units with Housed Centrifugal Fans: The air handling units shall be certified in accordance with AHRI 430 and tested/rated in accordance with AHRI 260.
   2. Air Handling Units with Plenum Fans:
      a. Air Handling Units with a single Plenum Fan shall be certified in accordance with AHRI 430 and tested/rated in accordance with AHRI 260.
      b. Air handling Units with Multiple Fans in an Array shall be tested and rated in accordance with AHRI 430 and AHRI 260.

C. Heating, Cooling, and Air Handling Capacity and Performance Standards: AHRI 430, AHRI 410, ASHRAE 51, and AMCA 210.

D. Performance Criteria:
   1. The fan BHP shall include all system effects for all fans and v-belt drive losses for housed centrifugal fans.
   2. The fan motor shall be selected within the rated nameplate capacity, without relying upon NEMA Standard Service Factor.
   3. 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 Fans Including Plenum Fans: At or near the peak static efficiency but at an appropriate distance from the stall line.
   4. Operating Limits: AMCA 99 and manufacturer’s recommendations.

E. Units shall be factory-fabricated, assembled, and tested by a manufacturer, in business of manufacturing similar air-handling units for at least five (5) years.

F. Bio-Based Materials: For products designated by the USDA’s Bio-Preferred Program, provide products that meet or exceed USDA recommendations for bio-based content, so long as products meet all performance requirements in this specifications section. For more information regarding the product categories covered by the Bio-Preferred Program, visit http://www.biopreferred.gov.

G. 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 AIR HANDLING UNITS

A. General:
   1. AHUs shall be fabricated from insulated, solid double-wall galvanized steel without any perforations in draw-through configuration. Galvanizing shall be hot dipped conforming to ASTM A653/A653M and shall provide a minimum of 0.275 kg of zinc per square meter (0.97 oz. of zinc per square foot) (G90). Aluminum constructed units, subject to VA approval, may be used in place of galvanized steel. The unit manufacturer shall provide published documentation confirming that the structural rigidity of aluminum air-handling units is equal or greater than the specified galvanized steel.

2. The contractor and the AHU manufacturer shall be responsible for ensuring that the unit will not exceed the allocated space shown in the contract documents, including required clearances for service and future overhaul or removal of unit components. All structural, piping, wiring, and ductwork alterations of units, which are dimensionally different than those specified, shall be the responsibility of the contractor at no additional cost or time to the Government.
3. AHUs shall be fully assembled by the manufacturer in the factory in accordance with the arrangement shown in the contract documents. The unit shall be assembled into the largest sections possible subject to shipping and rigging restrictions. The correct fit of all components and casing sections shall be verified in the factory for all units prior to shipment. All units shall be fully assembled, tested, and then split to accommodate shipment and job site rigging. On units not shipped fully assembled, the manufacturer shall tag each section and include air flow direction to facilitate assembly at the job site. Lifting lugs or shipping skids shall be provided for each section to allow for field rigging and final placement of unit.
4. The AHU manufacturer shall provide the necessary gasketing, caulking, and all screws, nuts, and bolts required for assembly. The manufacturer shall provide a factory-trained and qualified local representative at the job site to supervise the assembly and to assure that the units are assembled to meet manufacturer's recommendations and requirements noted in the contract documents. Provide documentation to the Contracting Officer that the local representative has provided services of similar magnitude and complexity on jobs of comparable size. If a local representative cannot be provided, the manufacturer shall provide a factory representative.
5. Gaskets: All door and casing and panel gaskets and gaskets between air handling unit components, if joined in the field, shall be high quality which seal airtight and retain their structural integrity and sealing capability after repeated assembly and disassembly of bolted panels and opening and closing of hinged components. Bolted sections may use a more permanent gasketing method provided they are not disassembled.
6. Structural Rigidity: Provide structural reinforcement when required by span or loading so that the deflection of the assembled structure shall not exceed 1/200 of the span based on a differential static pressure of 2000 Pa (8 inch WG) or higher.

B. Base:
1. Provide a heavy duty steel base for supporting all major AHU components. Bases shall be constructed of wide-flange steel I-beams, channels, or minimum 127 mm (5 inch) high 3.5 mm (10 Gauge) steel base rails. Welded or bolted cross members shall be provided as required for lateral stability. Contractor shall provide supplemental steel supports as required to obtain proper operation heights for cooling coil condensate drain trap as shown in the contract documents.
2. AHUs shall be completely self-supporting for installation on concrete housekeeping pad, steel support pedestals, or suspended as shown in the contract documents.
3. The AHU bases not constructed of galvanized steel shall be cleaned, primed with a rust inhibiting primer, and finished with rust inhibiting exterior enamel.

C. Casing (Including Wall, Floor, and Roof):
1. General: AHU casing shall be constructed as solid double wall, galvanized steel insulated panels without any perforations, integral of or attached to a structural frame. The thickness of insulation, mode of application and thermal breaks shall be such that there is no visible condensation on the exterior panels of the AHU located in the non-conditioned spaces.
2. Casing Construction:

Outer Panel	0.8 mm (22 Gauge) Minimum
Inner Panel	0.8 mm (22 Gauge) Minimum
Insulation	Foam

Thickness Density	50 mm (2 inch) Minimum 48 kg/m3 (3.0 lb/ft3) Minimum
Total R Value	2.3 m2.K/W (13.0 ft2.OF.hr/Btu) Minimum

3. Casing Construction (Contractor's Option):

Outer Panel	1.3 mm (18 Gauge) Minimum
Inner Panel	1.0 mm (20 Gauge) Minimum
Insulation Thickness Density	Fiberglass 50 mm (2 inch) Minimum 24 kg/m3 (1.5 lb/ft3) Minimum
Total R Value	1.4 m2.K/W (8.0 ft2.OF.hr/Btu) Minimum

4. Blank-Off: Provide blank-offs as required to prevent air bypass between the AHU sections, around coils, and filters.

5. Casing panels shall be secured to the support structure with stainless-steel or zinc-chromate plated screws and gaskets installed around the panel perimeter. Panels shall be completely removable to allow removal of fan, coils, and other internal components for future maintenance, repair, or modifications. Welded exterior panels are prohibited.

6. Access Doors: Provide in each access section and where shown in the contract documents. Show single-sided and double-sided access doors with door swings on the floor plans. Doors shall be a minimum of 50 mm (2 inch) thick with same double wall construction as the unit casing. Doors shall be a minimum of 610 mm (24 inches) wide, unless shown of different size in the contract documents, and shall be the full casing height up to a maximum of 1829 mm (6 feet). Doors shall be gasketed, hinged, and latched to provide an airtight seal. The access doors for fan section, mixing box, coil section shall include a minimum 152 mm x 152 mm (6 inch x 6 inch) double thickness, with air space between the glass panes tightly sealed, reinforced glass or Plexiglas window in a gasketed frame.

a. Hinges: Manufacturer's standard, designed for door size, weight and pressure classifications. Hinges shall hold door completely rigid with minimum 45 kg (100 lb) weight hung on latch side of door.
b. Latches: Non-corrosive alloy construction, with operating levers for positive cam action, operable from either inside or outside. Doors that do not open against unit operating pressure shall allow the door to ajar and then require approximately 0.785 radian (45 degrees) further movement of the handle for complete opening. Latch shall be capable of restraining explosive opening of door with a force not less than 2000 Pa (8 inch WG).
c. Gaskets: Neoprene, continuous around door, positioned for direct compression with no sliding action between the door and gasket. Secure with high quality mastic to eliminate possibility of gasket slipping or coming loose.

7. Provide sealed sleeves, metal or plastic escutcheons or grommets for penetrations through casing for power and temperature control wiring and pneumatic tubing. Coordinate with electrical and temperature control subcontractors for number and location of penetrations. Coordinate lights, switches, and duplex receptacles and disconnect switch location and mounting. All penetrations and equipment mounting may be provided in the factory or in the field. All field penetrations shall be performed neatly by drilling or saw cutting. No cutting by torches will be allowed. Neatly seal all openings airtight.

D. Floor:
   1. Unit floor shall be level without offset space or gap and designed to support a minimum of 488 kg/square meter (91 lbs per square foot) distributed load without permanent deformation or crushing of internal insulation. Provide adequate structural base members beneath floor in service access sections to support typical service foot traffic and to prevent damage to unit floor or internal insula tion. Unit floors in casing sections, which may contain water or condensate, shall be watertight with drain pan.
   2. Where indicated, furnish and install floor drains flush with the floor, with nonferrous grate cover and stub through floor for external connection.

E. Condensate Drain Pan: Drain pan shall be designed to extend entire length of cooling coils including headers and return bends. Depth of drain pan shall be at least 43 mm (1.7 inches) and shall handle all condensate without overflowing. Drain pan shall be double-wall, double sloping type, and fabricated from stainless-steel (304) with at least 50 mm (2 inch) thick insulation sandwiched between the inner and outer surfaces. Drain pan shall be continuous metal or welded watertight. No mastic sealing of joints exposed to water will be permitted. Drain pan shall be placed on top of casing floor or integrated into casing floor assembly. Drain pan shall be pitched in all directions to drain line.
   1. An intermediate, stainless-steel (304) condensate drip pan with copper downspouts shall be provided on stacked cooling coils. Use of intermediate condensate drain channel on upper casing of lower coil is permissible provided it is readily cleanable. Design of intermediate condensate drain shall prevent upper coil condensate from flowing across face of lower coil.
   2. Drain pan shall be piped to the exterior of the unit. Drain pan shall be readily cleanable.
   3. Installation, including frame, shall be designed and sealed to prevent blow-by.

F. Housed Centrifugal Fan Sections:
   1. Fans shall be minimum Class II construction, double width, double inlet centrifugal, air foil or backward inclined type as indicated in the contract documents, factory balanced and rated in accordance with AMCA 210 or ASHRAE 51. Provide self-aligning, pillow block, regreasable ball-type bearings selected for a B (10) life of not less than 50,000 hours and an L (50) average fatigue life of 200,000 hours per ABMA 9. Extend bearing grease lines to motor and drive side of fan section. Fan shall be located in airstream to assure proper air flow.
   2. Provide internally vibration isolated fan, motor and drive, mounted on a common integral bolted or welded structural steel base with adjustable motor slide rail with locking device. Provide vibration isolators and flexible duct connections at fan discharge to completely isolate fan assembly. Refer to Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT, for additional requirements.
   3. Allowable vibration tolerances for fan shall not exceed a self-excited vibration maximum velocity of 0.005 m/s (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. After field installation, compliance to this requirement shall be demonstrated with field test in accordance with Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT and Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC. Following fan assembly, the complete fan assembly balance shall be tested using an electronic balance analyzer with a tunable filter and stroboscope. Vibration measurements shall be taken on each motor bearing housing in the vertical, horizontal, and axial planes (5 total measurements, 2 each motor bearing and 1 axial).

G. Fan Motor, Drive, and Mounting Assembly (Housed Centrifugal Fans):
   1. Fan Motor and Drive: Motors shall be premium energy efficient type, as mandated by the Energy Policy Act of 2005, with efficiencies as shown in Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC AND STEAM GENERATION, in the contract

documents and suitable for use in variable frequency drive applications on AHUs where this type of drive is indicated. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC, for additional motor and drive specifications. Refer to Section 26 29 11, MOTOR CONTROLLERS.

2. Fan drive and belts shall be factory mounted with final alignment and belt adjustment to be made by the Contractor after installation. Drive and belts shall be as specified in Section 23 05 11, COMMON WORK RESULTS FOR HVAC. Provide additional drive(s) if required during balancing, to achieve desired airflow.

H. Fan Motor and Drive (Plenum Fans): Motors shall be premium energy efficient type, as mandated by the Energy Policy Act of 2005, with efficiencies as shown in Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC AND STEAM GENERATION EQUIPMENT, in the contract documents and suitable for use in variable frequency drive applications. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC, for additional motor and drive specifications. Refer to Section 26 29 11, MOTOR CONTROLLERS.

I. Filter Section: Refer to Section 23 40 00, HVAC AIR CLEANING DEVICES, for filter requirements.

1. Filters including one complete set for temporary use at site shall be provided independent of the AHU. The AHU manufacturer shall install filter housings and racks in filter section compatible with filters furnished. The AHU manufacturer shall be responsible for furnishing temporary filters (pre-filters and after-filters, as shown in the contract documents) required for AHU testing.
2. Factory-fabricated filter section shall be of the same construction and finish as the AHU casing including filter racks and hinged double wall access doors. Filter housings shall be constructed in accordance with side service or holding frame housing requirements in Section 23 40 00, HVAC AIR CLEANING DEVICES.

J. Coils: Coils shall be mounted on hot dipped galvanized steel supports to assure proper anchoring of coil and future maintenance. Coils shall be face or side removable for future replacement thru the access doors or removable panels. Each coil shall be removable without disturbing adjacent coil. Cooling coils shall be designed and installed to ensure no condensate carry over. Provide factory-installed extended supply, return, drain, and vent piping connections. All coils in the high humidity areas, shall be epoxy-coated as shown below. Refer to the contract documents and Section 23 82 16, AIR COILS for additional coil requirements.

1. Epoxy Immersion Coating – Electrically Deposited: The multi-stage corrosion-resistant coating application comprises of cleaning (heated alkaline immersion bath) and reverse-osmosis immersion rinse prior to the start of the coating process. The coating thickness shall be maintained between 0.6-mil and 1.2-mil. Before the coils are subjected to high-temperature oven cure, they are treated to permeate immersion rinse and spray. Where the coils are subject to UV exposure, UV protection spray treatment comprising of UV-resistant urethane mastic topcoat shall be applied. Provide complete coating process traceability for each coil and minimum five years of limited warranty.
2. The coating process shall such that uniform coating thickness is maintained at the fin edges. The quality control shall be maintained by ensuring compliance to the applicable ASTM Standards for the following:
    a. Salt Spray Resistance (Minimum 6,000 Hours)
    b. Humidity Resistance (Minimum 1,000 Hours)
    c. Water Immersion (Minimum 260 Hours)
    d. Cross-Hatch Adhesion (Minimum 4B-5B Rating)
    e. Impact Resistance (Up to 160 Inch/Pound)

K. Discharge Section: Provide aerodynamically designed framed discharge openings or spun bellmouth fittings to minimize pressure loss.

L. Electrical and Lighting: Wiring and equipment specifications shall conform to Division 26, ELECTRICAL.

1. Vapor-proof lights using cast aluminum base style with glass globe and cast aluminum guard shall be installed in access sections for fan, mixing box, and any section over 305 mm (12 inch) wide. A switch shall control the lights in each compartment with pilot light mounted outside the respective compartment access door. Wiring between switches and lights shall be factory-installed. All wiring shall run in neatly installed electrical conduits and terminate in a junction box for field connection to the building system. Provide single point 115 volt - one phase connection at junction box.
2. Install compatible LED bulb in each light fixture.
3. Provide a convenience duplex receptacle next to the light switch.
4. Disconnect switch and power wiring: Provide factory or field mounted disconnect switch. Coordinate with Division 26, ELECTRICAL.
5. Provide single point power connection. Coordinate with Division 26, ELECTRICAL.

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 air handling unit in conformance with AHRI 430.

C. Assemble air handling unit components following manufacturer's instructions for handling, testing and operation. Repair damaged galvanized areas with paint in accordance with Mil. Spec. P-21035B. Repair painted units by touch up of all scratches with finish paint material. Vacuum the interior of air handling units clean prior to operation.

D. Leakage and test requirements for air handling units shall be the same as specified for ductwork in Section 23 31 00, HVAC DUCTS AND CASINGS except leakage shall not exceed Leakage Class (CL) 12 listed in SMACNA HVAC Air Duct Leakage Test Manual when tested at 1.5 times the design static pressure. Repair casing air leaks that can be heard or felt during normal operation and to meet test requirements.

E. Perform field mechanical (vibration) balancing in accordance with Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.

F. Seal and/or fill all openings between the casing and AHU components and utility connections to prevent air leakage or bypass.

3.2 STARTUP AND TESTING

A. The air handling unit shall not be operated for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings are lubricated, and the fan has been test run under observation.

B. After the air handling unit is installed and tested, provide startup and operating instructions to VA personnel.

C. An authorized factory representative should startup, test, and certify the final installation and application specific calibration of control components. Items to be verified include fan performance over entire operating range, noise and vibration testing, verification of proper alignment, overall inspection of the installation, Owner/Operator training, etc.

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.

END OF SECTION

SECTION 23 81 00
DECENTRALIZED UNITARY HVAC EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies] split-systems].

B. A complete listing of common acronyms and abbreviations are included in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

C. Definitions:
   1. Energy Efficiency Ratio (EER): The ratio of net cooling capacity is Btu/h to total rate of electricity input in watts under designated operating conditions (Btu hour/Watt).
   2. Seasonal Energy Efficiency Ratio (EER): The ratio of the total cooling output of an air conditioner during its normal annual usage period for cooling in Btu/h divided by total electric energy input in watts during the same period (Btu hour/Watt).
   3. Unitary: A Unitary Air Conditioner consists of one or more factory-made assemblies which normally include an evaporator or cooling coil, a compressor and condenser combination, and may include a heating function as well.
   4. Where such equipment is provided in greater than one assembly the separated assemblies are to be designed to be used together and the requirements of rating are based upon use of matched assemblies.

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 03 30 00, CAST-IN-PLACE CONCRETE.

E. Section 07 72 00, ROOF ACCESSORIES.

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 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 23 00, REFRIGERANT PIPING.

M. Section 23 31 00, HVAC DUCTS and CASINGS.

N. Section 23 36 00, AIR TERMINAL UNITS.

O. Section 23 73 00, INDOOR CENTRAL-STATION AIR-HANDLING UNITS.

P. Section 23 81 23, COMPUTER-ROOM AIR-CONDITIONERS.

1.3 SUBMITTALS

A. Submit in accordance with specification 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 81 00, DECENTRALIZED UNITARY HVAC EQUIPMENT”, with applicable paragraph identification.

C. Manufacturer’s literature and data Including:

1. Sufficient information, including capacities, pressure drops, and piping connections clearly presented, shall be included to determine compliance with contract documents for units noted below:
    a. Unitary air conditioners:
        1) Split systems
2. Unit Dimensions required clearances, operating weights accessories and start-up instructions.
3. Electrical requirements, wiring diagrams, interlocking and control wiring showing factory installed and portions to be field installed.
4. Mounting and flashing of the roof curb to the roofing structure with coordinating requirements for the roof membrane system.

D. Certification: Submit proof of specified ARI Certification.

E. Performance Rating: Submit catalog selection data showing equipment ratings and compliance with required sensible-to-heat-ratio, integrated energy efficiency ratio (IEER), and coefficient of performance (COP).

F. Operating and Maintenance Manual: Submit three copies of Operating and Maintenance manual to COR three weeks prior to final inspection.

G. Completed System Readiness Checklists 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.

1.4 QUALITY ASSURANCE

A. Refer to specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. Safety Standards: ASHRAE Standard 15, Safety Code for Mechanical Refrigeration.

1.5 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Where conflicts occur these specifications and the VHA standards will govern.

B. Air-Conditioning, Heating, and Refrigeration Institute (AHRI):

210/240-2023(2020)	Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment
270-2015	Sound Rating of Outdoor Unitary Equipment
310/380-2017	Standard for Packaged Terminal Air-Conditioners and Heat Pumps (CSA-C744-04)
340/360-(I-P 2019)	Performance Rating of Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment
520-2004	Performance Rating of Positive Displacement Condensing Units

C. Air Movement and Control Association (AMCA):

210-2016	Laboratory Methods of Testing Fans for Aerodynamic Performance Rating (ANSI)
410-1996	Recommended Safety Practices for Users and Installers of Industrial and Commercial Fans

D. American National Standards Institute (ANSI):

S12.51-2012(R2020)	Acoustics - Determination of Sound Power Levels of Noise Sources Using Sound Pressure - Precision Method for Reverberation Rooms (same as ISO 3741:1999)

E. American Society of Civil Engineers (ASCE)

ASCE 7-2017	Minimum Design Loads for Buildings and Other Structures

F. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE):

Handbook 2016	HVAC Systems and Equipment
15-2019	Safety Standard for Refrigeration Systems (ANSI)
62.1-2019	Ventilation for Acceptable Indoor Air Quality (ANSI)

G. American Society of Testing and Materials (ASTM):

B117-2019	Standard Practice for Operating Salt Spray (Fog) Apparatus

H. Military Specifications (Mil. Specs.):

MIL-PRF-26915D-2006	Primer Coating, for Steel Surfaces

I. National Electrical Manufacturer's Association (NEMA):

ICS 1-2005	Industrial Controls and Systems: General Requirements
MG 1-2016 (R2019)	Motors and Generators (ANSI)

J. National Fire Protection Association (NFPA) Publications:

90A-2021	Standard for the Installation of Air-Conditioning and Ventilating Systems

1.6 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 UNITARY AIR CONDITIONERS - GENERAL

A. Applicable ARI Standards:
   1. Cooling Capacity 39.6 kW (135,000 Btu/hour) and greater: AHRI 340/ 360.
   2. Cooling Capacity Less Than 39.6 kW (135,000 Btu/hour): AHRI 210/240. Units shall be listed in the ARI Directory of Certified Unitary Air-Conditioners.

B. Performance Rating: Cooling capacity of units shall meet the sensible heat and total heat requirements shown in the contract documents. In selecting unit size, make true allowance for "sensible to total heat ratio" to satisfy required sensible cooling capacity.

C. Machinery Guards: 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. Drive guards may be excluded where motors and drives are inside factory fabricated casings.

D. Corrosion Prevention: Unless specified otherwise, equipment fabricated from ferrous metals that do not have a zinc coating or a duplex coating of zinc and paint shall be treated for prevention of rust with a factory coating or paint system that will withstand 125 hours in a salt-spray fog test, except that equipment located outdoors shall be tested for 500 hours. The salt-spray fog test shall be in accordance with ASTM B117 using a 20 percent sodium chloride

solution. Immediately after completion of the test, the coating shall show no signs of blistering, wrinkling or cracking, no loss of adhesion, and the specimen shall show no signs of rust beyond 3 mm (1/8-inch) on both sides from the scratch mark. Provide factory-coated coils for protection from corrosion by using multiple stage electro-deposition coating process.

2.2 SPLIT-SYSTEM AIR CONDITIONERS

A. Description: Factory assembled and tested, floor-mounted or wall-mounted unit, with an air-cooled remote condensing unit, and field-installed refrigeration piping.

B. Concealed Evaporator Components:
   1. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
   2. Insulation: Factory-applied duct liner.
   3. Drain Pans: Galvanized steel, with connection for drain; insulated and complying with ASHRAE 62.1.
   4. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
   5. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with AHRI 210/240, and with thermal-expansion valve.
   6. Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.
   7. Fan Motors: Comply with requirements in Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC and STEAM GENERATION EQUIPMENT for multi-tapped, multi-speed motors with internal thermal protection and permanent lubrication.
   8. Disposable Filters: 25 mm (1 inch) thick, in fiberboard frames with MERV rating of 7 or higher according to ASHRAE 52.2.
   9. Wiring Terminations: Connect motor to chassis wiring with plug connection.

C. Floor-Mounting, Evaporator-Fan Components:
   1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect.
   2. Discharge Grille: Steel with surface-mounted frame welded steel bars forming a linear grille and welded into supporting panel .
   3. Insulation: Factory-installed duct liner.
   4. Drain Pans: Galvanized steel, with connection for drain; insulated and complying with ASHRAE 62.1.
   5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
   6. Coils:
      a. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with AHRI 210/240, and with thermal-expansion valve.
   7. Fan: Direct drive, centrifugal.
   8. Fan Motors: Comply with requirements in Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC and STEAM GENERATION EQUIPMENT for multi-tapped, multi-speed motors with internal thermal protection and permanent lubrication.
   9. Filters: Disposable, with MERV rating of 7 or higher according to ASHRAE 52.2.

D. Wall-Mounting, Evaporator-Fan Components:
   1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.
   2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
   3. Drain Pan and Drain Connection: Comply with ASHRAE 62.1-2007.
   4. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with AHRI 210/240, and with thermal-expansion valve.
   5. Fan: Direct drive, centrifugal fan.

6. Fan Motors: Comply with requirements in Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC and STEAM GENERATION EQUIPMENT for multi-tapped, multi-speed motors with internal thermal protection and permanent lubrication.
7. Filters: Disposable, with MERV rating of 7 or higher according to ASHRAE 52.2.

E. Ceiling-Mounting, Evaporator-Fan Components:
1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.
2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
3. Drain Pan and Drain Connection: Comply with ASHRAE 62.1.
4. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with AHRI 210/240, and with thermal-expansion valve.
5. Electric-Resistance Heating Coil: Helical, nickel-chrome, resistance-wire heating elements with refractory ceramic support bushings; automatic-reset thermal cutout; built-in magnetic contactors; manual-reset thermal cutout; airflow proving device; and one-time fuses in terminal box for overcurrent protection.
6. Fan: Direct drive, centrifugal fan, and integral condensate pump.
7. Fan Motors: Comply with requirements in Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC and STEAM GENERATION EQUIPMENT for multi-tapped, multi-speed motors with internal thermal protection and permanent lubrication.
8. Filters: Disposable, with MERV rating of 7 or higher according to ASHRAE 52.2.

F. Air-Cooled, Compressor-Condenser Components:
1. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Service valves, fittings, and gauge ports shall be brass and located outside of the casing.
2. Compressor: Hermetically sealed variable speed scroll with crankcase heater and mounted on vibration isolation. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
3. Compressor motor with manual-reset, high-pressure switch and automatic-reset, low-pressure switch.
4. Refrigerant: R-410A unless otherwise indicated.
5. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with AHRI 210/240, and with liquid subcooler.
6. Fan: Aluminum, propeller type, directly connected to motor.
7. Motor: Permanently lubricated, with integral thermal-overload protection.
8. Low Ambient Kit: Permit operation down to minus 18 degrees C (0 degrees F).
9. Mounting Base: Polyethylene.
10. Minimum Energy Efficiency: Comply with ASHRAE/IESNA 90.1 "Energy Standard for Buildings except Low-Rise Residential Buildings."

G. Water-Cooled, Compressor-Condenser Components:
1. Casing: Steel, with baked-enamel finish in color selected by Architect, removable panels for access to controls, and mounting holes in base. Service valves, fittings, and gauge ports shall be brass and located on outside of casing.
2. Compressor: Hermetically sealed scroll with crankcase heater and mounted on vibration isolation. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
3. Compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
4. Refrigerant:R-410A unless otherwise indicated.
5. Heat Exchanger: Copper tubes in copper tube or in steel shell, with water-temperature-actuated, water-regulating valve.
6. Minimum Energy Efficiency: Comply with ASHRAE/IESNA 90.1, "Energy Standard for Buildings except Low-Rise Residential Buildings."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Rooftop Unit Support: Install unit level on structural pilings. Coordinate wall penetrations and flashing with wall construction. Secure rooftop units to structural support with anchor bolts.

B. Install units level and plumb maintaining manufacturer's recommended clearances and tolerances.

C. Install water-cooled units with thermometer and pressure gauge at the water supply and return connection.

D. Install ground-mounting, compressor-condenser components on 100 mm (4-inch) thick, reinforced concrete base; 100 mm (4 inches) greater on each side than unit. Concrete, reinforcement, and formwork are specified in Section 03 30 00, CAST-IN-PLACE CONCRETE. Coordinate anchor installation with concrete base.

E. Install ground-mounting, compressor-condenser components on polyethylene mounting base.

F. Install roof-mounting compressor-condenser components on equipment supports specified in Section 07 72 00, ROOF ACCESSORIES. Anchor units to supports with removable, cadmium-plated fasteners.

G. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

H. Install wall sleeves in finished wall assembly and weatherproof. Install and anchor wall sleeves to withstand, without damage seismic forces as required by code.

3.2 CONNECTIONS

A. Verify condensate drainage requirements.

B. Install condensate drain, minimum connection size, with trap and indirect connection to nearest roof drain or area drain.

C. Install piping adjacent to units to allow service and maintenance.

D. Install ducts to termination at top of roof curb. Cut roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.

E. Connect supply ducts to units with flexible duct connectors specified in Section 23 31 00, HVAC DUCTS and CASINGS.

F. Install return-air duct continuously through roof structure.

G. Install normal-weight, 20.7-MPa (3000-psi), compressive strength (28-day) concrete mix inside roof curb, 100 mm (4 inches) thick.

H. Ground equipment and install power wiring, switches, and controls for self-contained and split systems.

I. Connect refrigerant piping to coils with shutoff valves on the suction and liquid lines at the coil and a union or flange at each connection at the coil and condenser.

J. Install ducts to the units with flexible duct connections.

K. Connect piping with shutoff duty valves on the supply and return side of the coil and unions at all connections and with a throttling valve on the return piping near the coil.

L. Connect piping with shutoff duty valves on the supply and return side of the water-cooled condenser and unions at all connections and with a throttling valve on the return piping near the condenser

M. Connect piping with shutoff duty valves and unions on the steam supply and condensate side of the steam coil. On the condensate line near the coil provide a strainer, trap and shutoff valve.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections: After installing units and after electrical circuitry has been energized, test units for compliance with requirements. Inspect for and remove shipping bolts, blocks, and tie-down straps. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment. Remove and replace malfunctioning units and retest as specified above.

3.4 STARTUP AND TESTING

A. 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 7 days prior notice.

B. Provide services of manufacturer's technical representative for four hours to instruct VA personnel in operation and maintenance of units.

3.5 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 CxA.

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.

3.6 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer's technical representative for 4 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 23 08 00 – COMMISSIONING OF HVAC SYSTEMS.

END OF SECTION

SECTION 23 81 23
COMPUTER ROOM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies process cooling split systems air conditioning unit.

B. A complete listing of common acronyms and abbreviations are included in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

C. Definitions:

1. Energy Efficiency Ratio (EER): A ratio calculated by dividing the cooling capacity in Btu per hour by the power input in watts at any given set of rating conditions, expressed in Watts (Btu/h) per watt.
2. Integrated Energy Efficiency Ratio (IEER): Calculated by weighting the EER values at different load capacities and adding them together. The formula is based in the approximate number of hours a unit spends at each load point throughout its life. A minimum of four loads points are used for the calculation.
3. Coefficient of Performance (COP): A ratio calculated by dividing the change in heating or cooling capacity (Btu/h) to the energy consumed by the system (kW), expressed in Btu/kWh.
4. Unitary (AHRI): Consists of one or more factory-made assemblies, which normally include an evaporator or cooling coil, a compressor and condenser combination, and may include a heating function.
5. CRAC Units: Computer Room Air Conditioning 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 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

D. Section 22 05 23, GENERAL-DUTY VALVES FOR PLUMBING PIPING.

E. Section 22 11 00, FACILITY WATER DISTRIBUTION.

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 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 21 13, HYDRONIC PIPING.

M. Section 23 23 00, REFRIGERANT PIPING.

N. Section 23 31 00, HVAC DUCTS and CASINGS.

O. Section 23 40 00, HVAC AIR CLEANING DEVICES.

1.3 SUBMITTALS

A. Submit in accordance with specification 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 81 23, COMPUTER-ROOM-AIR-CONDITIONERS”, with applicable paragraph identification.

C. Manufacturer's Literature and Data Including: Rated capacities (at design indoor and outdoor conditions), EER/COP, operating characteristics, required specialties and accessories. Submit published catalog selection data showing equipment ratings and compliance with required sensible ratio.
   1. Indoor Air Conditioning Unit
   2. Air Cooled Condensing Unit

D. Submit detailed equipment assemblies with dimensions, operating weights, required clearances.

E. Submit wiring diagrams for power, alarm and controls.

F. Certification: Submit, simultaneously with shop drawings, a proof of certification:

G. Completed System Readiness Checklists 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.

H. Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

1.4 QUALITY ASSURANCE

A. Refer to specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

1.5 WARRANTY

A. The unit shall be warranted against all mechanical defects in material, parts or workmanship and shall be repaired or replaced at the Contractor's expense within the period of one year from final acceptance. Contractor shall adhere to a four-hour service response time to troubles during the warrantee period.

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. Where conflicts occur these specifications and the VHA standards will govern.

B. Air-Conditioning, Heating and Refrigeration Institute (AHRI) Standards:

210/240-2023	Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment
340/360-(I-P 2019)	Performance Rating of Commercial and Industrial Unitary Air Conditioning and Heat Pump Equipment
410-2001	Forced-Circulation Air-Cooling and Air-Heating Coils
460-2005	Performance Rating of Remote Mechanical-Draft Air-Cooled Refrigerant Condensers
520-2004	Performance Rating of Positive Displacement Condensing Units
DCPP (Web-based)	Directory of Certified Product Performance - Applied Directory of Certified Products

C. Air Movement and Control Association (AMCA):

210-2016	Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating (ANSI)

410-1996	Recommended Safety Practices for Users and Installers of Industrial and Commercial Fans

D. American Society of Heating, Refrigerating, and Air-Conditioning Engineers Inc. (ASHRAE):

15-2019	Safety Standard for Refrigeration Systems and Designation and Classification of Refrigerants (ANSI)
62-1-2019	Ventilation for Acceptable Indoor Air Quality (ANSI)
90.1-2019 (I-P)	Energy Standard for Buildings except Low-Rise Residential Buildings (ANSI Approved; IES Co-sponsored)
2020	HVAC Systems and Equipment Handbook
2018	Refrigeration Handbook

E. American Society of Testing and Materials (ASTM):

B117-2019	Standard Practice for Operating Salt Spray (Fog) Apparatus

F. National Electrical Manufacturer's Association (NEMA):

MG 1-2016 (R2019)	Motors and Generators (ANSI)

G. National Fire Protection Association (NFPA) Publications:

70-2020	National Electrical Code
90A-2021	Standard for the Installation of Air-Conditioning and Ventilating Systems

1.7 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 FLOOR-MOUNTED UNITS 28 KW (8 TONS) AND LARGER

A. Description: Packaged, factory assembled, prewired, and prepiped; consisting of cabinet, fans, filters, humidifier, and controls.

B. Cabinet and Frame: Welded steel, braced for rigidity, and supporting compressors and other mechanical equipment and fittings.

C. Doors and Access Panels: Galvanized steel with polyurethane gaskets, hinges, and concealed fastening devices.

D. Insulation: Thermally and acoustically insulate cabinet interior with - 25-mm (1-inch) thick 24 kilogram/cubic meter (1.5 pound/cubic foot) high-density mineral fiber duct liner coated on airstream side.

E. Finish of Interior Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

F. Finish of Exterior Surfaces: Baked-on, textured vinyl enamel; color as selected from manufacturer's standard colors to match computer equipment .

G. Floor Stand: Welded tubular steel, 12 inches high, with adjustable legs and vibration isolation pads.

H. Supply-Air Fan(s): Double-inlet, plenum fans(s), statically and dynamically balanced.

I. Drive:

1. Plenum Fans: Direct-drive, Arrangement 4, variable-speed drive fan(s) with aluminum wheels; with multiple fans, the number of fans shall not exceed four.

J. Compressors: Hermetic scroll; variable speed with oil strainer, internal motor overload protection, resilient suspension system, crankcase heater, manual-reset high-pressure switch, and pump-down low-pressure switch. Compressors shall have multiple stages of cooling as listed on the drawing equipment schedule.

K. Refrigeration Circuits: Two; each with hot-gas mufflers, thermal-expansion valve with external equalizer, liquid-line solenoid valve, liquid-line filter-dryer, sight glass with moisture indicator, service shutoff valves, charging valves, and charge of refrigerant.

L. Refrigerant: R-407C unless otherwise indicated.

M. Refrigerant Evaporator Coil: Alternate-row or split-face-circuit, direct-expansion coil of seamless copper tubes expanded into aluminum fins.
1. Coil assembly shall be mounted over stainless-steel drain pan complying with ASHRAE 62.1 and having a condensate pump unit with integral float switch, pump-motor assembly, and condensate reservoir.

N. Remote Air-Cooled Refrigerant Condenser: Corrosion-resistant cabinet, copper-tubeE-coated aluminum-fins coils arranged for two circuits, multiple direct-drive propeller fans with permanently lubricated ball bearings, and single-phase motors with internal overload protection and integral electric control panel. Control capacity by modulating fan speeds .

O. Heating Coil:
1. Electric-Resistance Heating Coil: Enclosed finned-tube electric elements arranged for SCR control, with thermal safety switches, manual-reset overload protection, and branch-circuit over current protection.
2. Refrigerant Heating Coil: Hot-gas coil of seamless copper tubes expanded into aluminum fins with three-way solenoid valve on first-stage refrigerant circuit.

P. Filter Extended-Surface, Disposable, Panel type: Pleated, lofted, nonwoven, reinforced cotton fabric; supported and bonded to welded wire grid; enclosed in cardboard frame with 50-mm (2-inch) thick, disposable, glass-fiber prefilter.
1. Thickness: 50 mm (2 inches).
2. Initial Resistance: _____ Pa (inches wg).
3. Recommended Changeover Resistance: _____ Pa (inches wg).
4. Arrestance: 90 percent according to ASHRAE 52.1.
5. MERV Rating: 7, according to ASHRAE 52.2.

Q. Humidifier:
1. Infrared Humidifier: High-intensity quartz lamps mounted above stainless-steel evaporator pan, serviceable without disconnecting water, drain, or electrical connections; prepiped and using condensate water from cooling coils with stainless-steel or brass float-valve mechanism; located in bypass airstream; with flush-cycle timer and solenoid drain valve.
2. Evaporative Pan Humidifier: Stainless-steel pan and cover, serviceable without disconnecting water, drain, or electrical connections; prepiped with stainless-steel or brass float-valve mechanism; electric-resistance heating coil low-water-cutoff switch; flush-cycle timer; and solenoid drain valve.
3. Electrode Steam Humidifier: Self-contained, microprocessor-controlled unit with disposable, polypropylene-plastic cylinders, and having field-adjustable steel electrodes and stainless-steel steam dispersion tube.
4. Plumbing Components and Valve Bodies: Plastic, linked by flexible rubber hosing, with water fill with air gap and solenoid valve incorporating built-in strainer, pressure-reducing and flow-regulating orifice, and drain with integral air gap.
5. Control: Fully modulating to provide gradual 0 to 100 percent capacity with field-adjustable maximum capacity; with high-water probe.
6. Drain Cycle: Field-adjustable drain duration and drain interval.

R. Controls:
   1. Integral Electrical Controls: Unit-mounted electrical enclosure with piano-hinged door, grounding lug, combination magnetic starters with overload relays, circuit breakers and cover interlock, and fusible control-circuit transformer.
      a. Disconnect Switch: Nonautomatic, molded-case circuit breaker with handle accessible when panel is closed and capable of preventing access until switched to off position.
   2. Electronic-Control System: Solid state, with start button, stop button, temporary loss of power indicator, manual-reset circuit breakers, temperature control, humidity control, and monitor panel.

S. Microprocessor-Control System: Continuously monitors operation of process cooling system; continuously displays room temperature and room relative humidity; sounds alarm on system malfunction and simultaneously displays problem. If more than one malfunction occurs, system displays fault in sequence with room temperature and continues to display fault when malfunction is cleared until system is reset.

T. Malfunctions:
   1. Power loss, loss of airflow, clogged air filter, high room temperature, and low room temperature.
   2. High humidity.
   3. Low humidity.
   4. Smoke/fire, water under floor supply fan overload, compressor No. 1, overload compressor No. 1 low pressure.
   5. Compressor No. 1, high pressure.
   6. Compressor No. 2 overload.
   7. Compressor No. 2, low pressure.
   8. Compressor No. 2 high pressure.
   9. Digital Display:
      a. Control power on.
      b. Humidifying.
      c. Dehumidifying
      d. Compressor No. 1 operating.
      e. Compressor No. 2 operating.
      f. Heat operating.
      g. Economy cooling.
   10. Push buttons shall stop and start process cooling system, silence audible alarm, test indicators, and display room's relative humidity.

U. BAS Interface: Factory-installed hardware and software to enable the BAS to monitor, control, and display unit status and alarms via an open protocol BACnet data interface.

V. Hardwired Points:
   1. Monitoring: On-off status, common trouble alarm. space temperature, space relative humidity.
   2. Control: On-off operation, space temperature set-point adjustment, space relative humidity set-point adjustment

W. Compatible with ASHRAE 135 (BACnet) Industry-accepted, open-protocol for communication interface with the BAS shall enable the DDC or the BAS operator to remotely control and monitor the unit from an operator workstation. Control features and monitoring points displayed locally at unit control panel shall be available through the DDC or the BAS.

2.2 FLOOR-MOUNTED UNITS 24 KW (7 TONS) AND SMALLER

A. Description: Self-contained, factory assembled, prewired, and prepiped; consisting of cabinet, fan, filters, and controls; for vertical floor mounting in upflow or downflow configuration.

B. Cabinet and Frame: Welded tubular-steel frame with removable steel panels with baked-enamel finish, insulated with 1-inch- (25-mm-) thick duct liner.

C. Floor Stand: Welded tubular steel, 300 mm (12 inches), with adjustable legs and vibration isolation pads.

D. Finish of Interior Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

E. Supply-Air Fan:
   1. Plenum Fans: Direct-drive, Arrangement 4, variable-speed drive fan(s) with aluminum wheels; with multiple fans, the number of fans shall not exceed four.

F. Compressor: Hermetic, scroll variable speed with oil strainer, internal motor overload protection, resilient suspension system, and crankcase heater.

G. Refrigeration Circuit: Low-pressure switch, manual-reset high-pressure switch, thermal-expansion valve with external equalizer, sight glass with moisture indicator, service shutoff valves, charging valves, and charge of refrigerant.

H. Refrigerant: R-407C unless otherwise indicated.

I. Refrigerant Evaporator Coil: Direct-expansion coil of seamless copper tubes expanded into aluminum fins, with two circuits, each with solenoid valve.
   1. Mount coil assembly over stainless-steel drain pan complying with ASHRAE 62.1-2010 and having a condensate pump unit with integral float switch, pump-motor assembly, and condensate reservoir.

J. Remote Air-Cooled Refrigerant Condenser: Integral, copper-tube E-coated aluminum-fin coil with propeller fan, direct driven.

K. Split system shall have suction- and liquid-line compatible fittings and refrigerant piping for field interconnection.

L. Remote Air-Cooled, Glycol-Solution Cooler: Corrosion-resistant cabinet, copper-tube E-coated aluminum-fin coil, direct-drive propeller fan with fan guards, and single-phase motors with internal overload protection.

M. Disconnect Switch: Nonautomatic, molded-case circuit breaker with handle accessible when panel is closed and capable of preventing access until switched to off position.

N. Electric-Resistance Heating Coil: Finned-tube electric elements with contactor and high-temperature-limit switches.

O. Filter: 50-mm (2-inch) thick, disposable, glass-fiber media.
   1. Initial Resistance: _____ Pa (inches wg).
   2. Recommended Final Resistance: _____ Pa (inches wg).
   3. Arrestance: 90 percent according to ASHRAE 52.1.
   4. MERV Rating: 7, according to ASHRAE 52.2.

P. Infrared Humidifier: High-intensity quartz lamps mounted above stainless-steel evaporator pan, serviceable without disconnecting water, drain, or electrical connections; prepiped and located in bypass airstream; with flush-cycle timer and solenoid drain valve.

Q. Plumbing Components and Valve Bodies: Plastic, linked by flexible rubber hosing, with water fill with air gap and solenoid valve incorporating built-in strainer, pressure-reducing and flow-regulating orifice, and drain with integral air gap.

R. Control: Fully modulating to provide gradual 0 to 100 percent capacity with field-adjustable maximum capacity; with high-water probe.

S. Drain Cycle: Field-adjustable drain duration and drain interval.

T. Disconnect Switch: Nonautomatic, molded-case circuit breaker with handle accessible when panel is closed and capable of preventing access until switched to off position.

U. Control System: Unit-mounted panel with main fan contactor, compressor contactor, compressor start capacitor, control transformer with circuit breaker, solid-state temperature and humidity control modules humidity contactor , time-delay relay, heating contactor, and high-temperature thermostat. Provide solid-state, wall-mounted control panel with start-stop switch, adjustable humidity set point, and adjustable temperature set point.

V. DDC Interface or BAS: Provide connection to the DDC or the BAS.

2.3 CONSOLE UNITS

A. Description: Split system consisting of evaporator section for floor or wall mounting and remote condensing section.

B. Evaporator Cabinet: Furniture-grade steel with baked-enamel finish; with front access and containing direct-drive centrifugal fans and two-speed motor.

C. Finish of Interior Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2007.

D. Condenser Cabinet: Steel with baked-enamel finish and containing compressor and condenser.

E. Compressor: Hermetic scroll, variable speed with oil strainer, internal motor overload protection, resilient suspension system, and crankcase heater.

F. Refrigeration Circuit: Filter/dryer, manual-reset high-pressure switch, thermal-expansion valve with external equalizer, sight glass with moisture indicator, service shutoff valves, charging valves, and charge of refrigerant.

G. Refrigerant: R-407C unless otherwise indicated.

H. Refrigerant Evaporator Coil: Direct-expansion coil of seamless copper tubes expanded into aluminum fins.
   1. Mount coil assembly over stainless-steel drain pan, complying with ASHRAE 62.1 and having a condensate pump unit with integral float switch, pump-motor assembly, and condensate reservoir.

I. Integral, Water-Cooled Refrigerant Condenser: Coaxial, counterflow, tube-in-tube Brazed-plate type with liquid-line stop valve and head-pressure-actuated, water-regulating valve.

J. Remote Air-Cooled Refrigerant Condenser: Integral, copper-tube E-coated aluminum-fin coil with propellerplenum fan, direct driven.

K. Split system shall have suction- and liquid-line compatible fittings and refrigerant piping for field interconnection.

L. Hydronic Cooling Coil: Seamless copper tubes expanded into aluminum fins with modulating control valve.
   1. Cooling Medium: Water
   2. Mount coil assembly over stainless-steel drain pan complying with ASHRAE 62.1 and having a condensate pump unit with integral float switch, pump-motor assembly, and condensate reservoir.

M. Electric-Resistance Heating Coil: Finned-tube electric elements with contactor and high-temperature-limit switches.

N. Filter: Disposable, glass-fiber media 25-mm (1-inch) thick.
   1. Initial Resistance: _____ Pa (inches wg)>.
   2. Recommended Final Resistance: ____ Pa (inches wg)>.
   3. Arrestance: 90 percent according to ASHRAE 52.1.
   4. MERV Rating: 7 according to ASHRAE 52.2.

O. Electrode Steam Humidifier: Self-contained and microprocessor controlled; with replaceable cylinder.

P. Disconnect Switch: Nonautomatic, molded-case circuit breaker with handle accessible when panel is closed and capable of preventing access until switched to off position.

Q. Control System: Unit-mounted panel with contactors, control transformer with circuit breaker, and solid-state temperature-and humidity- control modules. Wall-mounted control panel shall be solid-state, with start-stop switch , adjustable humidity set point, and adjustable temperature set point.

R. DDC or BAS Interface: Provide connection to the DDC or the BAS system.

2.4 FAN MOTORS

A. Default motor characteristics are specified in Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC and STEAM GENERATION EQUIPMENT.

B. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC and STEAM GENERATION EQUIPMENT.

C. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0. Provide high static fan motors for ducted applications.

D. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.

2.5 SPECIAL TOOLS

A. If any part of equipment furnished under these specifications requires a special tool for assembly, adjustment, setting, or maintenance and the tool is not readily available from the commercial tool market, furnish the necessary tools with equipment as a standard accessory.

2.6 CORROSION CONTROL

A. Remote Outdoor Condenser Coils:

1. Epoxy Immersion Coating – Electrically Deposited: The multi-stage corrosion-resistant coating application comprises of cleaning (heated alkaline immersion bath) and reverse-osmosis immersion rinse prior to the start of the coating process. The coating thickness shall be maintained between 0.6-mil and 1.2-mil. Before the coils are subjected to high-temperature oven cure, they are treated to permeate immersion rinse and spray. Where the coils are subject to UV exposure, UV protection spray treatment comprising of UV-resistant urethane mastic topcoat shall be applied. Provide complete coating process traceability for each coil and minimum five years of limited warranty. The coating process shall be such that uniform coating thickness is maintained at the fin edges. The quality control shall be maintained by ensuring compliance to the applicable ASTM Standards for the following:
   a. Salt Spray Resistance (Minimum 6,000 Hours)
   b. Humidity Resistance (Minimum 1,000 Hours)
   c. Water Immersion (Minimum 260 Hours)
   d. Cross-Hatch Adhesion (Minimum 4B-5B Rating)
   e. Impact Resistance (Up to 160 Inch/Pound)

B. Exposed Outdoor Cabinet

1. Casing Surfaces (Exterior and Interior): All exposed and accessible metal surfaces shall be protected with a water-reducible acrylic with stainless steel pigment spray-applied over the manufacturer’s standard finish. The spray coating thickness shall be 2-4 mils and provide minimum salt-spray resistance of 1,000 hours (ASTM B117) AND 500 hours UV resistance (ASTM D4587).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Handle and install refrigeration units and accessories in accordance with the instructions and recommendations of the manufacturer.

B. Coordinate installation of Computer room Air Conditioning Units with Computer room access flooring installer.

C. Field Refrigerant Piping: As specified in specification Section 23 23 00, REFRIGERANT PIPING.

3.2 CONNECTIONS

A. Coordinate piping installations and specialty arrangements with schematics on Drawings and with requirements specified in piping systems. If Drawings are explicit enough, these requirements may be reduced or omitted.

B. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

C. Install piping adjacent to machine to allow service and maintenance.

D. Water and Drainage Connections: Comply with applicable requirements in Section 22 05 23, GENERAL-DUTY VALVES FOR PLUMBING PIPING and Section 22 11 00, FACILITY WATER DISTRIBUTION. Provide adequate connections for water-cooled units, condensate drain, and humidifier flushing system.

E. Refrigerant Piping: Comply with applicable requirements in Section 23 23 00, REFRIGERANT PIPING. Provide shutoff valves and piping.

3.3 FIELD QUALITY CONTROL

A. Tests and Inspections:
   1. Inspect for and remove shipping bolts, blocks, and tie-down straps.
   2. After installing computer-room air conditioners and after electrical circuitry has been energized, test for compliance with requirements.
   3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. After startup service and performance test, change filters and flush humidifier.

3.4 STARTUP AND TESTING

A. 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 7 days prior notice.

B. Provide services of manufacturer’s technical representative for four hours to instruct VA personnel in operation and maintenance of computer room air conditioning equipment.

3.5 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 CxA.

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.

3.6 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer’s technical representative for 4hours to instruct VA personnel in operation and maintenance of units.

B. Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

END OF SECTION

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 Resident 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. 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.
   3. 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, device wall plate, 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)

END OF SECTION

SECTION 26 05 19
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

2.1 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.

2.2 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.

E. Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION: Installation of conductors and cables in manholes and ducts.

2.3 QUALITY ASSURANCE

A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

2.4 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.

SECTION 26 05 19

      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.

3.2 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):
   1. D2301-10.....Standard Specification for Vinyl Chloride
      a. Plastic Pressure-Sensitive Electrical Insulating Tape
   2. D2304-10.....Test Method for Thermal Endurance of Rigid
      a. Electrical Insulating Materials
   3. D3005-10.....Low-Temperature Resistant Vinyl Chloride

a. Plastic Pressure-Sensitive Electrical Insulating Tape

C. National Electrical Manufacturers Association (NEMA):
1. WC 70-09.....Power Cables Rated 2000 Volts or Less for the
a. Distribution of Electrical Energy

D. National Fire Protection Association (NFPA):
1. 70-17.....National Electrical Code (NEC)

E. Underwriters Laboratories, Inc. (UL):
1. 44-14.....Thermoset-Insulated Wires and Cables
2. 83-14.....Thermoplastic-Insulated Wires and Cables
3. 467-13.....Grounding and Bonding Equipment
4. 486A-486B-13.....Wire Connectors
5. 486C-13.....Splicing Wire Connectors
6. 486D-15.....Sealed Wire Connector Systems
7. 486E-15.....Equipment Wiring Terminals for Use with
a. Aluminum and/or Copper Conductors
1) 493-07.....Thermoplastic-Insulated Underground Feeder and Branch Circuit Cables
8. 514B-12.....Conduit, Tubing, and Cable Fittings

SECTION 26 05 19

PART 2 - PRODUCTS

5.1 CONDUCTORS AND CABLES

A. Conductors and cables shall be in accordance with ASTM, NEMA, NFPA, UL, as specified herein, and as shown on the drawings.

B. All conductors shall be copper.

C. Single Conductor and Cable:
1. All conductors regardless of size shall be stranded.
2. Insulation: THHN-THWN and XHHW-2. XHHW-2 shall be used for isolated power systems.

D. Color Code:
1. All conductors regardless of size shall have solid color insulation or solid color coating.
2. For modifications and additions to existing wiring systems, color coding shall conform to the existing wiring system.
3. 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

4. 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.

SECTION 26 05 19

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

6.2 SPLICES

A. Splices shall be in accordance with NEC and UL.

B. Above Ground Splices for No. 10 AWG and Smaller:
   1. Solderless, screw-on, reusable pressure cable type, with integral insulation, approved for copper and aluminum conductors.
   2. The integral insulator shall have a skirt to completely cover the stripped conductors.
   3. The number, size, and combination of conductors used with the connector, as listed on the manufacturer's packaging, shall be strictly followed.

C. Above Ground Splices for No. 8 AWG to No. 4/0 AWG:
   1. Compression, hex screw, or bolt clamp-type of high conductivity and corrosion-resistant material, listed for use with copper and aluminum conductors.
   2. Insulate with materials approved for the particular use, location, voltage, and temperature. Insulation level shall be not less than the insulation level of the conductors being joined.
   3. Splice and insulation shall be product of the same manufacturer.
   4. All bolts, nuts, and washers used with splices shall be zinc- plated 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..

6.3 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
   1. corrosion-resistant material, with minimum of two compression indents per wire, listed for use with copper and aluminum conductors.

SECTION 26 05 19

A. All bolts, nuts, and washers used to connect connections and terminations to bus bars or other termination points shall be zinc- plated steel.

7.2 CONTROL WIRING

A. Unless otherwise specified elsewhere in these specifications, control wiring shall be as specified herein, except that the minimum size shall be not less than No. 14 AWG.

B. Control wiring shall be sized such that the voltage drop under in-rush conditions does not adversely affect operation of the controls.

7.3 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

8.1 GENERAL

A. Installation shall be in accordance with the NEC, as shown on the drawings, and manufacturer’s instructions.

B. Install all conductors in raceway systems.

C. Splice conductors only in outlet boxes, junction boxes, pullboxes, manholes, or handholes.

D. Conductors of different systems (e.g., 120 V and 277 V) shall not be installed in the same raceway.

E. Install cable supports for all vertical feeders in accordance with the NEC. Provide split wedge type which firmly clamps each individual cable and tightens due to cable weight.

F. In panelboards, cabinets, wireways, switches, enclosures, and equipment assemblies, neatly form, train, and tie the conductors with non- metallic ties.

G. For connections to motors, transformers, and vibrating equipment, stranded conductors shall be used only from the last fixed point of connection to the motors, transformers, or vibrating equipment.

H. Use expanding foam or non-hardening duct-seal to seal conduits entering a building, after installation of conductors.

I. Conductor and Cable Pulling:
   1. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling. Use lubricants approved for the cable.

SECTION 26 05 19

   1. Use nonmetallic pull ropes.
   2. Attach pull ropes by means of either woven basket grips or pulling eyes attached directly to the conductors.
   3. All conductors in a single conduit shall be pulled simultaneously.
   4. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

B. No more than three branch circuits shall be installed in any one conduit.

C. When stripping stranded conductors, use a tool that does not damage the conductor or remove conductor strands.

9.2 SPLICE AND TERMINATION INSTALLATION

A. Splices and terminations shall be mechanically and electrically secure, and tightened to manufacturer's published torque values using a torque screwdriver or wrench.

B. Where the Government determines that unsatisfactory splices or terminations have been installed, replace the splices or terminations at no additional cost to the Government.

9.3 CONDUCTOR IDENTIFICATION

A. When using colored tape to identify phase, neutral, and ground
   1. Color taping is prohibited

9.4 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 in diameter andthick. Attach tags with plastic ties.

9.5 EXISTING CONDUCTORS

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

9.6 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.

SECTION 26 05 19

A. Install a separate power supply circuit for each system, except where otherwise shown on the drawings.

10.2 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.

10.3 ACCEPTANCE CHECKS AND TESTS

A. Perform in accordance with the manufacturer's recommendations. In addition, include the following:
   1. Visual Inspection and Tests: Inspect physical condition.
   2. Electrical tests:
      a. After installation but before connection to utilization devices, such as fixtures, motors, or appliances, test conductors phase- to-phase and phase-to-ground resistance with an insulation resistance tester. Existing conductors to be reused shall also be tested.
      b. Applied voltage shall be 500 V DC for 300 V rated cable, and 1000 V DC for 600 V rated cable. Apply test for one minute or until reading is constant for 15 seconds, whichever is longer. Minimum insulation resistance values shall not be less than 25 megohms for 300 V rated cable and 100 megohms for 600 V rated cable.
      c. Perform phase rotation test on all three-phase circuits.

---END---

END OF SECTION

SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

2.1 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.

2.2 RELATED WORK

A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.

B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.

C. Section	26	05	33,	RACEWAY AND	BOXES FOR ELECTRICAL SYSTEMS: Conduit and
boxes.					
D. Section	26	22	00,	LOW-VOLTAGE	TRANSFORMERS: Low-voltage transformers.
E. Section	26	23	00,	LOW-VOLTAGE	SWITCHGEAR: Low-voltage switchgear.

C. F. Section 26 24 13, DISTRIBUTION SWITCHBOARDS: Low-voltage distribution switchboards.
   1. G. Section 26 24 16, PANELBOARDS: Low-voltage panelboards.

2.3 QUALITY ASSURANCE

A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

2.4 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.

SECTION 26 05 26

      a. 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.

3.2 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):
1. B1-13.....Standard Specification for Hard-Drawn Copper
   a. Wire
2. B3-13.....Standard Specification for Soft or Annealed
   a. Copper Wire
3. B8-11.....Standard Specification for Concentric-Lay-
   a. Stranded Copper Conductors, Hard, Medium-Hard, or Soft

C. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
1. 81-12.....IEEE Guide for Measuring Earth Resistivity,
   a. Ground Impedance, and Earth Surface Potentials of a Ground System Part 1: Normal Measurements

D. National Fire Protection Association (NFPA):
1. 70-17.....National Electrical Code (NEC)
2. 70E-15.....National Electrical Safety Code
3. 99-15.....Health Care Facilities

E. Underwriters Laboratories, Inc. (UL):
1. 44-14 .....Thermoset-Insulated Wires and Cables
2. 83-14 .....Thermoplastic-Insulated Wires and Cables
3. 467-13 .....Grounding and Bonding Equipment

SECTION 26 05 26

PART 2 - PRODUCTS

5.1 GROUNDING AND BONDING CONDUCTORS

A. Equipment grounding conductors shall be insulated stranded copper. Insulation color shall be continuous green for all equipment grounding conductors.

B. Bonding conductors shall be bare stranded 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.

5.2 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-platedsteel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.
2. Connection to Building Steel: Exothermic-welded type connectors.
3. Connection to Grounding Bus Bars: Listed for use with aluminum and copper conductors. Use mechanical type lugs, with zinc- plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.

4. Connection to Equipment Rack and Cabinet Ground Bars: Listed for use with aluminum and copper conductors. Use mechanical type lugs, with
   a. zinc-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.

SECTION 26 05 26

6.1 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 (6.35 mm)) thick x 19 mm (0.75 inch (19.05 mm)) wide, with length as required or as shown on the drawings. Provide insulators and mounting brackets.

6.2 GROUND TERMINAL BLOCKS

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

6.3 GROUNDING BUS BAR

A. Pre-drilled rectangular copper bar with stand-off insulators, minimum
   1. mm (0.25 inch (6.35 mm)) thick x 100 mm (4 inches (101.6 mm)) 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

7.1 GENERAL

7.2 REFERENCE STANDARDS

A. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System; 2012.

B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

C. Installation shall be in accordance with the NEC, as shown on the drawings, and manufacturer’s instructions.

D. 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.

E. 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.

F. For patient care area electrical power system grounding, conform to the latest NFPA 70 and 99.

7.3 INACCESSIBLE GROUNDING CONNECTIONS

A. Make grounding connections, which are normally buried or otherwise inaccessible, by exothermic weld.

SECTION 26 05 26

8.1 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

8.2 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.

SECTION 26 05 26

1. Metallic conduits which terminate without mechanical connection to an electrical equipment housing by means of locknut and bushings or adapters, shall be provided with grounding bushings. Connect bushings with a equipment grounding conductor to the equipment ground bus.

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

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

D. Wireway Systems:
1. Bond the metallic structures of wireway to provide electrical continuity throughout the wireway system, by connecting a No. 6 AWG bonding jumper at all intermediate metallic enclosures and across all section junctions.
2. Install insulated No. 6 AWG bonding jumpers between the wireway system, bonded as required above, and the closest building ground at each end and approximately every 16 M (50 feet (1524 cm)).
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 (1493.52 cm)).

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.

SECTION 26 05 26

A. Fixed electrical appliances and equipment shall be provided with a ground lug for termination of the equipment grounding conductor.

B. Raised Floors: Provide bonding for all raised floor components as shown on the drawings.

C. 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.

10.2 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.

10.3 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.

10.4 GROUND RESISTANCE

A. Grounding system resistance to ground shall not exceed 5 ohms. Make any modifications or additions to the grounding electrode system necessary for compliance without additional cost to the Government. Final tests shall ensure that this requirement is met.

B. Grounding system resistance shall comply with the electric utility company ground resistance requirements.
   1. ACCEPTANCE CHECKS AND TESTS

C. 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.

D. 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

SECTION 26 05 26

1. resistance, but the specified number of electrodes must still be provided.

B. Below-grade connections shall be visually inspected by the COR and electric shop supervisor prior to backfilling. The Contractor shall notify the COR 24 hours before the connections are ready for inspection.

---END---

END OF SECTION

SECTION 26 05 33
RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

1.1 REFERENCE STANDARDS

A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2020.

B. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S); 2020.

C. ANSI C80.6 - American National Standard for Electrical Intermediate Metal Conduit; 2018.

D. UL 1 - Flexible Metal Conduit; Current Edition, Including All Revisions.

E. UL 5 - Surface Metal Raceways and Fittings; Current Edition, Including All Revisions.

F. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.

G. UL 360 - Liquid-Tight Flexible Metal Conduit; Current Edition, Including All Revisions.

H. UL 467 - Grounding and Bonding Equipment; Current Edition, Including All Revisions.

I. UL 514B - Conduit, Tubing, and Cable Fittings; Current Edition, Including All Revisions.

J. UL 514C - Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers; Current Edition, Including All Revisions.

K. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings; Current Edition, Including All Revisions.

L. UL 651A - High Density Polyethylene (HDPE) Conduit; Current Edition, Including All Revisions.

M. UL 797 - Electrical Metallic Tubing-Steel; Current Edition, Including All Revisions.

N. UL 1242 - Electrical Intermediate Metal Conduit-Steel; Current Edition, Including All Revisions.

.PART 1 - GENERAL

2.1 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.

2.2 RELATED WORK

A. Section 06 10 00, ROUGH CARPENTRY: Mounting board for telephone closets.

B. Section 07 60 00, FLASHING AND SHEET METAL: Fabrications for the deflection of water away from the building envelope at penetrations.

C. Section 07 84 00, FIRESTOPPING: Sealing around penetrations to maintain the integrity of fire rated construction.

D. Section 07 92 00, JOINT SEALANTS: Sealing around conduit penetrations through the building envelope to prevent moisture migration into the building.

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

F. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Conduits bracing.

G. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.

H. 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.

I. Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION: Underground conduits.

J. Section 31 20 00, EARTHWORK: Bedding of conduits.

2.3 QUALITY ASSURANCE

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

SECTION 26 05 33

3.1 SUBMITTALS

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

3.2 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

B. American National Standards Institute (ANSI):
   1. C80.1-05.....Electrical Rigid Steel Conduit
   2. C80.3-05.....Steel Electrical Metal Tubing
   3. C80.6-05.....Electrical Intermediate Metal Conduit

C. National Fire Protection Association (NFPA):
   1. 70-11.....National Electrical Code (NEC)

D. Underwriters Laboratories, Inc. (UL):
   1. 1-05.....Flexible Metal Conduit
   2. 5-11.....Surface Metal Raceway and Fittings
   3. 6-07.....Electrical Rigid Metal Conduit - Steel
   4. 50-95.....Enclosures for Electrical Equipment

SECTION 26 05 33

   1. 360-13.....Liquid-Tight Flexible Steel Conduit
   2. 467-13.....Grounding and Bonding Equipment
   3. 514A-13.....Metallic Outlet Boxes
   4. 514B-12.....Conduit, Tubing, and Cable Fittings
   5. 514C-07.....Nonmetallic Outlet Boxes, Flush-Device Boxes
      a. and Covers
   6. 651-11.....Schedule 40 and 80 Rigid PVC Conduit and
      a. Fittings
   7. 651A-11.....Type EB and A Rigid PVC Conduit and HDPE
      a. Conduit
   8. 797-07.....Electrical Metallic Tubing
   9. 1242-06.....Electrical Intermediate Metal Conduit - Steel

B. National Electrical Manufacturers Association (NEMA):
   1. TC-2-13.....Electrical Polyvinyl Chloride (PVC) Tubing and
      a. Conduit
   2. TC-3-13.....PVC Fittings for Use with Rigid PVC Conduit and
      a. Tubing
   3. FB1-12.....Fittings, Cast Metal Boxes and Conduit Bodies
      a. for Conduit, Electrical Metallic Tubing and Cable
   4. FB2.10-13.....Selection and Installation Guidelines for
      a. Fittings for use with Non-Flexible Conduit or Tubing (Rigid Metal Conduit, Intermediate Metallic Conduit, and Electrical Metallic Tubing)
   5. FB2.20-12.....Selection and Installation Guidelines for
      a. Fittings for use with Flexible Electrical Conduit and Cable

C. American Iron and Steel Institute (AISI):
   1. S100-2007.....North American Specification for the Design of
      a. Cold-Formed Steel Structural Members

PART 2 - PRODUCTS

5.1 MATERIAL

A. Conduit Size:In accordance with the NEC, but not less than ¾ inch unless otherwise shown. Where permitted by the NEC, 0.51 inch (13 mm) flexible conduit may be used for tap connections to recessed lighting fixtures.

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A. Conduit:
   1. Size: In accordance with the NEC, but not less than ¾ inch.
   2. RigidSteelConduit (RMC):Shall conform to UL 6 and ANSI C80.1.
   3. Rigid Intermediate Steel Conduit (IMC): Shall conform to UL 1242 and ANSI C80.6.
   4. Electrical Metallic Tubing (EMT):Shall conform to UL 797 and ANSI C80.3. Maximum size not to exceed 4.13 inch (105 mm)(4 inches (101.6 mm)) and shall be permitted only with cable rated 600 V or less.
   5. Flexible MetalConduit:Shall conform to UL 1.
   6. Liquid-tight Flexible Metal Conduit:Shall conform to UL 360.
   7. Direct Burial Plastic Conduit:Shall conform to UL 651 and UL 651A, heavy wall PVC or high density polyethylene (PE).
   8. Surface Metal Raceway:Shall conform to UL 5.

B. Conduit Fittings:
   1. Rigid Steel and Intermediate MetallicConduit 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 coverplates having the same finishes as that of other electrical plates in the room.

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1. Electrical Metallic Tubing Fittings:
   a. Fittings and conduit bodies shall meet the requirements of UL 514B, ANSI C80.3, and NEMA FB1.
   b. Only steel or malleable iron materials are acceptable.
   c. Compression Couplings and Connectors: Concrete-tight and rain- tight, with connectors having insulated throats.
   d. Setscrew Couplings and Connectors: Use setscrews of case- hardened steel with hex head and cup point, to firmly seat in wall of conduit for positive grounding with connectors having insulated throats for trade sizes 2 ½" and larger.
   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.
2. Flexible Metal Conduit Fittings:
   a. Conform to UL 514B. Only steel or malleable iron materials are acceptable.
   b. Clamp-type, with insulated throat.
3. 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.
4. Direct Burial Plastic Conduit Fittings:Fittings shall meet the requirements of UL 514C and NEMA TC3.
5. Surface Metal Raceway Fittings: As recommended by the raceway manufacturer. Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, conduit entry fittings, accessories, and other fittings as required for complete system.
6. Expansion and Deflection Couplings:
   a. Conform to UL 467 and UL 514B.
   b. Accommodate a0.75 inch (19 mm) 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
      1) accordance with UL 467 and the NEC tables for equipment grounding 26 05 33 - 5 (05-01-14 VA Revision)
      2) conductors.

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   a. Jacket: Flexible, corrosion-resistant, watertight, moisture and heat-resistant molded rubber material with stainless steel jacket clamps.

B. Conduit Supports:
   1. Parts and Hardware: Zinc-coat or provide equivalent corrosion protection.
   2. Individual Conduit Hangers: Designed for the purpose, having a
      a. pre-assembled closure bolt and nut, and provisions for receiving a hanger rod.
   3. Multiple Conduit (Trapeze) Hangers: Not less than 1.5 inch (38 mm) x 38 mm (1.5 x 1.5 inches (38.1 mm)), 12-gauge steel, cold-formed, lipped channels; with not less than 0.35 inch (9 mm)(0.375-inch) diameter steel hanger rods.
   4. Solid Masonry and Concrete Anchors: Self-drilling expansion shields, or machine bolt expansion.

C. Outlet, Junction, and PullBoxes:
   1. UL-50 and UL-514A.
   2. Rustproof cast metal where required by the NEC or shown on drawings.

3. Sheet Metal Boxes: Galvanized steel, except where shown on drawings.

D. 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

9.1 PENETRATIONS

A. Cutting or Holes:
1. Cutholes 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

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1. spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING.

B. Waterproofing: At floor, exterior wall, and roof conduit penetrations, completely seal the gaparound conduit to render it watertight, as specified in Section 07 92 00, JOINT SEALANTS.

10.2 INSTALLATION, GENERAL

A. In accordance with UL, NEC, NEMA, as shown on drawings, and as specified herein.

B. Raceway systems used for Essential Electrical Systems (EES) shall be entirely independent of other raceway systems.

C. Install conduit as follows:
1. In complete mechanically and electrically continuous runs before pulling in cables or wires.
2. Unless otherwise indicated on the drawings or specified herein, installation of all conduits shall be concealed within finished walls, floors, and ceilings.
3. Flattened, dented, or deformed conduit is not permitted. Remove and replace the damaged conduits with new conduits.
4. Assure conduit installation does not encroach into the ceiling height head room, walkways, or doorways.
5. Cut conduits square, ream, remove burrs, and draw up tight.
6. Independently support conduit at 2.4 M (8 feet (243.84 cm)) 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 (304.8 mm)) 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.
   a. Conduit installations under fume and vent hoods are prohibited.
   b. 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.

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a. Flashing of penetrations of the roof membrane is specified in Section 07 60 00, FLASHING AND SHEET METAL.

b. Conduit bodies shall only be used for changes in direction, and shall not contain splices.

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 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.

11.2 CONCEALED WORK INSTALLATION

A. In Concrete:
1. Conduit: Rigid steel, IMC, or EMT, schedule 40 or greater PVC
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 (76.2 mm)) 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, andone conduit diameter at conduit crossings.
c. Install conduits approximately in the center of the slab so that there will be a minimum of 0.75 inch (19 mm) 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

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a. continuity through the conduits. Tightening setscrews with pliers is prohibited.

B. Above Furred or Suspended Ceilings and in Walls:
1. Conduit for Conductors 600 V and Below:Rigid steel, IMC, or EMT.Mixing different types of conduits in the same system is prohibited.
2. Align and run conduit parallel or perpendicular to the building lines.
3. Connect recessed lighting fixtures to conduit runs with maximum 1.8 M (6 feet (182.88 cm)) of flexible metal conduit extending from a junction box to the fixture.
4. Tightening setscrews with pliers is prohibited.
5. For conduits running through metal studs, limit field cut holes to no more than 70% of web depth. Spacing between holes shall be at least 457 mm (18 inches (457.2 mm)). Cuts or notches in flanges or return lips shall not be permitted.

12.2 EXPOSED WORK INSTALLATION

A. Unless otherwise indicated on drawings, exposed conduit is only permitted in mechanical and electrical rooms.

B. Conduit for Conductors 600 V and Below:Rigid steel, IMC, or EMT.Mixing different types of conduits in the system is prohibited.

C. Align and run conduit parallel or perpendicular to the building lines.

D. Install horizontal runs close to the ceiling or beams and secure with conduit straps.

E. Support horizontal or vertical runs at not over 2.4 M (8 feet (243.84 cm)) intervals.

F. Surface Metal Raceways: Use only where shown on drawings.

G. Painting:

1. Paint exposed conduit as specified in Section09 91 00, PAINTING.
2. Paint all conduits containing cables rated over 600 Vsafety orange. Refer to Section 09 91 00, PAINTING for preparation, paint type, and exact color. In addition, paint legends, using 50 mm (2 inch (50.8 mm)) 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 (609.6 cm))intervals in between.
    a. DIRECT BURIAL INSTALLATION
3. Refer to Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION.

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a. HAZARDOUS LOCATIONS

B. Use rigid steel conduit only.

C. 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.

a. WET OR DAMP LOCATIONS

D. Use rigid steel or IMC conduits unless as shown on drawings.

E. 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.

F. 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 behalf- lapped with 10 mil (0.254 mm) PVC tape before installation. After installation, completely recoat or retapeany damaged areas of coating.

G. 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 (243.84 cm)) with 0.35 inch (9 mm) galvanized threaded rods, square washer and locknut. Conduits shall be attached to steel channel with conduit clamps.

a. MOTORS AND VIBRATING EQUIPMENT

H. Use flexible metal conduit for connections to motors and other electrical equipment subject to movement, vibration, misalignment, cramped quarters, or noise transmission.

I. 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.

J. Provide a green equipment grounding conductor with flexible and liquid- tight flexible metal conduit.

a. EXPANSION JOINTS

K. Conduits 75 mm (3 inch (76.2 mm)) 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.

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A. Provide conduits smaller than 75 mm (3 inch (76.2 mm))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 (127 mm)) 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.

B. Install expansion and deflection couplings where shown.

14.2 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 inserts set in place prior to placing the concrete.
   2. Existing Construction:
      a. Steel expansion anchors not less than 0.24 inch (6 mm) bolt size and not less than 28 mm (1.125 inch (28.58 mm)) in embedment.
      b. Power set fasteners not less than 0.24 inch (6 mm)diameter with depth of penetration not less than 75 mm (3 inch (76.2 mm)).
      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.

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A. Chain, wire, or perforated strap shall not be used to support or fasten conduit.

B. Spring steel type supports or fasteners are prohibited for all uses except horizontal and vertical supports/fasteners within walls.

C. 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.

15.2 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. Plugunused 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 (609.6 mm))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 (101.6 mm)) square x55 mm (2.125 inches (53.97 mm)) deep, with device covers for the wall material and thickness involved.

H. Stencil or install phenolic nameplates on covers of the boxes identified on riser diagrams; for example "SIG-FA JB No. 1."

I. On all branch circuit junction box covers, identify the circuits with black marker.

--- E N D ---

END OF SECTION

SECTION 26 05 41
UNDERGROUND ELECTRICAL CONSTRUCTION

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, and connection of underground ducts and raceways, and precast manholes and pullboxes to form a complete underground electrical raceway system.

B. The terms “duct” and “conduit” are used interchangeably in this section.

1.2 RELATED WORK

A. Section 07 92 00, JOINT SEALANTS: Sealing of conduit penetrations.

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.

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.

B. Coordinate layout and installation of ducts and pullboxes with final arrangement of other utilities, site grading, and surface features.

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 information on pullboxes, ducts, and hardware. Submit elevation drawings, showing openings, pulling irons, cable supports, cover, ladder, sump, and other accessories.
   c. Proposed deviations from the drawings shall be clearly marked on the submittals. If it is necessary to locate manholes, pullboxes, or duct banks at locations other than shown on the drawings, show the proposed locations accurately on scaled site drawings, and submit to the COR for approval prior to construction.
2. Certifications: Two weeks prior to the final inspection, submit the following.
   a. Certification by the manufacturer that the materials conform to the requirements of the drawings and specifications.
   b. Certification by the Contractor that the materials have been properly installed, connected, 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 Concrete Institute (ACI):

Building Code Requirements for Structural Concrete	
318-19/318M-19	Building Code Requirements for Structural Concrete & Commentary
MNL-66-20	ACI Detailing Manual

C. American National Standards Institute (ANSI):

77-17	Underground Enclosure Integrity

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

C478/C478M-20	Standard Specification for Precast Reinforced Concrete Manhole Sections
C858-19	Underground Precast Concrete Utility Structures
C990/C990M-09	Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants

E. National Electrical Manufacturers Association (NEMA):

TC 2-20	Electrical Polyvinyl Chloride (PVC) Conduit
TC 3-21	Polyvinyl Chloride (PVC) Fittings for Use With Rigid PVC Conduit And Tubing
TC 6 & 8-20	Polyvinyl Chloride (PVC) Plastic Utilities Duct For Underground Installations
TC 9-20	Fittings For Polyvinyl Chloride (PVC) Plastic Utilities Duct For Underground Installation

F. National Fire Protection Association (NFPA):

70-23	National Electrical Code (NEC)
70E-21	National Electrical Safety Code

G. Underwriters Laboratories, Inc. (UL):

6-09	Electrical Rigid Metal Conduit-Steel
467-13	Grounding and Bonding Equipment
651-11	Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings
651A-11	Schedule 40 and 80 High Density Polyethylene (HDPE) Conduit

PART 2 - PRODUCTS

2.1 PULLBOXES

A. General: Size as indicated on the drawings. Provide pullboxes with weatherproof, non-skid covers with recessed hook eyes, secured with corrosion- and tamper-resistant hardware. Cover material shall be identical to pullbox material. Covers shall have molded lettering, ELECTRIC, as applicable. Pullboxes shall comply with the requirements of ANSI 77 Tier 15 loading. Provide pulling irons, 22 mm (0.875 inch) diameter galvanized steel bar with exposed triangular-shaped opening.

B. Polymer Concrete Pullboxes: Shall be molded of sand, aggregate, and polymer resin, and reinforced with steel, fiberglass, or both. Pullbox shall have open bottom.

C. Concrete Pullboxes: Shall be monolithically-poured reinforced concrete.

2.2 DUCTS

A. Number and sizes shall be as shown on the drawings.

B. Ducts (concrete-encased):
   1. Plastic Duct:
      a. UL 651 and 651A Schedule 40 PVC conduit or as called out on drawing.
      b. Duct shall be suitable for use with 90˚ C (194˚ F) rated conductors.
   2. Conduit Spacers: Prefabricated plastic.

C. Ducts (direct-burial):
   1. Plastic duct:
      a. Schedule 40 PVC.
      b. Duct shall be suitable for use with 75˚ C (167˚ F) rated conductors.
   2. Rigid metal conduit: UL 6 and NEMA RN1 galvanized rigid metal, half-lap wrapped with 10 mil PVC tape.

2.3 GROUNDING

A. Ground Rods and Ground Wire: Per Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

2.4 WARNING TAPE

A. 4-mil polyethylene 75 mm (3 inches) wide detectable tape, red with black letters, imprinted with “CAUTION - BURIED ELECTRIC CABLE BELOW” or similar.

2.5 PULL ROPE FOR SPARE DUCTS

A. Plastic with 890 N (200 lb) minimum tensile strength.

PART 3 - EXECUTION

3.1 PULLBOX INSTALLATION

A. Assembly and installation shall be per the requirements of the manufacturer.
   1. Install manholes and pullboxes level and plumb.
   2. Units shall be installed on a 300 mm (12 inches) thick level bed of 90% compacted granular fill, well-graded from the 25 mm (1 inch) sieve to the No. 4 sieve. Granular fill shall be compacted with a minimum of four passes with a plate compactor.

B. Access: Ensure the top of frames and covers are flush with finished grade.

3.2 TRENCHING

A. Before performing trenching work at existing facilities, a Ground Penetrating Radar Survey shall be carefully performed by a certified technician to reveal all existing underground ducts, conduits, cables, and other utility systems.

B. Work with extreme care near existing ducts, conduits, and other utilities to avoid damaging them.

C. Cut the trenches neatly and uniformly.

D. Pitch ductbanks away from buildings. Refer to drawings for fill and compaction requiremetns.

E. Individual conduits to be installed under existing paved areas and roads that cannot be disturbed shall be jacked into place using rigid metal conduit, or bored using plastic utilities duct or PVC conduit, as approved by the/COR.

3.3 DUCT INSTALLATION

A. General Requirements:
   1. Ducts shall be in accordance with the NEC, as shown on the drawings, and as specified.
   2. Join and terminate ducts with fittings recommended by the manufacturer.
   3. Slope ducts to drain towards manholes and pullboxes, and away from building and equipment entrances. Pitch not less than 100 mm (4 inches) in 30 M (100 feet).
   4. Underground conduit stub-ups and sweeps to equipment inside of buildings shall be galvanized rigid metal conduit half-lap wrapped with PVC tape, and shall extend a

minimum of 1.5 M (5 feet) outside the building foundation. Tops of conduits below building slab shall be minimum 610 mm (24 inches) below bottom of slab.

5. Stub-ups and sweeps to equipment mounted on outdoor concrete slabs shall be galvanized rigid metal conduit half-lap wrapped with PVC tape, and shall extend a minimum of 1.5 M (5 feet) away from the edge of slab.
6. Install insulated grounding bushings on the conduit terminations.
7. Radius for sweeps shall be sufficient to accomplish pulls without damage. Minimum radius shall be six times conduit diameter.
8. All multiple conduit runs shall have conduit spacers. Spacers shall securely support and maintain uniform spacing of the duct assembly a minimum of 75 mm (3 inches) above the bottom of the trench during the concrete pour. Spacer spacing shall not exceed 1.5 M (5 feet). Secure spacers to ducts and earth to prevent floating during concrete pour. Provide nonferrous tie wires to prevent displacement of the ducts during concrete pour. Tie wires shall not act as substitute for spacers.
9. Duct lines shall be installed no less than 300 mm (12 inches) from other utility systems, such as water, sewer, chilled water.
10. Clearances between individual ducts:
    a. For similar services, not less than 75 mm (3 inches).
    b. For power and signal services, not less than 150 mm (6 inches).
11. Duct lines shall terminate at window openings in manhole walls as shown on the drawings. All ducts shall be fitted with end bells.
12. Couple the ducts with proper couplings. Stagger couplings in rows and layers to ensure maximum strength and rigidity of the duct bank.
13. Keep ducts clean of earth, sand, or gravel, and seal with tapered plugs upon completion of each portion of the work.
14. Spare Ducts: Where spare ducts are shown, they shall have a nylon pull rope installed. They shall be capped at each end and labeled as to location of the other end.
15. Duct Identification: Place continuous strip of warning tape approximately 300 mm (12 inches) above ducts before backfilling trenches. Warning tape shall be preprinted with proper identification.
16. Duct Sealing: Seal ducts, including spare ducts, at building entrances and at outdoor terminations for equipment, with a suitable non-hardening compound to prevent the entrance of foreign objects and material, moisture, and gases.
17. Use plastic ties to secure cables to insulators on cable arms. Use minimum two ties per cable per insulator.

B. Concrete-Encased Ducts:
1. Install concrete-encased ducts for medium-voltage systems, low-voltage systems, and signal systems, unless otherwise shown on the drawings.
2. Duct banks shall be single or multiple duct assemblies encased in concrete. Ducts shall be uniform in size and material throughout the installation.
3. Tops of concrete-encased ducts shall be:
    a. Not less than 600 mm (24 inches) and not less than shown on the drawings, below finished grade.
    b. Not less than 750 mm (30 inches) and not less than shown on the drawings, below roads and other paved surfaces.
    c. Additional burial depth shall be required in order to accomplish NEC-required minimum bend radius of ducts.
    d. Conduits crossing under grade slab construction joints shall be installed a minimum of 1.2 M (4 feet) below slab.
4. Extend the concrete envelope encasing the ducts not less than 75 mm (3 inches) beyond the outside walls of the outer ducts.
5. Within 3 M (10 feet} of building and manhole wall penetrations, install reinforcing steel bars at the top and bottom of each concrete envelope to provide protection against vertical shearing.

6. Install reinforcing steel bars at the top and bottom of each concrete envelope of all ducts underneath roadways and parking areas.
7. Where new ducts and concrete envelopes are to be joined to existing manholes, pullboxes, ducts, and concrete envelopes, make the joints with the proper fittings and fabricate the concrete envelopes to ensure smooth durable transitions.
8. Duct joints in concrete may be placed side by side horizontally, but shall be staggered at least 150 mm (6 inches) vertically.
9. Pour each run of concrete envelope between manholes or other terminations in one continuous pour. If more than one pour is necessary, terminate each pour in a vertical plane and install 19 mm (0.75 inch) reinforcing rod dowels extending 450 mm (18 inches) into concrete on both sides of joint near corners of envelope.
10. Pour concrete so that open spaces are uniformly filled. Do not agitate with power equipment unless approved by COR.

C. Direct-Burial Ducts:
1. Install direct-burial ducts only where shown on the drawings. Provide direct-burial ducts only for low-voltage power and lighting branch circuits.
2. Tops of ducts shall be:
   a. Not less than 600 mm (24 inches) and not less than shown on the drawings, below finished grade.
   b. Not less than 750 mm (30 inches) and not less than shown on the drawings, below roads and other paved surfaces.
   c. Additional burial depth shall be required in order to accomplish NEC-required minimum bend radius of ducts.
3. Do not kink the ducts. Compaction shall not deform the ducts.

D. Connections to Existing Manholes: For duct connections to existing manholes, break the structure wall out to the dimensions required and preserve the steel in the structure wall. Cut steel and extend into the duct bank envelope. Chip the perimeter surface of the duct bank opening to form a key or flared surface, providing a positive connection with the duct bank envelope.

E. Connections to Existing Ducts: Where connections to existing ducts are indicated, excavate around the ducts as necessary. Cut off the ducts and remove loose concrete from inside before installing new ducts. Provide a reinforced-concrete collar, poured monolithically with the new ducts, to take the shear at the joint of the duct banks.

F. Partially-Completed Ducts: During construction, wherever a construction joint is necessary in a duct bank, prevent debris such as mud and dirt from entering ducts by providing suitable plugs. Fit concrete envelope of a partially completed ducts with reinforcing steel extending a minimum of 600 mm (2 feet) back into the envelope and a minimum of 600 mm (2 feet) beyond the end of the envelope. Provide one No. 4 bar in each corner, 75 mm (3 inches) from the edge of the envelope. Secure corner bars with two No. 3 ties, spaced approximately 300 mm (12 inches) apart. Restrain reinforcing assembly from moving during pouring of concrete.

3.4 ACCEPTANCE CHECKS AND TESTS

A. Duct Testing and Cleaning:
1. Upon completion of the duct installation, a standard flexible mandrel shall be pulled through each duct to loosen particles of earth, sand, or foreign material left in the duct, and to test for out-of-round conditions.
2. The mandrel shall be not less than 300 mm (12 inches) long, and shall have a diameter not less than 13 mm (0.5 inch) less than the inside diameter of the duct. A brush with stiff bristles shall then be pulled through each duct to remove the loosened particles. The diameter of the brush shall be the same as, or slightly larger than, the diameter of the duct.
3. If testing reveals obstructions or out-of-round conditions, the Contractor shall replace affected section(s) of duct and retest to the satisfaction of the COR.

4. Mandrel pulls shall be witnessed by the COR.

END OF SECTION

SECTION 26 05 73
OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the overcurrent protective device coordination study, related calculations and analysis, indicated as the study in this section.

B. A short-circuit and selective coordination study, and arc flash calculations and analysis shall be prepared for the electrical overcurrent devices to be installed under this project.

C. The study shall present a well-coordinated time-current analysis of each overcurrent protective device from the individual device up to the utility source and the on-site generator sources.

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 24 13, DISTRIBUTION SWITCHBOARDS: Low-voltage distribution switchboards.

C. Section 26 24 16, PANELBOARDS: Low-voltage panelboards.

D. Section 26 32 13, ENGINE GENERATORS: Engine generators.

E. Section 26 36 23, AUTOMATIC TRANSFER SWITCHES: Automatic transfer switches.

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.

B. The study shall be prepared by the equipment manufacturer, and performed by the equipment manufacturer’s licensed electrical engineer.

1.4 SUBMITTALS

A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:

1. Product data on the software program to be used for the study. Software shall be in mainstream use in the industry, shall provide device settings and ratings, and shall show selective coordination by time-current drawings.
2. Complete study as described in paragraph 1.6. Submittal of the study shall be well-coordinated with submittals of the shop drawings for equipment in related specification sections. Provide to Engineer of Record 4 weeks prior to installation of equipment.
3. Certifications: Two weeks prior to final inspection, submit the following.
   a. Certification by the Contractor that the overcurrent protective devices have been set in accordance with the approved study.

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. Institute of Electrical and Electronics Engineers (IEEE):

241-90	Recommended Practice Electrical Systems in Commercial Buildings
242-03	Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems

399-97	Recommended Practice for Industrial and Commercial Power Systems Analysis
1584-18	Performing Arc-Flash Hazards Calculations

C. National Fire Protection Association (NFPA):

70-23	National Electrical Code (NEC)
70E-21	Standard for Electrical Safety in the Workplace
99-21	Health Care Facilities Code

1.6 STUDY REQUIREMENTS

A. The study shall be in accordance with IEEE and NFPA standards.

B. The study shall include one line diagram, short-circuit and ground fault analysis, protective coordination plots for all overcurrent protective devices, and arc flash calculations and analysis.

C. One Line Diagram:
   1. Show all electrical equipment and wiring to be protected by the overcurrent devices.
   2. Show the following specific information:
      a. Calculated fault impedance, X/R ratios, and short-circuit values at each feeder and branch circuit bus.
      b. Relay, circuit breaker, and fuse ratings.
      c. Generator kW/kVA and transformer kVA and voltage ratings, percent impedance, X/R ratios, and wiring connections.
      d. Voltage at each bus.
      e. Identification of each bus, matching the identification on the drawings.
      f. Conduit, conductor, and busway material, size, length, and X/R ratios.

D. Short-Circuit Study:
   1. The study shall be performed using computer software designed for this purpose. Pertinent data and the rationale employed in developing the calculations shall be described in the introductory remarks of the study.
   2. Calculate the fault impedance to determine the available short-circuit and ground fault currents at each bus. Incorporate applicable motor and/or generator contribution in determining the momentary and interrupting ratings of the overcurrent protective devices.
   3. Present the results of the short-circuit study in a table. Include the following:
      a. Device identification.
      b. Operating voltage.
      c. Overcurrent protective device type and rating.
      d. Calculated short-circuit current.

E. Coordination Study:
   1. Prepare the coordination curves to determine the required settings of overcurrent protective devices to demonstrate selective coordination. Graphically illustrate on log-log paper that adequate time separation exists between devices, including the utility company upstream device if applicable. Plot the specific time-current characteristics of each overcurrent protective device in such a manner that all devices are clearly depicted.
   2. The following specific information shall also be shown on the coordination curves:
      a. Device identification.
      b. Potential transformer and current transformer ratios.
      c. Three-phase and single-phase ANSI damage points or curves for each cable, transformer, or generator.
      d. Applicable circuit breaker or protective relay characteristic curves.
      e. No-damage, melting, and clearing curves for fuses.
      f. Transformer in-rush points.

3. Develop a table to summarize the settings selected for the overcurrent protective devices. Include the following in the table:
   a. Device identification.
   b. Protective relay or circuit breaker potential and current transformer ratios, sensor rating, and available and suggested pickup and delay settings for each available trip characteristic.
   c. Fuse rating and type.

F. Arc Flash Calculations and Analysis:
1. Arc flash warning labels shall comply with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
2. Arc flash calculations shall be based on actual over-current protective device clearing time. Maximum clearing time shall be in accordance with IEEE 1584.
3. Arc flash analysis shall be based on the lowest clearing time setting of the over-current protective device to minimize the incident energy level without compromising selective coordination.
4. Arc flash boundary and available arc flash incident energy at the corresponding working distance shall be calculated for all electrical power distribution equipment specified in the project, and as shown on the drawings.
5. Required arc-rated clothing and other PPE shall be selected and specified in accordance with NFPA 70E.

1.7 ANALYSIS

A. Analyze the short-circuit calculations, and highlight any equipment determined to be underrated as specified. Propose solutions to effectively protect the underrated equipment.

1.8 ADJUSTMENTS, SETTINGS, AND MODIFICATIONS

A. Final field settings and minor modifications of the overcurrent protective devices shall be made to conform with the study, without additional cost to the Government.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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.

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.

END OF SECTION

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 24 16, PANELBOARDS: Panelboard enclosure and interior bussing used for lighting control panels.

F. Section 26 27 26, WIRING DEVICES: Wiring devices used for control of the lighting systems.

G. Section 26 51 00, INTERIOR LIGHTING: Luminaire balla 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 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.

2.2 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 and for 1 hp at 120 volt.
   3. Monitoring Range: 108 to 2152 lx (10 to 200 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.

2.3 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 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.

2.4 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.

2.5 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.

B. Central Control Station: Central control station shall be integrated into lighting relay panel and able to be connected via IP.

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.

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 10 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.

END OF SECTION

SECTION 26 22 00
VOLTAGE TRANSFORMERS

PART 1 – GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, connection, and testing of low-voltage dry-type general-purpose transformers, indicated as transformers in this section.

1.2 RELATED WORK

A. Section 03 30 00, CAST-IN-PLACE CONCRETE: Requirements for concrete equipment pads.

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 fault currents.

E. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduit.

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, materials, required clearances, terminations, weight, temperature rise, wiring and connection diagrams, plan, front, side, and rear elevations, accessories, and device nameplate data.
   c. Certification from the manufacturer that representative transformers 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, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals including technical data sheets and wiring diagrams.
      1) Schematic signal and control diagrams, with all terminals identified, matching terminal identification in the transformers.
      2) Include information for testing, repair, troubleshooting, assembly, disassembly, and factory recommended/required periodic maintenance procedures and frequency.
   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 transformers conform to the requirements of the drawings and specifications.
   b. Certification by the Contractor that the transformers 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 Fire Protection Association (NFPA):

70-23	National Electrical Code (NEC)

D. National Electrical Manufacturers Association (NEMA):

TR 1-19	Transformers, Step Voltage Regulators and Reactors
ST 20-14	Dry Type Transformers for General Applications

E. Underwriters Laboratories, Inc. (UL):

UL 506-17	Standard for Safety - Specialty Transformers
UL 1561-11	Standard for Safety - Dry-Type General Purpose and Power Transformers

F. United States Department of Energy:

10 CFR Part 431	Energy Efficiency Program for Certain Commercial and Industrial Equipment

PART 2 - PRODUCTS

2.1 TRANSFORMERS

A. Unless otherwise specified, transformers shall be in accordance with NEMA, NFPA, UL and as shown on the drawings.

B. Transformers shall have the following features:
   1. Self-cooled by natural convection, isolating windings, indoor dry-type. Autotransformers will not be accepted, except as specifically allowed for buck-boost applications.
   2. Rating and winding connections shall be as shown on the drawings.
   3. Ratings shown on the drawings are for continuous duty without the use of cooling fans.
   4. Copper windings.
   5. Insulation systems:
      a. Transformers 30 kVA and larger: UL rated 220 °C (428 °F) system with an average maximum rise by resistance of 150 °C (302 °F) in a maximum ambient of 40 °C (104 °F).
      b. Transformers below 30 kVA: Same as for 30 kVA and larger or UL rated 185 °C (365 °F) system with an average maximum rise by resistance of 115 °C (239 °F) in a maximum ambient of 40 °C (104 °F).
   6. Core and coil assemblies:
      a. Rigidly braced to withstand the stresses caused by short-circuit currents and rough handling during shipment.
      b. Cores shall be grain-oriented, non-aging, and silicon steel.
      c. Coils shall be continuous windings without splices except for taps.
      d. Coil loss and core loss shall be minimized for efficient operation.
      e. Primary and secondary tap connections shall be brazed or pressure type.
      f. Coil windings shall have end filters or tie-downs for maximum strength.
   7. Average audible sound levels shall comply with NEMA.
   8. If not shown on drawings, nominal impedance shall be as permitted by NEMA.

9. Single phase transformers rated 15 kVA through 25 kVA shall have two 5% full capacity taps below normal rated primary voltage. All transformers rated 30 kVA and larger shall have two 2.5% full capacity taps above, and four 2.5% full capacity taps below normal rated primary voltage.
10. Core assemblies shall be grounded to their enclosures with adequate flexible ground straps.
11. Enclosures:
    a. Comprised of not less than code gauge steel.
    b. Outdoor enclosures shall be NEMA 3R.
    c. Temperature rise at hottest spot shall conform to NEMA Standards, and shall not bake and peel off the enclosure paint after the transformer has been placed in service.
    d. Ventilation openings shall prevent accidental access to live components.
    e. The enclosure at the factory shall be thoroughly cleaned and painted with manufacturer's prime coat and standard finish.
12. Standard NEMA features and accessories, including ground pad, lifting provisions, and nameplate with the wiring diagram and sound level indicated.
13. Dimensions and configurations shall conform to the spaces designated for their installations.
14. Transformers shall meet the energy conservation standards for transformers per the United States Department of Energy’s 10 CFR Part 431

2.2 NONLINEAR TRANSFORMERS

A. Nonlinear transformers shall be as specified in Paragraph 2.1, with additional features as specified below.

B. Transformers shall be designed to withstand the overheating effects caused by harmonics resulting from non-linear (non-sinusoidal) loads.

C. Neutral rating shall be 200% of rated secondary phase current.

D. Transformers with K factor of 13 shall be provided, if K factor is not shown on contract drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation of transformers shall be in accordance with the NEC, as recommended by the equipment manufacturer and as shown on the drawings.

B. Anchor transformers with rustproof bolts, nuts, and washers, in accordance with manufacturer’s instructions, and as shown on drawings.

C. In seismic areas, transformers shall be adequately anchored and braced per details on structural contract drawings to withstand the seismic forces at the location where installed.

D. Install transformers with manufacturer's recommended clearance from wall and adjacent equipment for air circulation. Minimum clearance shall be 150 mm (6 inches).

E. Install transformers on vibration pads designed to suppress transformer noise and vibrations.

3.2 ACCEPTANCE CHECKS AND TESTS

A. Perform tests 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 and mechanical condition.
        c. Inspect all field-installed bolted electrical connections, using the calibrated torque-wrench method to verify tightness of accessible bolted electrical connections.

d. Perform specific inspections and mechanical tests as recommended by manufacturer.
e. Verify correct equipment grounding.
f. Verify proper secondary phase-to-phase and phase-to-neutral voltage after energization and prior to connection to loads.

3.3 FOLLOW-UP VERIFICATION

A. Upon completion of acceptance checks, settings, and tests, the contractor shall demonstrate that the transformers are in good operating condition, and properly performing the intended function.

END OF SECTION

SECTION 26 24 13
DISTRIBUTION SWITCHBOARDS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, connection, and testing of the low-voltage circuit-breaker distribution switchboards, indicated as switchboard(s) in this section.

1.2 RELATED WORK

A. Section 03 30 00, CAST-IN-PLACE CONCRETE: Requirements for concrete equipment pads.

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 fault currents.

E. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduit.

F. Section 26 05 73, OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY: Short circuit and coordination study, and requirements for a coordinated electrical system.

G. Section 26 43 13, SURGE PROTECTIVE DEVICES: Surge protective devices for switchboards.

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 FACTORY TESTS

A. Factory Tests shall be required.

B. Factory Tests shall be in accordance with Paragraph, MANUFACTURED PRODUCTS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirement:

1. Tests shall be conducted per NEMA PB 2.
2. Verify that circuit breaker sizes and types correspond to drawings, and the Overcurrent Protective Device Coordination Study.
3. Verify tightness of bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer’s published data.
4. Exercise all active components.
5. Perform an insulation-resistance test, phase to ground, on each bus section, with phases not under test grounded, in accordance with manufacturer’s published data.
6. Perform insulation-resistance tests on control wiring with respect to ground. Applied potential shall be 500 V DC for 300-volt rated cable and 1000 V DC for 600-volt rated cable, or as required if solid-state components or control devices cannot tolerate the applied voltage.
7. Perform testing per NETA

1.5 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. Switchboard shop drawings shall be submitted simultaneously with or after the Overcurrent Protective Device Coordination Study.
   b. Submit sufficient information to demonstrate compliance with drawings and specifications.

c. Prior to fabrication of switchboards, submit the following data for approval:
   1) Complete electrical ratings.
   2) Circuit breaker sizes.
   3) Interrupting ratings.
   4) Safety features.
   5) Accessories and nameplate data.
   6) Switchboard one line diagram, showing ampere rating, number of bars per phase and neutral in each bus run (horizontal and vertical), bus spacing, equipment ground bus, and bus material.
   7) Elementary and interconnection wiring diagrams.
   8) Technical data for each component.
   9) Dimensioned exterior views of the switchboard.
   10) Dimensioned section views of the switchboard.
   11) Floor plan of the switchboard.
   12) Foundation plan for the switchboard.
   13) Provisions and required locations for external conduit and wiring entrances.
   14) Approximate design weights.

2. Manuals:
   a. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals, including technical data sheets, wiring diagrams, and information for ordering replacement parts.
      1) Schematic signal and control diagrams, with all terminals identified, matching terminal identification in the switchboard.
      2) Include information for testing, repair, trouble shooting, assembly, disassembly, and factory recommended/required periodic maintenance procedures and frequency.
      3) Provide a replacement and spare parts list. Include a list of tools and instruments for testing and maintenance purposes.
   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 switchboards conform to the requirements of the drawings and specifications.
   b. Certification by the Contractor that the switchboards have been properly installed, adjusted, and tested.

1.6 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by basic designation only.

B. Institute of Engineering and Electronic Engineers (IEEE):

C37.13-15	Low Voltage AC Power Circuit Breakers Used in Enclosures
C57.13-16	Instrument Transformers
C62.41.1-08	Surge Environment in Low-voltage (1000V and less) AC Power Circuits
C62.45-08	Surge Testing for Equipment connected to Low-Voltage AC Power Circuits

C. International Code Council (ICC):

IBC-21	International Building Code

D. National Electrical Manufacturer's Association (NEMA):

PB 2-11	Deadfront Distribution Switchboards
PB 2.1-13	Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards Rated 600 Volts or Less

E. National Fire Protection Association (NFPA):

70-23	National Electrical Code (NEC)

F. Underwriters Laboratories, Inc. (UL):

67-18	Panelboards
489-16	Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
891-19	Switchboards

PART 2 - PRODUCTS

2.1 GENERAL

A. Shall be in accordance with IEEE, NEMA, NFPA, UL, as shown on the drawings, and have the following features:
   1. Switchboard shall be a complete, grounded, continuous-duty, integral assembly, dead-front, dead-rear, self-supporting, indoor type switchboard assembly, . Incorporate devices shown on the drawings and all related components required to fulfill operational and functional requirements.
   2. Ratings shall not be less than shown on the drawings. Short circuit ratings shall not be less than the available fault current shown in the Overcurrent Protective Device Coordination Study.
   3. Switchboard shall conform to the arrangements and details shown on the drawings.
   4. Switchboards shall be assembled, connected, and wired at the factory so that only external circuit connections are required at the construction site. Split the structure only as required for shipping and installation. Packaging shall provide adequate protection against rough handling during shipment.
   5. All non-current-carrying parts shall be grounded per Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS for additional requirements.
   6. Series rated switchboards are not allowed.

2.2 BASIC ARRANGEMENT

A. Type 1: Switchboard shall be front accessible with the following features:
   1. Device mounting:
      a. Main breaker: Individually mounted and compartmented or group mounted with feeder breakers.
      b. Feeder breakers: Group mounted.
   2. Section alignment: As shown on the drawings.
   3. Accessibility:
      a. Main section line and load terminals: Front and side.
      b. Distribution section line and load terminals: Front.
      c. Through bus connections: Front and end.
   4. Bolted line and load connections.
   5. Full height wiring gutter covers for access to wiring terminals.

2.3 HOUSING

A. Shall have the following features:
   1. Frames and enclosures:
      a. The assembly shall be braced with reinforcing gussets using jig welds to assure rectangular rigidity.

b. The enclosure shall be steel, leveled, and not less than the gauge required by applicable publications.
c. Die-pierce the holes for connecting adjacent structures to ensure proper alignment, and to allow for future additions.
d. All bolts, nuts, and washers shall be zinc-plated steel.

B. Finish:
1. All metal surfaces shall be thoroughly cleaned, phosphatized and factory primed prior to applying baked enamel or lacquer finish.
2. Provide a light gray finish for indoor switchboard.

2.4 BUSES

A. Bus Bars and Interconnections:
1. Provide copper phase and neutral buses, fully rated for the amperage as shown on the drawings for the entire length of the switchboard. Bus laminations shall have a minimum of 6 mm (1/4 inch) spacing.
2. Mount the buses on appropriately spaced insulators and brace to withstand the available short circuit currents.
3. The bus and bus compartment shall be designed so that the acceptable NEMA standard temperature rises are not exceeded.
4. Install a copper ground bus the full length of the switchboard assembly.
5. Main Bonding Jumper: An un-insulated copper bus, size as shown on drawings, shall interconnect the neutral and ground buses, when the switchboard is used to establish the system common ground point.
6. All bolts, nuts, and washers shall be /zinc-plated\ steel. Bolts shall be torqued to the values recommended by the manufacturer.
7. Make provisions for future bus extensions by means of bolt holes or other approved method.

2.5 MAIN CIRCUIT BREAKERS

A. Type I or Type II Switchboards: Provide molded case main circuit breakers as shown on the drawings. Circuit breakers shall be the solid state adjustable trip type.
1. Trip units shall have field adjustable tripping characteristics as follows:
a. Long time pickup.
b. Long time delay.
c. Short time pickup.
d. Short time delay.
e. Instantaneous.
2. Breakers with same frame size shall be interchangeable with each other.
3. Breakers shall be fully rated as noted on drawings.

2.6 FEEDER CIRCUIT BREAKERS

A. Provide molded case circuit breakers as shown on the drawings.

B. Adjustable Trip Molded Case Circuit Breakers:
1. Provide molded case, solid state adjustable trip type circuit breakers.
2. Trip units shall have field adjustable tripping characteristics as follows:
a. Long time pickup.
b. Long time delay.
c. Short time pickup.
d. Short time delay.
e. Instantaneous.
f. Ground fault delay.
3. Breakers with same frame size shall be interchangeable with each other.

2.7 SURGE PROTECTIVE DEVICES

A. SPDs shall be integral to switchboards.

B. Refer to Section 26 43 13, SURGE PROTECTIVE DEVICES.

2.8 METERING

A. Provide current transformers for each meter. Current transformers shall be wired to shorting-type terminal blocks.

B. Meters shall be PowerLogic PM8244 or 5563 as noted on drawings as basis of design and provide a minimum of the following:
   1. Energy
   2. Active and Reactive Power
   3. Voltage
   4. Current
   5. Frequency
   6. Power Factor
   7. Up to the 63rd Harmonic

C. Meter shall have I/O ports capable of tying into existing BMS and metering system.

2.9 OTHER EQUIPMENT

A. Furnish tools and accessories required for circuit breaker and switchboard test, inspection, maintenance, and proper operation.

2.10 CONTROL WIRING

A. Switchboard control wires shall not be less than No. 14 AWG copper 600 volt rated. Install wiring complete at the factory, adequately bundled and protected. Provide separate control circuit fuses in each breaker compartment and locate for ease of access and maintenance.

2.11 NAMEPLATES AND MIMIC BUS

A. Nameplates: For Normal Power system, provide laminated black phenolic resin with white core with 12 mm (1/2 inch) engraved lettered nameplates next to each circuit breaker. For Essential Electrical System, provide laminated red phenolic resin with white core with 12 mm (1/2 inch) engraved lettered nameplates next to each circuit breaker. Nameplates shall indicate equipment served, spaces, or spares in accordance with one line diagram shown on drawings. Nameplates shall be mounted with plated screws on front of breakers or on equipment enclosure next to breakers. Mounting nameplates only with adhesive is not acceptable.

B. Mimic Bus: Provide an approved mimic bus on front of each switchboard assembly. Color shall be black for the Normal Power system and red for the Essential Electrical System, either factory-painted plastic or metal strips. Plastic tape shall not be used. Use symbols similar to one line diagram shown on drawings. Plastic or metal strips shall be mounted with plated screws

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install switchboards in accordance with the NEC, as shown on the drawings, and as recommended by the manufacturer.

B. Anchor switchboards with rustproof bolts, nuts, and washers not less than 13 mm (1/2 inch) diameter, in accordance with manufacturer’s instructions, and as shown on drawings.

C. Interior Location. Mount switchboard on concrete slab. Unless otherwise indicated, the slab shall be at least 100 mm (4 inches) thick. The top of the concrete slab shall be approximately 100 mm (4 inches) above finished floor. Edges above floor shall have 12.5 mm (1/2 inch) chamfer. The slab shall be of adequate size to project at least 200 mm (8 inches) beyond the equipment. Provide conduit turnups and cable entrance space required by the equipment to be mounted. Seal voids around conduit openings in slab with water- and oil-resistant caulking or

sealant. Cut off and bush conduits 75 mm (3 inches) above slab surface. Concrete work shall be as specified in Section 03 30 00, CAST-IN-PLACE CONCRETE.

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 appropriate anchorage, required area clearances, and correct alignment.
      d. Verify that circuit breaker sizes and types correspond to approved shop drawings.
      e. Verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey after energization.
      f. Vacuum-clean switchboard enclosure interior. Clean switchboard enclosure exterior.
      g. Inspect insulators for evidence of physical damage or contaminated surfaces.
      h. Verify correct shutter installation and operation.
      i. Exercise all active components.
      j. Verify the correct operation of all sensing devices, alarms, and indicating devices.
      k. Verify that vents are clear.
   2. Electrical tests:
      a. Perform insulation-resistance tests on each bus section.
      b. Perform insulation-resistance test on control wiring; do not perform this test on wiring connected to solid-state components.
      c. Perform phasing check on double-ended switchboards to ensure correct bus phasing from each source.

B. Prior to the final inspection for acceptance, a technical representative from the electric utility company shall witness the testing of the equipment to assure the proper operation of the individual components, and to confirm proper operation/coordination with electric utility company’s equipment.

3.3 FOLLOW-UP VERIFICATION

A. Upon completion of acceptance checks, settings, and tests, the Contractor shall show by demonstration in service that the switchboard is in good operating condition and properly performing the intended function.

3.4 WARNING SIGN

A. Mount on each entrance door of the switchboard room, approximately 1500 mm (5 feet) above grade or floor, a clearly lettered warning sign for warning personnel. The sign shall be attached with rustproof metal screws.

3.5 ONE LINE DIAGRAM AND SEQUENCE OF OPERATION

A. At final inspection, an as-built one line diagram shall be laminated or mounted under acrylic glass, and installed in a frame mounted in the switchboard room or in the outdoor switchboard enclosure.

B. Deliver an additional four copies of the as-built one line diagram and sequence of operation to the COR.

3.6 AS-LEFT TRIP UNIT SETTINGS

A. The trip unit settings shall be set in the field by an authorized representative of the switchboard manufacturer per the approved Electrical System Protective Device Study in accordance with Section 26 05 73, OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY.

B. The trip unit settings of the main breaker(s) shall be reviewed by the electric utility company to assure coordination with the electric utility company primary fusing. Prior to switchboard activation, provide written verification of this review to the COR.

C. Post a durable copy of the "as-left" trip unit settings in a convenient location in the switchboard room. Deliver four additional copies of the settings to the COR. Furnish this information prior to the activation of the switchboard.

3.7 INSTRUCTION

A. Furnish the services of a factory-trained technician for one, 4-hour training period for instructing personnel in the maintenance and operation of the switchboards, on the dates requested by the COR.

END OF SECTION

SECTION 26 24 16
PANELBOARDS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, and connection of panelboards.

1.2 RELATED WORK

A. Section 09 91 00, PAINTING: Painting of panelboards.

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 fault currents.

E. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits.

F. Section 26 05 73, OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY: Short circuit and coordination study, and requirements for a coordinated electrical system.

G. Section 26 09 23, LIGHTING CONTROLS: Lighting controls integral to panelboards.

H. Section 26 43 13, SURGE PROTECTIVE DEVICES: Surge protective devices integral to panelboards.

1.3 QUALITY ASSURANCE

A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:
   1. Shop Drawings:
      a. Submit sufficient information to demonstrate compliance with drawings and specifications.
      b. Include electrical ratings, dimensions, mounting details, materials, required clearances, terminations, weight, circuit breakers, wiring and connection diagrams, accessories, and nameplate data.
   2. Manuals:
      a. Submit, simultaneously with the shop drawings, complete maintenance and operating manuals including technical data sheets, wiring diagrams, and information for ordering circuit breakers and replacement parts.
         1) Include schematic diagrams, with all terminals identified, matching terminal identification in the panelboards.
         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 panelboards conform to the requirements of the drawings and specifications.
      b. Certification by the Contractor that the panelboards 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):

PB 1-11	Panelboards
250-20	Enclosures for Electrical Equipment (1,000V Maximum)

D. National Fire Protection Association (NFPA):

70-23	National Electrical Code (NEC)
70E-21	Standard for Electrical Safety in the Workplace

E. Underwriters Laboratories, Inc. (UL):

50-15	Enclosures for Electrical Equipment
67-09	Panelboards
489-16	Molded Case Circuit Breakers and Circuit Breaker Enclosures

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Panelboards shall be in accordance with NEC, NEMA, UL, as specified, and as shown on the drawings.

B. Panelboards shall have main breaker or main lugs, bus size, voltage, phases, number of circuit breaker mounting spaces, top or bottom feed, flush or surface mounting, branch circuit breakers, and accessories as shown on the drawings.

C. Panelboards shall be completely factory-assembled with molded case circuit breakers and integral accessories as shown on the drawings or specified herein.

D. Non-reduced size copper bus bars, rigidly supported on molded insulators, and fabricated for bolt-on type circuit breakers.

E. Bus bar connections to the branch circuit breakers shall be the “distributed phase” or “phase sequence” type.

F. Mechanical lugs furnished with panelboards shall be cast, stamped, or machined metal alloys listed for use with the conductors to which they will be connected.

G. Neutral bus shall be 100%rated, mounted on insulated supports.

H. Grounding bus bar shall be equipped with screws or lugs for the connection of equipment grounding conductors.

I. Bus bars shall be braced for the available short-circuit current as shown on the drawings, but not be less than 10,000 A symmetrical for 120/208 V and 120/240 V panelboards, and 14,000 A symmetrical for 277/480 V panelboards.

J. In two-section panelboards, the main bus in each section shall be full size. The first section shall be furnished with subfeed lugs on the line side of main lugs only, or through-feed lugs for main breaker type panelboards, and have field-installed cable connections to the second section as shown on the drawings. Panelboard sections with tapped bus or crossover bus are not acceptable.

K. Series-rated panelboards are not permitted.

2.2 ENCLOSURES AND TRIMS

A. Enclosures:
   1. Provide galvanized steel enclosures, with NEMA rating as shown on the drawings or as required for the environmental conditions in which installed.
   2. Enclosures shall not have ventilating openings.
   3. Enclosures may be of one-piece formed steel or of formed sheet steel with end and side panels welded, riveted, or bolted as required.
   4. Provide manufacturer's standard option for prepunched knockouts on top and bottom endwalls.
   5. Include removable inner dead front cover, independent of the panelboard cover.

B. Trims:
   1. Hinged "door-in-door" type.
   2. Interior hinged door with hand-operated latch or latches, as required to provide access only to circuit breaker operating handles, not to energized parts.
   3. Outer hinged door shall be securely mounted to the panelboard enclosure with factory bolts, screws, clips, or other fasteners, requiring a key or tool for entry. Hand-operated latches are not acceptable.
   4. Inner and outer doors shall open left to right.
   5. Trims shall be flush or surface type as shown on the drawings.

2.3 MOLDED CASE CIRCUIT BREAKERS

A. Circuit breakers shall be per UL, NEC, as shown on the drawings, and as specified.

B. Circuit breakers shall be bolt-on type.

C. Circuit breakers shall have minimum interrupting rating as required to withstand the available fault current, but not less than:
   1. 120/208 V Panelboard: 10,000 A symmetrical.
   2. 120/240 V Panelboard: 10,000 A symmetrical.
   3. 277/480 V Panelboard: 14,000 A symmetrical.

D. Circuit breakers shall have automatic, trip free, non-adjustable, inverse time, and instantaneous magnetic trips for less than 400 A frame. Circuit breakers with 400 A frames and above shall have magnetic trip, adjustable from 5x to 10x. Breaker trip setting shall be set in the field, based on the approved protective device study as specified in Section 26 05 71, ELECTRICAL SYSTEM PROTECTIVE DEVICE STUDY

E. Circuit breaker features shall be as follows:
   1. A rugged, integral housing of molded insulating material.
   2. Silver alloy contacts.
   3. Arc quenchers and phase barriers for each pole.
   4. Quick-make, quick-break, operating mechanisms.
   5. A trip element for each pole, thermal magnetic type with long time delay and instantaneous characteristics, a common trip bar for all poles and a single operator.
   6. Electrically and mechanically trip free.
   7. An operating handle which indicates closed and open positions, as well as a red or yellow visual indicator (display) for tripped.
   8. An overload on one pole of a multi-pole breaker shall automatically cause all the poles of the breaker to open.
   9. Ground fault current interrupting breakers, shunt trip breakers, lighting control breakers (including accessories to switch line currents), or other accessory devices or functions shall be provided where shown on the drawings.
   10. For circuit breakers being added to existing panelboards, coordinate the breaker type with existing panelboards. Modify the panel directory accordingly in type, handwriting is not acceptable.

2.4 SURGE PROTECTIVE DEVICES

A. Where shown on the drawings, furnish panelboards with integral surge protective devices. Refer to Section 26 43 13, SURGE PROTECTIVE DEVICES.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be in accordance with the manufacturer’s instructions, the NEC, as shown on the drawings, and as specified.

B. Locate panelboards so that the present and future conduits can be conveniently connected.

C. Install a printed schedule of circuits in each panelboard after approval by the COR. Schedules shall reflect final load descriptions, room numbers, and room names connected to each circuit breaker. Schedules shall be printed on the panelboard directory cards and be installed in the appropriate panelboards

D. Mount panelboards such that the maximum height of the top circuit breaker above the finished floor shall not exceed 1980 mm (78 inches).

E. Provide blank cover for each unused circuit breaker mounting space.

F. Panelboard enclosures shall not be used for conductors feeding through, spliced, or tapping off to other enclosures or devices.

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 appropriate anchorage and required area clearances.
      d. Verify that circuit breaker sizes and types correspond to approved shop drawings.
      e. To verify tightness of accessible bolted electrical connections, use the calibrated torque-wrench method or perform thermographic survey after energization.
      f. Vacuum-clean enclosure interior. Clean enclosure exterior.

3.3 FOLLOW-UP VERIFICATION

A. Upon completion of acceptance checks, settings, and tests, the Contractor shall demonstrate that the panelboards are in good operating condition and properly performing the intended function.

END OF SECTION

SECTION 26 27 26
WIRING DEVICES

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

A. NFPA 99 - Health Care Facilities Code; 2024, with Errata.

B. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

1.2 DESCRIPTION

A. This section specifies the furnishing, installation, connection, and testing of wiring devices.

1.3 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.

1.4 QUALITY ASSURANCE

A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section
   1. 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.5 SUBMITTALS

A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
   1. Shop Drawings:
      a. Submit sufficient information to demonstrate compliance with drawings and specifications.
      b. 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.

      a. 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.
   2. 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.

2.2 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by basic designation only.

B. National Fire Protection Association (NFPA):
   1. 70-14.....National Electrical Code (NEC)
   2. 99-15.....Health Care Facilities

C. National Electrical Manufacturers Association (NEMA):
   1. WD 1-10.....General Color Requirements for Wiring Devices WD 6-12 .....Wiring Devices – Dimensional Specifications

D. Underwriter's Laboratories, Inc. (UL):
   1. 5-11.....Surface Metal Raceways and Fittings
   2. 20-10.....General-Use Snap Switches
   3. 231-08.....Power Outlets
   4. 467-13.....Grounding and Bonding Equipment
   5. 498-12.....Attachment Plugs and Receptacles
   6. 943-15.....Ground-Fault Circuit-Interrupters
   7. 1449-14.....Surge Protective Devices
   8. 1472-15.....Solid State Dimming Controls

PART 2 - PRODUCTS

3.1 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.

SECTION 26 27 26

   1. 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
         1) 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

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.

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

SECTION 26 27 26

A. 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.

B. Surge Protective (TVSS) Receptacles shall have integral surge suppression in line to ground, line to neutral, and neutral to ground modes.
   1. TVSS Components: Multiple metal-oxide varistors; with a nominal clamp-level rating of 400 Volts, and minimum single transient pulse energy dissipation of 210 Joules.
   2. Active TVSS Indication: LED, visible in face of device to indicate device is active or no longer in service.

5.2 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.Emergency lighting switches shall be red in color.
   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.
   4. MANUAL DIMMING CONTROL
      a. B. Electronic full-wave manual slide dimmer with on/off switch and audible frequency and EMI/RFI suppression filters.

B. C. Manual dimming controls shall be fully compatible with LED dimming driver and be approved by the driver manufacturer, shall operate over full specified dimming range, and shall not degrade the performance or rated life of the electronic dimming ballast and lamp.
   1. D. Provide single-pole, three-way or four-way, as shown on the drawings.

SECTION 26 27 26

6.1 WALL PLATES

A. Wall plates for switches and receptacles shall be type 302 stainless steel. Oversize plates are not acceptable.

B. For receptacles or switches mounted adjacent to each other, wall plates shall be common for each group of receptacles or switches.

C. In areas requiring tamper-proof wiring devices, wall plates shall be type 302 stainless steel, and shall have tamper-proof screws and beveled edges.

D. Duplex Receptacles on Emergency Circuit: Wall plates shall be type 302 stainless steel, with the word “EMERGENCY” engraved in 6 mm (1/4 inch (6.35 mm)) red letters.

E. All emergency devices shall be red in color.

6.2 SURFACE MULTIPLE-OUTLET ASSEMBLIES

A. Shall have the following features:
   1. Enclosures:
      a. a. Thickness of steel shall be not less than 1 mm (0.040 inch (1.02 mm)) for base and cover. Nominal dimensions shall be 1.57 inch (40 mm) x 70 mm (1-1/2 inches (38

mm) by 2-3/4 inches (70 mm)) 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 (609.6 mm)) 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.

SECTION 26 27 26

PART 3 - EXECUTION

8.1 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 (1219.2 mm)) above floor, with the toggle OFF position down.

I. Install wall dimmers 1.2 M (48 inches (1219.2 mm)) above floor.

J. Install receptacles 450 mm (18 inches (457.2 mm)) above floor, and 152 mm (6 inches (152.4 mm)) 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.

9.1 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.
      a. ---END---

END OF SECTION

SECTION 26 29 21
ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, and connection of fused and unfused disconnect switches (indicated as switches in this section), and separately-enclosed circuit breakers for use in electrical systems rated 600 V and below.

1.2 RELATED WORK

A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.

B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.

C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground faults.

D. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits.

E. Section 26 24 16, PANELBOARDS: Molded-case circuit breakers.

1.3 QUALITY ASSURANCE

A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:
   1. Shop Drawings:
      a. Submit sufficient information to demonstrate compliance with drawings and specifications.
      b. Submit the following data for approval:
         1) Electrical ratings, dimensions, mounting details, materials, required clearances, terminations, weight, fuses, circuit breakers, wiring and connection diagrams, accessories, and device nameplate data.
      c. Certification from the manufacturer that representative enclosed switches and circuit breakers have been seismically tested to International Building Code requirements.
   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 I-12	Low Voltage Cartridge Fuses
KS I-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 UNFUSED SWITCHES RATED 600 AMPERES AND LESS

A. Shall be the same as fused switches, but without provisions for fuses.

2.2 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.

2.3 CARTRIDGE FUSES

A. Shall be in accordance with NEMA FU 1.

B. Motor Branch Circuits: Class RK5, time delay.

C. Other Branch Circuits: Class RK5, time delay.

D. Control Circuits: Class CC, /time delay.

2.4 SEPARATELY-ENCLOSED CIRCUIT BREAKERS

A. Provide circuit breakers in accordance with the applicable requirements in Section 26 24 16, PANELBOARDS.

B. Enclosures shall be the NEMA types shown on the drawings. Where the types are not shown, they shall be the NEMA type most suitable for the ambient environmental conditions.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be in accordance with the NEC, as shown on the drawings, and manufacturer’s instructions.

B. Fused switches shall be furnished complete with fuses. Arrange fuses such that rating information is readable without removing the fuses.

3.2 ACCEPTANCE CHECKS AND TESTS

A. Perform in accordance with the manufacturer's recommendations. In addition, include the following:

1. Visual Inspection and Tests:

a. Compare equipment nameplate data with specifications and approved shop drawings.
b. Inspect physical, electrical, and mechanical condition.
c. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method.
d. Vacuum-clean enclosure interior. Clean enclosure exterior.

3.3 SPARE PARTS

A. Two weeks prior to the final inspection, furnish one complete set of spare fuses for each fused disconnect switch installed on the project. Deliver the spare fuses to the COR.

END OF SECTION

SECTION 26 32 13
ENGINE GENERATORS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, connection, and testing of the low-voltage engine generators.

1.2 RELATED WORK

A. Section 03 30 00, CAST-IN-PLACE CONCRETE: Requirements for concrete equipment pads.

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 fault currents.

E. Section 26 05 73, OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY: Short circuit and coordination study, and requirements for a coordinated electrical system.

F. Section 26 24 13, DISTRIBUTION SWITCHBOARDS: Requirements for secondary distribution switchboards.

G. Section 26 36 23, AUTOMATIC TRANSFER SWITCHES: Requirements for automatic transfer switches for use with engine generators.

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.

B. A factory-authorized representative shall be capable of providing emergency maintenance and repairs at the project site within 4 hours maximum of notification.

1.4 FACTORY TESTS

A. Factory Tests shall be required.

B. Factory Tests shall be in accordance with Paragraph, MANUFACTURED PRODUCTS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirement:

1. Load Test: Shall include two hours while the engine generator is delivering 100% of the specified kW, and four hours while the engine generator is delivering 80% of the specified kW. During this test, record the following data at 20-minute intervals:

Time	Engine RPM	Oil Temperature Out
kW	Water Temperature In	Fuel Pressure
Voltage	Water Temperature Out	Oil Pressure
Amperes	Oil Temperature In	Ambient Temperature

2. Cold Start Test: Record time required for the engine generator to develop specified voltage, frequency, and kW load from a standstill condition with engine at ambient temperature.
3. The manufacturer shall furnish fuel, load banks, testing instruments, and all other equipment necessary to perform these tests.

1.5 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. Scaled drawings, showing plan views, side views, elevations, and cross-sections.

2. Diagrams:
   a. Control system diagrams, control sequence diagrams or tables, wiring diagrams, interconnections diagrams (between engine generators, automatic transfer switches, paralleling switchgear, local control panels, remote annunciator panels, and fuel storage tanks, as applicable), and other like items.
3. Technical Data:
   a. Published ratings, catalog cuts, pictures, and manufacturer's specifications for engine generator, governor, voltage regulator, radiator, muffler, dampers, day tank, pumps, fuel tank, batteries and charger, jacket heaters, torsional vibration, and control and supervisory equipment.
   b. Description of operation.
   c. Short-circuit current capacity and sub-transient reactance.
   d. Sound power level data.
4. Calculations:
   a. Calculated performance derations appropriate to installed environment.
5. Manuals:
   a. When submitting the shop drawings, submit complete maintenance and operating manuals, to include the following:
      1) Technical data sheets.
      2) Wiring diagrams.
      3) Include information for testing, repair, troubleshooting, and factory recommended periodic maintenance procedures and frequency.
      4) Provide a replacement and spare parts list. Include a list of tools and instruments for testing and maintenance purposes.
   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.
6. Test Reports:
   a. Submit certified factory test reports for approval.
   b. Submit field test reports two weeks prior to the final inspection.
7. Certifications:
   a. Prior to fabrication of the engine generator, submit the following for approval:
      1) A certification in writing that an engine generator of the same model and configuration, with the same bore, stroke, number of cylinders, and equal or higher kW/kVA ratings as the proposed engine generator, has been operating satisfactorily with connected loads of not less than 75% of the specified kW/kVA rating, for not fewer than 2,000 hours without any failure of a crankshaft, camshaft, piston, valve, injector, or governor system.
      2) A certification in writing that devices and circuits will be incorporated to protect the voltage regulator and other components of the engine generator during operation at speeds other than the rated RPM while performing maintenance. Submit thorough descriptions of any precautions necessary to protect the voltage regulator and other components of the system during operation of the engine generator at speeds other than the rated RPM.
      3) A certification from the engine manufacturer stating that the engine exhaust emissions meet the applicable federal, state, and local regulations and restrictions. At a minimum, this certification shall include emission factors for criteria pollutants including nitrogen oxides, carbon monoxide, particulate matter, sulfur dioxide, non-methane hydrocarbon, and hazardous air pollutants (HPAs).
   b. Prior to installation of the engine generator at the job site, submit certified factory test data.

c. Two weeks prior to the final inspection, submit the following.
   1) Certification by the manufacturer that the engine generators conform to the requirements of the drawings and specifications.
   2) Certification by the Contractor that the engine generators have been properly installed, adjusted, and tested.

1.6 STORAGE AND HANDLING

A. Engine generators shall withstand shipping and handling stresses in addition to the electrical and mechanical stresses which occur during operation of the system. Protect radiator core with wood sheet.

B. Store the engine generators in a location approved by the COR.

1.7 JOB CONDITIONS

A. Job conditions shall conform to the arrangements and details shown on the drawings. The dimensions, enclosures, and arrangements of the engine generator system shall permit the operating personnel to safely and conveniently operate and maintain the system in the space designated for installation.

1.8 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 of Testing Materials (ASTM):

A53/A53M-20	Standard Specification for Pipe, Steel, Black, and Hot–Dipped, Zinc Coated Welded and Seamless
B88-20	Specification for Seamless Copper Water Tube
B88M-20	Specification for Seamless Copper water Tube (Metric)
D975-21	Diesel Fuel Oils

C. Institute of Electrical and Electronic Engineers (IEEE):

C37.13-15	Low Voltage AC Power Circuit Breakers Used In Enclosures
C37.90.1-12	Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus

D. International Code Council (ICC):

IBC-21	International Building Code

E. International Organization for Standardization (ISO):

8528-1-18	Reciprocating Internal Combustion Engine-Driven Alternate Current Generating Sets – Part 1: Application, Ratings and Performance

F. National Electrical Manufacturers Association (NEMA):

ICS 6-93(R2016)	Enclosures
ICS 4-15	Application Guideline for Terminal Blocks
MG 1-16	Motor and Generators

MG 2-14	Safety Standard and Guide for Selection, Installation and Use of Electric Motors and Generators
PB 2-11	Dead-Front Distribution Switchboards
250-20	Enclosures for Electrical Equipment (1000 Volts Maximum)

G. National Fire Protection Association (NFPA):

30-21	Flammable and Combustible Liquids Code
37-21	Installations and Use of Stationary Combustion Engine and Gas Turbines
70-23	National Electrical Code (NEC)
99-21	Health Care Facilities
110-22	Standard for Emergency and Standby Power Systems

H. Underwriters Laboratories, Inc. (UL):

50-15	Enclosures for Electrical Equipment
142-19	Steel Aboveground Tanks for Flammable and Combustible Liquids
467-13	Grounding and Bonding Equipment
489-16	Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures
508-18	Industrial Control Equipment
891-19	Switchboards
1236-15	Battery Chargers for Charging Engine-Starter Batteries
2085-97	Insulated Aboveground Tanks for Flammable and Combustible Liquids
2200-20	Stationary Engine Generator Assemblies

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. The engine generator system shall be in accordance with ASTM, ISO, NEMA, NFPA, UL, as shown on the drawings, and as specified herein.

B. Provide a factory-assembled, wired (except for field connections), complete, fully automatic engine generator system, as well as all associate equipment and devices intended for the operating, control, monitoring, and remote manual stop functions.

C. Engine Generator Parameter Schedule:
1. Power Rating: Emergency Standby
2. Voltage: 277/480V
3. Rated Power: 350 kW 438 kVA continuous
4. Power Factor: 0.8 lagging
5. Engine Generator Application: stand-alone /
6. Fuel: diesel
7. Voltage Regulation: +/-.25% (maximum) (No Load to Full Load) (standalone applications)
8. Phases: 3 Phase, Wye

D. Assemble, connect, and wire the engine generator at the factory so that only the external connections need to be made at the construction site.

E. Engine Generator Unit shall be factory-painted with manufacturer's primer and standard finishes.

F. Connections between components of the system shall conform to the recommendations of the manufacturer.

G. Couplings, shafts, and other moving parts shall be enclosed and guarded. Guards shall be metal, ruggedly constructed, rigidly fastened, and readily removable for convenient servicing of the equipment without disassembling any pipes and fittings.

H. Engine generator shall have the following features:
   1. Factory-mounted on a common, rigid, welded, structural steel base.
   2. Engine generator shall be statically and dynamically balanced so that the maximum vibration in the horizontal, vertical, and axial directions shall be limited to 0.15 mm (0.0059 inch), with an overall velocity limit of 24 mm/sec (0.866 inch per second) RMS, for all speeds.
   3. The isolators shall be constrained with restraints capable of withstanding static forces in any direction equal to twice the weight of the supported equipment.
   4. Shall be capable of operating satisfactorily as specified for not fewer than 10,000 hours between major overhauls.

I. Each engine generator specified for parallel operation shall be configured for automatic parallel operation.

2.2 ENGINE

A. The engine shall be coupled directly to a generator.

B. Minimum four cylinders.

C. The engine shall be able to start in a 4.5 ˚C (40 ˚F) ambient temperature while using No. 2 diesel fuel oil without the use of starting aids such as glow plugs and ether injections.

D. The engine shall be equipped with electric heater for maintaining the coolant temperature between 32-38 °C (90-100 °F), or as recommended by the manufacturer.
   1. Install thermostatic controls, contactors, and circuit breaker-protected circuits for the heaters.
   2. The heaters shall operate continuously except while the engine is operating or the water temperature is at the predetermined level.

2.3 GOVERNOR

A. Isochronous, electronic type.

B. Steady-state speed band at 60 Hz shall not exceed plus or minus 0.33%.

2.4 LUBRICATION OIL SYSTEM

A. Pressurized type.

B. Positive-displacement pump driven by engine crankshaft.

C. Full-flow strainer and full-flow or by-pass filters.

D. Filters shall be cleanable or replaceable type and shall remove particles as small as 3 microns without removing the additives in the oil. For by-pass filters, flow shall be diverted without flow interruption.

E. Extend lube oil sump drain line out through the skid base and terminate it with a drain valve and plug.

2.5 FUEL SYSTEM

A. Fuel system shall comply with the requirements of Section 23 10 00, FACILITY FUEL SYSTEMS.

2.6 COOLING SYSTEM

A. Liquid-cooled, closed loop, with fin-tube radiator mounted on the engine generator, and integral engine driven circulating pump,/ as shown on the drawings.

B. Cooling capacity shall not be less than the cooling requirements of the engine generator and its lubricating oil while operating continuously at 100% of its specified rating.

C. Water circulating pumps shall be the centrifugal type driven by engine. Incorporate pressure relief devices where required to prevent excessive pressure increase after the engine stops.

D. Coolant shall be extended-life antifreeze solution, 50% ethylene glycol and 50% soft water, with corrosion inhibitor additive as recommended by the manufacturer.

E. Coolant hoses shall be flexible, per manufacturer's recommendation.

F. Self-contained thermostatic-control valve shall modulate coolant flow to maintain optimum constant coolant temperature, as recommended by the engine manufacturer.

G. Motor-Operated Dampers:
   1. Dampers, which are provided under Section 23 31 00, HVAC DUCTS AND CASINGS, shall be two-position, electric motor-operated.
   2. Dampers shall open simultaneously with the starting of the diesel engine and shall close simultaneously with the stopping of the diesel engine.

2.7 AIR INTAKE AND EXHAUST SYSTEMS

A. Refer to mechanical drawings and specifications.

2.8 ENGINE STARTING SYSTEM

A. The engine starting system shall start the engine at any position of the flywheel.

B. Electric cranking motor:
   1. Shall be engine-mounted.
   2. Shall crank the engine via a gear drive.
   3. Rating shall be adequate for cranking the cold engine at the voltage provided by the battery system, and at the required RPM during five consecutive starting attempts of 10 seconds cranking each at 10-second intervals, for a total of 50 seconds of actual cranking without damage (the fifth starting attempt will be manually initiated upon failure of a complete engine cranking cycle).

C. Batteries shall be nickel-cadmiumhigh discharge rate type.
   1. Each battery cell shall have minimum and maximum electrolyte level indicators and a flip-top flame arrestor vent cap.
   2. Batteries shall have connector covers for protection against external short circuits.
   3. With the charger disconnected, the batteries shall have sufficient capacity so that the total system voltage does not fall below 85% of the nominal system voltage with the following demands:
   4. Five consecutive starting attempts of 10 seconds cranking at 10 second intervals for a total of 50 seconds of actual cranking (the fifth starting attempt will be manually initiated upon failure of a complete engine cranking cycle).
   5. Battery racks shall be metal with an alkali-resistant finish and thermal insulation, and secured to the floor.

D. Battery Charger:
   1. A current-limiting battery charger, conforming to UL 1236, shall be provided and shall automatically recharge the batteries. The charger shall be capable of an equalize-charging rate for recharging fully depleted batteries within 24 hours and a floating charge rate for maintaining the batteries at fully charged condition.
   2. An ammeter shall be provided to indicate charging rate. A voltmeter shall be provided to indicate charging voltage.

2.9 LUBRICATING OIL HEATER

A. Provide a thermostatically-controlled electric heater to automatically maintain the oil temperature within plus or minus 1.7 °C (3 °F) of the control temperature.

2.10 JACKET COOLANT HEATER

A. Provide a thermostatically-controlled electric heater mounted in the engine coolant jacketing to automatically maintain the coolant within plus or minus 1.7 °C (3 °F) of the temperature recommended by the engine manufacturer to meet the starting time specified at the minimum winter outdoor temperature.

2.11 GENERATOR

A. Synchronous, amortisseur windings, bracket-bearing, self-venting, rotating-field type connected directly to the engine.

B. Lifting lugs designed for convenient connection to and removal from the engine.

C. Integral poles and spider, or individual poles dove-tailed to the spider.

D. Designed for sustained short-circuit currents in conformance with NEMA Standards.

E. Designed for sustained operation at 100% of the RPM specified for the engine generator without damage.

F. Telephone influence factor shall conform to NEMA MG 1.

G. Furnished with brushless excitation system or static-exciter-regulator assembly.

H. Nameplates attached to the generator shall show the manufacturer's name, equipment identification, serial number, voltage ratings, field current ratings, kW/kVA output ratings, power factor rating, time rating, temperature rise ratings, RPM ratings, full load current rating, number of phases and frequency, and date of manufacture.

I. The grounded (neutral) conductor shall be electrically isolated from equipment ground and terminated in the same junction box as the phase conductors.

2.12 GENERATOR OVERCURRENT AND FAULT PROTECTION

A. Integrate ground-fault indication with other engine generator alarm indications.

2.13 CONTROLS

A. Shall include Engine Generator Control Panels(s).

B. General:
   1. Control equipment shall be in accordance with UL 508, NEMA ICS-4, ICS-6, and ANSI C37.90.1.
   2. Panels shall be in accordance with UL 50.
   3. Cubicles shall be in accordance with UL 891.
   4. Coordinate controls with the automatic transfer switches shown on the drawings so that the systems will operate as specified.
   5. Cubicles:
      a. Code gauge steel: manufacturer's recommended heavy gauge steel with factory primer and light gray finish.
      b. Doors shall be gasketed, attached with concealed or semi-concealed hinges, and shall have a permanent means of latching in closed position.
      c. Panels shall be wall-mounted or incorporated in other equipment as indicated on the drawings or as specified.
      d. Door locks for panels and cubicles shall be keyed identically to operate from a single key.
   6. Wiring: Insulated, rated at 600 V.
      a. Install the wiring in vertical and horizontal runs, neatly harnessed.
      b. Terminate all external wiring at heavy duty, pressure-type, terminal blocks.
   7. The equipment, wiring terminals, and wires shall be clearly and permanently labeled.

8. The appropriate wiring diagrams shall be laminated or mounted under plexiglass within the frame on the inside of the cubicles and panels.
9. All indicating lamps and switches shall be accessible and mounted on the cubicle doors.
10. Meters shall be per the requirements of Section 25 10 10, ADVANCED UTILITY METERING.
11. The manufacturer shall coordinate the interconnection and programming of the generator controls with all related equipment, including automatic transfer switches and generator paralleling controls as applicable, specified in other sections.

C. Engine generator Control Panel:
1. Starting and Stopping Controls:
   a. A three-position, maintained-contact type selector switch with positions marked "AUTOMATIC," "OFF," and "MANUAL." Provide flashing amber light for OFF and MANUAL positions.
   b. A momentary contact push-button switch with positions marked "MANUAL START" and "MANUAL STOP."
   c. Selector switch in AUTOMATIC position shall cause the engine to start automatically when a single pole contact in a remote device closes. When the generator's output voltage increases to not less than 90% of its rated voltage, and its frequency increases to not less than 58 Hz, the remote devices shall transfer the load to the generator. An adjustable time delay relay, in the 0 to 15 minute range, shall cause the engine generator to continue operating without any load after completion of the period of operation with load. Upon completion of the additional 0 to 15 minute (adjustable) period, the engine generator shall stop.
   d. Selector switch in OFF position shall prevent the engine from starting either automatically or manually. Selector switch in MANUAL position shall also cause the engine to start when the manual start push-button is depressed momentarily.
   e. With selector switch is in MANUAL position, depressing the MANUAL STOP push-button momentarily shall stop the engine after a cool-down period.
   f. A maintained-contact, red mushroom-head push-button switch marked "EMERGENCY STOP" will cause the engine to stop without a cool-down period, independent of the position of the selector switch.
2. Engine Cranking Controls:
   a. The cranking cycles shall be controlled by a timer that will be independent of the battery voltage fluctuations.
   b. The controls shall crank the engine through one complete cranking cycle, consisting of four starting attempts of 10 seconds each with 10 seconds between each attempt.
   c. Total actual cranking time for the complete cranking cycle shall be 40 seconds during a 70-second interval.
   d. Cranking shall terminate when the engine starts so that the starting system will not be damaged. Termination of the cranking shall be controlled by self-contained, speed-sensitive switch. The switch shall prevent re-cranking of the engine until after the engine stops.
   e. After the engine has stopped, the cranking control shall reset.
3. Supervisory Controls:
   a. Overcrank:
      1) When the cranking control system completes one cranking cycle (four starting attempts), without starting the engine, the overcrank signal light and the audible alarm shall be energized.
      2) The cranking control system shall lock-out, and shall require a manual reset.
   b. Coolant Temperature:
      1) When the temperature rises to the predetermined first stage level, the HIGH COOLANT TEMPERATURE - FIRST STAGE signal light and the audible alarm shall be energized.

2) When the temperature rises to the predetermined second stage level, which shall be low enough to prevent any damage to the engine and high enough to avoid unnecessary engine shutdowns, the HIGH COOLANT TEMPERATURE - SECOND STAGE signal light and the audible alarm shall be energized and the engine shall stop.
3) The difference between the first and second stage temperature settings shall be approximately -12 ˚C (10 ˚F).
4) Permanently indicate the temperature settings near the associated signal light.
5) When the coolant temperature drops to below 21 ˚C (70 ˚F), the "LOW COOLANT TEMPERATURE" signal light and the audible alarm shall be energized.

c. Low Coolant Level: When the coolant level falls below the minimum level recommended by the manufacturer, the low coolant level signal light and audible alarm shall be energized.
d. Lubricating Oil Pressure:
1) When the pressure falls to the predetermined first stage level, the OIL PRESSURE - FIRST STAGE signal light and the audible alarm shall be energized.
2) When the pressure falls to the predetermined second stage level, which shall be high enough to prevent damage to the engine and low enough to avoid unnecessary engine shutdowns, the OIL PRESSURE - SECOND STAGE signal light and the audible alarm shall be energized and the engine shall stop.
3) The difference between the first and second stage pressure settings shall be approximately 15% of the oil pressure.
4) The pressure settings near the associated signal light shall be permanently displayed so that the running oil pressure can be compared to the target (setpoint) value.
e. Overspeed:
1) When the engine RPM exceeds the maximum RPM recommended by the manufacturer of the engine, the engine shall stop.
2) Simultaneously, the OVERSPEED signal light and the audible alarm shall be energized.
f. Low Fuel - Day Tank:
1) When the fuel oil level in the day tank decreases to less than the level at which the fuel oil transfer pump should start to refill the tank, the Low Fuel Day tank light and the audible alarm shall be energized.
g. Low Fuel - Main Storage Tank:
1) When the fuel oil level in the storage tank decreases to less than one-third of total tank capacity, the Low Fuel-Main Storage Tank signal light and audible alarm shall be energized.
h. Reset Alarms and Signals:
1) Overcrank, Coolant Temperature, Coolant Level, Oil Pressure, Overspeed, and Low Fuel signal lights and the associated audible alarms shall require manual reset. A momentary-contact silencing switch and push-button shall silence the audible alarm by using relays or solid state devices to seal in the audible alarm in the de-energized condition. Elimination of the alarm condition shall automatically release the sealed-in circuit for the audible alarm so that it will be automatically energized again when the next alarm condition occurs. The signal lights shall require manual reset after elimination of the condition which caused them to be energized. Install the audible alarm just outside the engine generator room in a location as directed by the COR. The audible alarm shall be rated for 85 dB at 3 M (10 feet).
i. Generator Breaker Signal Light:

1) A flashing green light shall be energized when the engine generator circuit breaker is in the open or tripped position.
2) Simultaneously, the audible alarm shall be energized.

4. Monitoring Devices:
   a. Electric type gauges for the cooling water temperatures and lubricating oil pressures. These gauges may be engine mounted with proper vibration isolation.
   b. A running time indicator, totalizing not fewer than 9,999 hours, and an electric type tachometer.
   c. A voltmeter, ammeter, frequency meter, kilowatt meter, manual adjusting knob for the output voltage, and the other items shown on the drawings shall be mounted on the front of the generator control panels.
   d. Install potential and current transformers as required.
   e. Visual Indications:
      1) OVERCRANK
      2) HIGH COOLANT TEMPERATURE - FIRST STAGE
      3) HIGH COOLANT TEMPERATURE - SECOND STAGE
      4) LOW COOLANT TEMPERATURE
      5) OIL PRESSURE - FIRST STAGE
      6) OIL PRESSURE - SECOND STAGE
      7) LOW COOLANT LEVEL
      8) GENERATOR BREAKER
      9) OVERSPEED
      10) LOW FUEL - DAY TANK
      11) LOW FUEL – MAIN STORAGE TANK
   f. Lamp Test: The LAMP TEST momentary contact switch shall momentarily actuate the alarm buzzer and all the indicating lamps.
5. Automatic Voltage Regulator:
   a. Shall correct voltage fluctuations rapidly and restore the output voltage to the predetermined level with a minimum amount of hunting.
   b. Shall include voltage level rheostat located inside the control cubicle.
   c. Provide a 3-phase automatic voltage regulator immune to waveform distortion.

2.14 REMOTE MANUAL STOP STATION

A. Shall be provided per NFPA 101, and shall be a red mushroom-head push-button switch.

B. Shall be connected to the main generator control panel to provide emergency shutdown of the generator.

C. Shall be located outside the room housing the generator.

D. Shall have permanent label reading “EMERGENCY STOP”.

2.15 REMOTE ANNUNCIATOR PANEL

A. The annunciator shall indicate alarm conditions as required by NFPA 99 and 110. Utilize existing site BMS system to provide alarms at engineering control center.

2.16 SPARE PARTS

A. For each engine generator:
   1. Six lubricating oil filters.
   2. Six primary fuel oil filters.
   3. Six secondary fuel oil filters.
   4. Six intake air filters.

B. For each battery charger:
   1. Three complete sets of fuses.

C. For each control panel:
   1. Three complete sets of fuses, if applicable.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install concrete bases of dimensions shown on the drawings. Base shall act as an inertia base.

B. Installation of the engine generator shall comply with manufacturer's written instructions and with NFPA 110.

C. Mounting:
   1. Support the base of engine generator on vibration isolators, each isolator bolted to the floor (pad), and the generator base bolted to isolator.
   2. Install sufficient isolators so that the floor (pad) bearing pressure under each isolator is within the floor (pad) loading specification.
   3. Install equal number of isolators on each side of the engine generator's base.
   4. Locate isolators for approximately equal load distribution and deflection per isolator. The base of the engine generator shall be drilled at the factory for the isolator bolts.
   5. Isolators shall be shipped loose with the engine generator.
   6. All connections between the engine generator and exterior systems, such as fuel lines, electrical connections, and engine exhaust system and air exhaust shroud, shall be flexible.

D. Balance:
   1. The vibration velocity in the horizontal, vertical, and axial directions shall not exceed 16.25 mm (0.65 inch) per second peak at any specific frequency. These limits apply to main structural components such as the engine block and the generator frame at the bearings.

E. Connect all components of the generator system so that they will continue to be energized during failure of the normal electrical power supply system.

F. Install piping between engine generator and remote components of cooling, fuel, and exhaust systems.

3.2 ACCEPTANCE CHECKS AND TESTS

A. Provide the services of a factory-authorized, factory-trained representative of the engine generator manufacturer to inspect field-assembled components and equipment installation, and to supervise the field tests.

B. When the complete engine generator system has been installed and prior to the final inspection, test all components of the system in the presence of the \COR for proper operation of the individual components and the complete system and to eliminate electrical and mechanical defects.

C. Furnish fuel oil, lubricating oil, anti-freeze liquid, water treatment, rust-inhibitor, and load bank for testing of the engine generator.

D. Visual Inspection: Visually verify proper installation of engine generator and all components per manufacturer’s pre-functional installation checklist.

E. Set engine generator circuit breaker protective functions per Section 26 05 73, OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY.

F. Field Tests:
   1. Perform manufacturer’s after-starting checks and inspections.
   2. Test the engine generator for six hours of continuous operation as follows:
      a. Four hours while delivering 100% of the specified kW.
      b. Eight hours while the engine generator is delivering 60% of its specified kW rating.
      c. If during the 12-hour continuous test, an engine generator failure occurs or the engine generator cannot maintain specified power output, the test(s) are null and void. After repair and/or adjustments, the test(s) shall be repeated at no additional cost to the Government until satisfactory results are attained.
   3. Record the following test data at 30-minute intervals:

a. Time of day, as well as reading of running time indicator.
b. kW.
c. Voltage on each phase.
d. Amperes on each phase.
e. Engine RPM.
f. Frequency.
g. Coolant water temperature.
h. Fuel pressure.
i. Oil pressure.
j. Outdoor temperature.
k. Average ambient temperature in the vicinity of the engine generator.

4. Demonstrate that the engine generator will attain proper voltage and frequency within the specified time limit from a cold start after the closing of a single contact.
5. Furnish a resistance-type load for the testing of the engine generator. Test loads shall always include adequate resistance to assure stability of the loads and equipment during all of the testing operations. The test load kW rating shall not be less than 100% of the specified kW rating of the engine generator.

G. Starting System Test:
1. Demonstrate that the batteries and cranking motor are capable of five starting attempts of 10 seconds cranking each at 10-second intervals with the battery charger turned off.

H. Remote Annunciator Panel and Remote Manual Stop Tests:
1. Simulate conditions to verify proper operation of each visual or audible indication, interconnecting hardware and software, and reset button. Simulate emergency stop of the generator by initiating the remote manual stop station, while the generator is in operation.

I. Fuel systems shall be flushed and tested per Section 23 10 00, FACILITY FUEL SYSTEMS: Fuel supply and storage requirements.

J. Automatic Operation Tests:
1. Test the engine generator and associated automatic transfer switches to demonstrate automatic starting, loading and unloading. The load for this test shall be the actual connected loads. Initiate loss of normal source and verify the specified sequence of operation. Restore the normal power source and verify the specified sequence of operation. Verify resetting of controls to normal.

K. At the completion of the field tests, fill the main storage tank and day tank with fuel of grade and quality as recommended by the manufacturer of the engine. Fill all engine fluids to levels as recommended by manufacturer.

L. When any defects are detected during the tests, correct all the deficiencies and repeat all or part of the 6-hour continuous test as requested by the COR, at no additional cost to the Government.

M. Provide test and inspection results in writing to the COR.

3.3 FOLLOW-UP VERIFICATION

A. After completion of acceptance checks, settings, and tests, the Contractor shall demonstrate that the engine generator(s) and control and annunciation components are in good operating condition and properly performing the intended function.

3.4 INSTRUCTIONS AND FINAL INSPECTIONS

A. Laminate or mount under acrylic resin a set of operating instructions for the system and install instructions within a frame mounted on the wall near the engine generator at a location per the COR.

B. Furnish the services of a competent and factory-trained technician for one 4-hour period for instructions to VA personnel in operation and maintenance of the equipment, on the date requested by the COR/.

END OF SECTION

SECTION 26 33 53
STATIC UNINTERRUPTIBLE POWER SUPPLY

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, connection, and testing of the static uninterruptible power supply, indicated in this section as UPS.

1.2 RELATED WORK

A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.

B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.

C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible fault currents.

D. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits.

E. Section 26 05 73, OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY: Short circuit and coordination study, and requirements for a coordinated electrical system.

F. Section 26 24 13, DISTRIBUTION SWITCHBOARDS: For low-voltage switchboard required for maintenance bypass of multiple module UPS.

G. Section 26 26 00, POWER DISTRIBUTION UNITS FOR STATIC UNINTERRUPTIBLE POWER SYSTEMS: Power distribution units connected to the output of a UPS.

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 FACTORY TESTS

A. UPS shall be thoroughly tested at the factory to assure that there are no electrical or mechanical defects.

B. Factory Tests shall be in accordance with Paragraph, MANUFACTURED PRODUCTS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:

1. UPS shall be factory full-load tested to meet the requirements specified using a test battery (not the battery to be supplied with the system) with AC input power and with battery power for a minimum of 8 hours, with meter readings taken every 30 minutes. Should a malfunction occur, the problem shall be corrected and the test shall be repeated. The tests shall encompass all aspects of operation, such as module failure, static bypass operation, battery failure, input power failure and overload ratings.

1.5 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, materials, required clearances, terminations, weight, plan, front, side, and rear elevations, accessories, and device nameplate data.
   c. Provide detailed and project-specific system diagram, showing maintenance bypass, UPS module(s), battery cabinet(s) and batteries, major circuit protective devices, interconnecting power and control wiring, key-type mechanical interlocks, and

connections to power sources and loads, as applicable. Indicate whether interconnections are factory-provided/factory-installed, factory-provided/field-installed, or field-provided/field installed.

2. Manuals:
   a. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals including technical data sheets, wiring diagrams, and information for ordering replacement parts.
      1) Wiring diagrams shall have their terminals identified to facilitate installation, maintenance, and operation.
      2) Wiring diagrams shall indicate internal wiring for each item of equipment and the interconnection between the items of equipment.
      3) Provide a clear and concise description of operation, which gives, in detail, the information required to properly operate the UPS, including but not limited to bypass switchboard, UPS, key-type mechanical interlocks, remote devices, emergency power off buttons, fire alarm interface, and other components as applicable.
   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.
      1) Include complete "As Installed" diagrams that indicate all pieces of equipment and their interconnecting wiring.
      2) Include complete diagrams of the internal wiring for each piece of equipment, including "As Installed" revisions of the diagrams.
      3) The wiring diagrams shall identify the terminals to facilitate installation, maintenance, operation, and testing.
3. Test Reports:
   a. Submit certified factory design and production test reports for approval.
   b. Two weeks prior to the final inspection, submit certified field test reports and data sheets to the COR.
4. Certifications: Two weeks prior to final inspection, submit the following.
   a. Certification by the manufacturer that the UPS conforms to the requirements of the drawings and specifications.
   b. Certification by the Contractor that the UPS has been properly installed, adjusted, and tested.

1.6 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata), form a part of this specification to the extent referenced. Publications are referenced in the text by basic designation only.

B. Institute of Engineering and Electronic Engineers (IEEE):

C57.110-08	Recommended Practice for Establishing Transformer Capability When Supplying Nonsinusoidal Load Currents
C62.41.1-02	Surge Environment in Low-Voltage (1000 V and Less) AC Power Circuits
C62.41.2-02	Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits
450-20	Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications
485-20	Sizing Lead-Acid Batteries for Stationary Applications

C. International Code Council (ICC):

IBC-21	International Building Code

D. National Electrical Manufacturers Association (NEMA):

PE 1-12	Uninterruptible Power Systems - Specification and Performance Verification

E. National Fire Protection Association (NFPA):

70-23	National Electrical Code (NEC)

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Dimensions shall be per the drawings and shall be coordianted with coordination drawings prior to purchase.

B. This specification describes a three-phase continuous duty, on-line, double conversion, solid-state uninterruptible power system, hereafter referred to as the UPS. The UPS shall operate in conjunction with the existing building electrical system to provide power conditioning, back-up and distribution for critical electrical loads. The UPS shall consist of, as required by the project, the UPS module, batteries, or other DC storage systems, and accessory cabinet(s) for transformers, maintenance bypass, and distribution applications, and other features as described in this specification. Basis of design is Eaton 93PM UPS.

C. UPS Module Modes of Operation: The UPS Module shall operate as an on-line, fully automatic system in the following modes:
   1. Normal: Utilizing commercial AC power, the critical load shall be continuously supplied by the Inverter. The Inverter shall power the load while regulating both voltage and frequency. The Rectifier shall derive power from the commercial AC source and shall supply DC power to the Inverter. Simultaneously, the Battery Charger shall charge the battery.
   2. Battery: Upon failure of the commercial AC power, the critical load shall continue to be supplied by the Inverter, which shall obtain power from the batteries without any operator intervention. There shall be no interruption to the critical load upon failure or restoration of the commercial AC source. The 93PM UPS shall be capable of operating with 432V or 480VDC battery systems.
   3. Recharge: Upon restoration of the AC source, the Charger shall recharge the batteries and simultaneously the Rectifier shall provide power to the Inverter. This shall be an automatic function and shall cause no interruption to the critical load.
   4. Bypass: If the UPS module must be taken out of the Normal mode for overload, load fault, or internal failures, the static bypass switch shall automatically transfer the critical load to the commercial AC power. Return from Bypass mode to Normal mode of operation shall be automatic. No-break transfer to and from Bypass mode shall be capable of being initiated manually from the front panel.

D. System Capacity: Unless stated otherwise, the parameters listed are under full rated output load at a minimum of 0.9 power factor, with batteries fully charged and floating on the DC bus and with nominal input voltage. Overall load rating per the drawings with N+1 modules, at 40 □C.

E. Battery Capacity: Discharge time to end voltage: 10 minutes, at 25 □C (77 □F). Battery shall be capable of delivering 125 percent of full rated output load at initial start-up.

F. System Bus Bracing: Braced for amperes symmetrical interrupting capacity as shown on drawings.

G. AC Input:
   1. Voltage 480 volts line-to-line.
   2. Number of phases: 3-phase, 3-wire, plus ground.

3. Voltage Range: Plus 10 percent, minus 15 percent, without affecting battery float voltage or output voltage.
4. Frequency: 60 Hz, plus or minus 5 percent.
5. Total harmonic current distortion (THD) reflected into the primary line: 5 percent maximum.

H. AC Output
1. Voltage 208 volts line-to-line, 120volts line-to-neutral.
2. Number of phases: 3-phase, 4-wire, plus ground.
3. Voltage regulation:
   a. Balanced load: Plus or minus 1.0 percent.
   b. 100 percent load imbalance, phase-to-phase: Plus or minus 3 percent.
4. Frequency: 60 Hz.
5. Frequency regulation: Plus or minus 0.05 percent.
6. Harmonic content (RMS voltage): 5 percent maximum total harmonic distortion with 100% nonlinear load.
7. Load power factor operating range: 1.0 to 0.8 lagging.
8. Phase displacement:
9. Balanced load: Plus or minus 1 degree of bypass input.
10. Overload capability (at full voltage) (excluding battery):
    a. 125 percent load for 10 minutes.
    b. 150 percent load for 1 minute.

I. Voltage Transient Response:
1. 100 percent load step: Plus or minus 5 percent.

2.2 UPS

A. The UPS module shall consist of the following standard components, housed in a 100kW frame:
1. Quantity 3 identical 50kW UPM Universal Power Modules (providing N+1 redundancy), each containing:
   a. Rectifier/Charger: The rectifier/charger shall convert incoming AC power to regulated DC output for supplying the inverter and for charging the battery. The rectifier/charger shall be a high-frequency PWM design, using Insulated Gate Bi-polar Transistors (IGBTs). The modular design of the UPS shall permit safe and fast removal and replacement of the rectifier/charger module. Mean time to repair (MTTR) for the module shall be no more than 30 minutes in order to return UPS to normal mode. The rectifier/charger module shall also provide the following:
2. The rectifier shall be capable of drawing power from the utility with a power factor of 0.99 under nominal conditions.
3. The rectifier shall feature protection circuitry that prevents the IGBTs from sourcing current in excess of their published ratings.
4. Inverter: The inverter shall feature an IGBT pulse-width-modulation (PWM) design with high speed switching. The inverter shall also have the following features:
5. The inverter shall be capable of providing the specified quality output power while operating from any DC source voltage (rectifier or battery) within the specified DC operating range.
6. The modular design of the UPS shall permit safe and fast removal and replacement of the power module, while in maintenance bypass. Mean time to repair (MTTR) for the module shall be no more than 30 minutes in order to return UPS to normal mode.
7. The inverter shall feature protection circuitry that prevents the IGBTs from sourcing current in excess of their published ratings.

B. External Protection: UPS module shall have built-in self-protection against undervoltage, overvoltage, overcurrent and surges introduced on the AC input source and/or the bypass source. The UPS system shall sustain input surges without damage in accordance with IEEE

C62.41.1 and IEEE C62.41.2. The UPS shall also have built-in self-protection against overvoltage and voltage surges introduced at the output terminals by paralleled sources, load switching, or circuit breaker operation in the critical load distribution system.

C. Internal Protection: UPS module shall be self-protected against overcurrent, sudden changes in output load and short circuits at the output terminals. UPS module shall be provided with output reverse power detection which shall cause that module to be disconnected from the critical load bus when output reverse power is present. UPS module shall have built-in protection against permanent damage to itself and the connected load for predictable types of failure within itself and the connected load. At the end of battery discharge limit, the module shall shut down without damage to internal components.

2.3 STATIC BYPASS TRANSFER SWITCH

A. Static Bypass: The bypass shall serve as an alternative source of power for the critical load when an abnormal condition prevents operation in normal mode. The bypass for 50-200kW frames shall consist of a fully rated, continuous duty, naturally commutated static switch for high-speed transfers. The 400kW bypass system will consist of two 200kW static switches. The bypass shall feature the following transfer and operational characteristics.
   1. Transfers to bypass (for stand alone, and parallel capacity systems) shall be automatically initiated for the following conditions:
      a. Output overload period expired.
      b. Critical bus voltage out of limits.
      c. Internal over temperature period expired.
      d. Total battery discharge.
      e. UPS failure.

B. Uninterrupted automatic re-transfer shall take place whenever the inverter(s) is capable of assuming the critical load.
   1. Uninterrupted automatic re-transfers shall be inhibited for the following conditions:
   2. When transfer to bypass is activated manually or remotely.
   3. In the event of multiple transfers/re-transfer operations the control circuitry shall limit “cycling” to three (3) operations in any ten-minute period. The third transfer shall lock the critical load on the bypass source, for 60 minutes.
   4. UPS failure.

C. Uninterrupted manual transfers shall be initiated from the control panel. Uninterrupted manual transfers to bypass and from bypass shall be possible with the inverter logic. During manual transfers to bypass mode, the inverter must verify proper bypass operations before transferring the critical load to the bypass.

D. All transfers to bypass shall be inhibited for the following conditions:
   1. Bypass voltage out of limits (+10%, to -15% of nominal)
   2. Bypass frequency out of limits (+/- 4 Hz, adjustable, factory set)
   3. Bypass out of synchronization
   4. Bypass phase rotation / installation error
   5. Static transfer time: No break, complete in less than 4ms.

E. The bypass shall be manually energized using the control panel or remotely through a building alarm input.

2.4 MAINTENANCE BYPASS – MULTIPLE-MODULE UPS

A. IAC-B (Bypass) Sidecar: Three, breaker manual maintenance bypass switch in a sidecar configuration, to isolate UPS module from commercial AC input and critical load. The sidecar may be mounted on either side of the UPS module. Switch shall provide complete isolation of UPS for servicing. Switch shall be make-before-break, interlocked between UPS and bypass to prohibit improper operation. Breakers shall be RIB/BIB (input), BIB, and MBB (Maintence bypass breaker)

B. The maintenance bypass switch shall provide the capability of transferring the load from the UPS static bypass transfer switch to maintenance bypass and then back to the UPS static bypass transfer switch with no interruption to the load.

2.5 SYSTEM CONTROL CABINET – MULTI-MODULE UPS

A. The UPS shall be provided with a LCD control/indicator panel. Meters, controls, alarms, system diagnostics, mimic screen showing one-line diagram of the system, and indicators for operation of the UPS shall be on this panel. The system control cabinet shall communicate with each UPS module, the static bypass transfer switch and its bypass disconnect, the UPS input and output circuit breakers, and the UPS maintenance bypass .

1. Module Meters:
   a. Meters shall have 1 percent accuracy.
   b. The following functions shall be monitored and displayed:
      1) Input voltage, phase-to-phase (all three phases).
      2) Input current, all three phases.
      3) Input frequency.
      4) Battery voltage.
      5) Battery current (charge/discharge).
      6) Output voltage, phase-to-phase and phase-to-neutral (all three phases).
      7) Output current, all three phases.
      8) Output frequency.
      9) Output kilowatts.
      10) Elapsed time meter to indicate hours of operation, 6 digits.
      11) Bypass voltage, phase-to-phase and phase-to-neutral (all three phases).
      12) Output kilovars.
      13) Output kilowatt hours, with 15-minute interval.
2. Module Controls:
   a. Module shall have the following controls:
      1) Alarm test/reset function.
      2) Module input protective device trip function.
      3) Module output protective device trip function.
      4) Battery protective device trip function.
      5) Emergency Power Off (EPO) pushbutton, with guard.
      6) Control power off switch.
      7) Static bypass transfer switch enable/disable selector switch.
3. Module Alarm Indicators:
   a. Module shall have indicators for the following alarm items. Any one of these conditions shall turn on an audible alarm and the appropriate summary indicator. Each new alarm shall register without affecting any previous alarm.
      1) Input AC power source failure.
      2) Input protective device open.
      3) Output protective device open.
      4) Overload.
      5) Overload shutdown.
      6) DC overvoltage.
      7) DC ground fault.
      8) Low battery.
      9) Battery discharged.
      10) Battery protective device open.
      11) Cooling fan failure.
      12) Equipment overtemperature.
      13) Control power failure.
      14) Charger off.

15) Inverter off.
16) Emergency off.
17) UPS on battery.
18) Load on static bypass.
19) Static bypass transfer switch disabled.
20) Inverter output overvoltage, undervoltage, overfrequency, and underfrequency.
21) Bypass source overvoltage, undervoltage, overfrequency, and underfrequency.
22) Bypass source to inverter out of synchronization.
23) Inverter transformer overtemperature.

2.6 BATTERY SYSTEM

A. General: A storage battery with sufficient ampere-hour rating to maintain UPS output at full capacity for the specified duration shall be provided for each UPS module.

B. External Battery Cabinet: The battery cabinet shall feature valve regulated, high-rate discharge, lead-acid batteries which provide energy to the support the critical load during a momentary loss of input power to the rectifier. The batteries shall be flame retardant in accordance with UL 94V2 requirements. The battery cabinet shall have the following features:
   1. The battery cabinet shall be the same depth and height as the UPS module.
   2. The battery cabinet shall feature a mechanical enclosure of like appearance to the UPS module and shall feature casters for easy installation. Each battery cabinet shall require front access only for installation, service and maintenance. The battery cabinet shall provide bottom cable entry standard and top entry capability via sidecar.
   3. Power wiring internal to each battery cabinet shall be factory provided. Each battery cabinet shall feature up to 10 battery trays which can be individually disconnected from the battery cabinet power wiring with quick disconnect devices. Each battery tray shall be firmly secured to the battery cabinet frame with fasteners. Each battery tray shall be removable from the front of the battery cabinet.
   4. Up to 4 line and match battery cabinets may be connected to a single UPS, containing 2 or more 50 kW UPMs. Up to 2 battery cabinets may be connected to a single UPS containing only one UPM.

C. Each battery cabinet shall feature a DC rated circuit breaker. The circuit breaker within the battery cabinet shall only provide protection to the battery string(s) within that battery cabinet. For battery configurations involving multiple battery cabinets, the batteries in one battery cabinet may be isolated from the DC link via its circuit breaker without disconnecting other battery cabinets from the DC link and the UPS module.

D. The battery cabinet shall contain all wiring for the battery management system

E. The circuit breaker in each battery cabinet shall feature an A/B auxiliary switch. The UPS module shall be capable of monitoring and alarming an open battery cabinet circuit breaker condition.

F. The circuit breaker in each battery cabinet shall feature a 48VDC shunt trip device. The shunt trip shall operate to trip the battery breaker(s) for an emergency power off command or battery disable command.

G. Power and Control wiring between the co-located battery cabinet and the UPS shall be factory provided.

H. The batteries shall be optionally configured with a ¼" spade type connector for attaching sense leads to each jar to facilitate the future addition of a battery monitoring system.

I. Expected battery life: 200 complete full load discharge cycles when operated and maintained within specifications.

J. Electrolyte Spill Containment and Neutralization: Provide spill control and neutralization means integral to the battery cabinet or battery rack assembly. Provide spare neutralization materials in a manufacturer's cabinet.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The UPS shall be set in place, wired, and connected in accordance with the approved shop drawings and manufacturer's instructions.

3.2 ACCEPTANCE CHECKS AND TESTS

A. An authorized representative of the UPS manufacturer shall technically supervise and participate during all of the field adjustments and tests. Major adjustments and field tests shall be witnessed by the COR. The manufacturer's representative shall certify in writing that the equipment has been installed, adjusted, and tested in accordance with the manufacturer's recommendations.

B. Perform manufacturer's required field tests 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 appropriate anchorage, required area clearances, and correct alignment.
      d. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey after energization.
      e. Verify grounding connections.
      f. Vacuum-clean enclosure interior. Clean enclosure exterior.
      g. Verify the correct operation of all alarms and indicating devices.
      h. Attach a phase rotation meter to the UPS input, output, and bypass buses, and observe proper phase sequences.
      i. Check and test controls for proper operation.
      j. Check doors for proper alignment and operation.
      k. Check and test each protective device for proper mechanical and electrical operation.
      l. Verify protective device overcurrent trip settings against approved coordination study.
      m. Confirm correct operation and sequencing of key-type mechanical interlock systems.
   2. Load Test: The UPS shall be load tested for a continuous 24 hour period by means of resistive load banks, sized for full rated output load and provided by the UPS manufacturer. The UPS shall be continuously tested at 1/2 load for 8 hours, 3/4 load for 8 hours and full load for 8 hours. If a failure occurs during the burn-in period, the tests shall be repeated. Instrument readings shall be recorded every half hour for the following:
      a. Input voltage and current (all three phases, for each module).
      b. Input and output frequency.
      c. Battery voltage for each module.
      d. Output voltage and current (all three phases, for each module).
      e. Output kilowatts for each module.
      f. Output voltage and current (all three phases).
      g. Output kilowatts.
   3. Full Load Burn In Test: The UPS shall undergo an additional full load burn-in period of 24 continuous hours by means of resistive load banks, sized for full rated output load and provided by the UPS manufacturer. If a failure occurs during the burn-in period, the tests shall be repeated. Instrument readings shall be recorded every half hour as above. The following tests shall be performed:
      a. With the UPS carrying full rated output load and supplied from the normal source, switch 100 percentof load bank capacity on and off a minimum of five times within the burn-in period.

b. With the UPS carrying maximum continuous design load and supplied from the emergency source, repeat the switching operations described above.

4. Full Load Battery Burn In Test: The UPS shall undergo a full load battery test by means of resistive load banks, sized for full rated output load and provided by the UPS manufacturer. If a failure occurs during the battery discharge time, the tests shall be repeated. Instrument readings shall be recorded every half hour as above.
   a. With the UPS carrying full rated output load and operating on battery power, switch 100 percen of load bank capacity on and off a minimum of five times within the battery discharge time.
5. Battery Discharge and Recharge Test: With the battery fully charged, the UPS shall undergo a complete battery discharge test to full depletion followed by a full recharge. Instrument readings shall be recorded every minute during discharge for the following:
   a. Battery voltage and currentfor each module.
   b. Output voltage and current (all three phases) for each module.
   c. Output kilowatts for each module/
   d. Output voltage and current (all three phases).
   e. Output kilowatts (system).
   f. Output frequency.

3.3 FOLLOW-UP VERIFICATION

A. After completion of acceptance checks and tests, the Contractor shall show by demonstration in service that the UPS is in good operating condition and properly performing the intended function.

3.4 ONE LINE DIAGRAM AND SEQUENCE OF OPERATION

A. At final inspection, an as-built one line diagram shall be laminated or mounted under acrylic glass, and installed in a frame mounted near the UPS.

B. Furnish a written sequence of operation for the UPS and connected line side/load side electrical distribution equipment. The sequence of operation shall be laminated or mounted under acrylic glass, and installed in a frame mounted near the UPS.

C. Deliver an additional four copies of the as-built one line diagram and sequence of operation to the /COR.

3.5 INSTRUCTION

A. Furnish the services of a factory-trained technician for one 4-hour training period for instructing personnel in the maintenance and operation of the UPS, on the dates requested by the COR.

END OF SECTION

SECTION 26 36 23
AUTOMATIC TRANSFER SWITCHES

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, connection, and testing of open-transition automatic transfer switches with bypass isolation, indicated as automatic transfer switches or ATS in this section.

1.2 RELATED WORK

A. Section 03 30 00, CAST-IN-PLACE CONCRETE: Requirements for concrete equipment pads.

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 personal safety and to provide a low impedance path for possible ground fault currents.

E. Section 26 05 33, RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS: Conduits.

F. Section 26 05 73, OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY: Short circuit and coordination study, and requirements for a coordinated electrical system.

G. Section 26 23 13, GENERATOR PARALLELING CONTROLS: Paralleling controls for multiple engine-generators.

H. Section 26 32 13, ENGINE-GENERATORS: Requirements for normal and emergency power generation.

I. Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS: General communications requirements that are common to more than one section in Division 27.

J. Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATION SYSTEMS: Raceways for communications cabling.

K. SECTION 27 15 00, COMMUNICATIONS HORIZONTAL CABLING: Communications media for interconnecting automatic transfer switches and remote control and annunciation components.

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.

B. A factory-authorized representative shall be capable of providing emergency maintenance and repairs at the project site within 4 hours maximum of notification.

C. Automatic transfer switch, bypass/isolation switch, and annunciation control panels shall be products of the same manufacturer.

1.4 FACTORY TESTS

A. ATS shall be thoroughly tested at the factory to assure that there are no electrical or mechanical defects.

B. Factory Tests shall be in accordance with Paragraph, MANUFACTURED PRODUCTS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:

1. Perform visual inspection to verify that each ATS is as specified.
2. Perform mechanical test to verify that ATS sections are free of mechanical defects.
3. Perform insulation resistance test to ensure electrical integrity and continuity of entire system.

4. Perform main switch contact resistance test.
5. Perform electrical tests to verify complete system electrical operation.

1.5 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 voltage rating, continuous current rating, number of phases, withstand and closing rating, dimensions, weights, mounting details, conduit entry provisions, front view, side view, equipment and device arrangement, elementary and interconnection wiring diagrams, factory relay settings, and accessories.
   c. For automatic transfer switches that are networked together to a common means of annunciation and/or control, submit interconnection diagrams as well as site and building plans, showing connections for normal and emergency sources of power, load, control and annunciation components, and interconnecting communications paths. Equipment locations on the diagrams and plans shall match the site, building, and room designations on the drawings.
   d. Complete nameplate data, including manufacturer's name and catalog number.
   e. A copy of the markings that are to appear on the automatic transfer switches when installed.
2. Manuals:
   a. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals, including technical data sheets, wiring diagrams, and information for ordering replacement parts.
      1) Schematic signal and control diagrams, with all terminals identified, matching terminal identification in the automatic transfer switches.
      2) Include information for testing, repair, troubleshooting, assembly, disassembly, and factory recommended/required periodic maintenance procedures and frequency.
      3) Provide a replacement and spare parts list. Include a list of tools and instruments for testing and maintenance purposes.
   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.
      1) Include complete "As Installed" diagrams that indicate all pieces of equipment and their interconnecting wiring.
      2) Include complete diagrams of the internal wiring for each piece of equipment, including "As Installed" revisions of the diagrams.
      3) The wiring diagrams shall identify the terminals to facilitate installation, maintenance, operation, and testing.
3. Certifications:
   a. When submitting the shop drawings, submit a certified test report from a recognized independent testing laboratory that a representative sample has passed UL 1008 prototype testing.
   b. Two weeks prior to final inspection, submit the following.
      1) Certification by the manufacturer that the ATS conform to the requirements of the drawings and specifications.
      2) Certification by the Contractor that transfer switches have been properly installed, adjusted, and tested.

1.6 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

B. Institute of Electrical and Electronic Engineers (IEEE):

446-95	Emergency and Standby Power Systems for Industrial and Commercial Applications
C37.90.1-12	Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus
C62.41.1-02	Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits
C62.41.2-02	Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits

C. International Code Council (ICC):

IBC-18	International Building Code

D. National Electrical Manufacturers Association (NEMA):

250-20	Enclosures for Electrical Equipment (1000 Volts Maximum)
ICS 6-93	Enclosures
ICS 4-15	Application Guideline for Terminal Blocks
MG 1-21	Motors and Generators

E. National Fire Protection Association (NFPA):

70–23	National Electrical Code (NEC)
99-21	Health Care Facilities
110-22	Emergency and Standby Power Systems

F. Underwriters Laboratories, Inc. (UL):

50-15	Enclosures for Electrical Equipment
508-18	Industrial Control Equipment
891-19	Switchboards
1008-14	Transfer Switch Equipment

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Basis of design is ASCO 7000 series.

B. Automatic transfer switches shall comply with IEEE, NEMA, NFPA, UL, and have the following features:

1. Automatic transfer switches shall be open transition switches,/4- pole, draw-out construction, electrically operated, mechanically held open contact type, without integral overcurrent protection. Automatic transfer switches utilizing automatic or non-automatic molded case circuit breakers, insulated case circuit breakers, or power circuit breakers as switching mechanisms are not acceptable.
2. A two-way bypass-isolation switch shall provide manual bypass of hte load to either source and permit isolation of the automatic transfer switch from all source and load power conductors. All main contacts shall be manually driven.

3. Automatic transfer switches shall be completely factory-assembled and wired such that only external circuit connections are required in the field.
4. Each automatic transfer switch shall be equipped with an integral bypass/isolation switch.
5. Ratings:
   a. Phases, voltage, continuous current, poles, and withstand and closing ratings shall be as shown on the drawings.
   b. Transfer switches are to be rated for continuous duty at specified continuous current rating on 60Hz systems.
6. Markings:
   a. Markings shall be in accordance with UL 1008.
7. Tests:
   a. Automatic transfer switches shall be tested in accordance with UL 1008. The contacts of the transfer switch shall not weld during the performance of withstand and closing tests when used with the upstream overcurrent device and available fault current specified.
8. Surge Withstand Test:
   a. Automatic transfer switches utilizing solid-state devices in sensing, relaying, operating, or communication equipment or circuits shall comply with IEEE C37.90.1.
9. Housing:
   a. Enclose automatic transfer switches in wall- or floor-mounted steel cabinets, with metal gauge not less than No. 14, in accordance with UL 508, or in a switchboard assembly in accordance with UL 891, as shown on the drawings.
   b. Enclosure shall be constructed so that personnel are protected from energized bypass-isolation components during automatic transfer switch maintenance.
   c. Automatic transfer switch components shall be removable without disconnecting external source or load power conductors.
   d. Finish: Cabinets shall be given a phosphate treatment, painted with rust-inhibiting primer, and finish-painted with the manufacturer's standard enamel or lacquer finish.
   e. Viewing Ports: Provide viewing ports so that contacts may be inspected without disassembly.
10. Operating Mechanism:
   a. Actuated by an electrical operator.
   b. Electrically and mechanically interlocked so that the main contact cannot be closed simultaneously in either normal and emergency position.
   c. Normal and emergency main contacts shall be mechanically locked in position by the operating linkage upon completion of transfer. Release of the locking mechanism shall be possible only by normal operating action.
   d. Contact transfer time shall not exceed six cycles.
   e. Operating mechanism components and mechanical interlocks shall be insulated or grounded.
11. Contacts:
   a. Main contacts: Silver alloy.
   b. Neutral contacts: Silver alloy, with same current rating as phase contacts.
   c. Current carrying capacity of arcing contacts shall not be used in the determination of the automatic transfer switch rating, and shall be separate from the main contacts.
   d. Main and arcing contacts shall be visible for inspection with cabinet door open and barrier covers removed.
12. Manual Operator:
   a. Capable of operation by one person in either direction under no load.
13. Replaceable Parts:
   a. Include the main and arcing contacts individually or as units, as well as relays, and control devices.

b. Automatic transfer switch contacts and accessories shall be replaceable from the front without removing the switch from the cabinet and without removing main conductors.

14. Sensing Features:
    a. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100% of nominal, and dropout voltage is adjustable from 75 to 98% of pickup value. Factory set for pickup at 90% and dropout at 85%.
    b. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.
    c. Voltage/Frequency Lockout Relay: Prevent premature transfer to the engine-generator. Pickup voltage shall be adjustable from 85 to 100% of nominal. Factory set for pickup at 90%. Pickup frequency shall be adjustable from 90 to 100% of nominal. Factory set for pickup at 95%.
    d. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes to automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
    e. Test Switch: Simulate normal-source failure.
    f. Switch-Position Indication: Indicate source to which load is connected.
    g. Source-Available Indication: Supervise sources via transfer switch normal- and emergency-source sensing circuits.
    h. Normal Power Indication: Indicate "Normal Source Available."
    i. Emergency Power Indication: Indicate "Emergency Source Available."
    j. Transfer Override Control: Overrides automatic retransfer control so that automatic transfer switch shall remain connected to emergency power source regardless of condition of normal source. Control panel shall indicate override status.
    k. Engine Starting Contacts: One isolated and normally closed and one isolated and normally open; rated 5 A at 30 V DC minimum.
    l. Engine Shutdown Contacts: Time delay adjustable from zero to 15 minutes, and factory set for 5 minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
    m. Engine-Generator Exerciser: Programmable exerciser starts engine-generator(s) and transfers load to them from normal source for a preset time, then retransfers and shuts down engine-generator(s) after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings shall be for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period.
15. Controls:
    a. Controls shall provide indication of switch status and be equipped with alarm diagnostics.
    b. Controls shall control operation of the automatic transfer switches.
    c. Controller shall be a single mincroprocessor.
16. Factory Wiring: Train and bundle factory wiring and label either by color-code or by numbered/lettered wire markers. Labels shall match those on the shop drawings.
17. Annunciation, Control, and Programming Interface Components: Devices for communicating with remote programming devices, annunciators, or control panels shall have open-protocol communication capability matched with remote device.

2.2 SEQUENCE OF OPERATION

A. The specified voltage decrease in one or more phases of the normal power source shall initiate the transfer sequence. The automatic transfer switch shall start the engine-generator(s) after a specified time delay to permit override of momentary dips in the normal power source.

B. The automatic transfer switch shall transfer the load from normal to emergency source when the frequency and voltage of the engine-generator(s) have attained the specified percent of rated value.

C. Engine Start: A voltage decrease, at any automatic transfer switch, in one or more phases of the normal power source to less than the specified value of normal shall start the engine-generator(s) after a specified time delay.

D. Transfer to Emergency System Loads: Automatic transfer switches for Emergency System loads shall transfer their loads from normal to emergency source when frequency and voltage of the engine-generator(s) have attained the specified percent of rated value. Only those switches with deficient normal source voltage shall transfer.

E. Transfer to Equipment Branch Loads: Automatic transfer switches for Equipment Branch loads shall transfer their loads to the engine-generator on a time-delayed, staggered basis, after the Emergency System switches have transferred. Only those switches with deficient normal source voltage shall transfer.

F. Retransfer to Normal (All Loads): Automatic transfer switches shall retransfer the load from emergency to normal source upon restoration of normal supply in all phases to the specified percent or more of normal voltage, and after a specified time delay. Should the emergency source fail during this time, the automatic transfer switches shall immediately transfer to the normal source whenever it becomes available. After restoring to normal source, the engine-generator(s) shall continue to run unloaded for a specified interval before shut-down.

2.3 BYPASS-ISOLATION SWITCH

A. Provide each automatic transfer switch with two-way bypass-isolation manual type switch. The bypass-isolation switch shall permit load by-pass to either normal or emergency power source and complete isolation of the automatic transfer switch, independent of transfer switch position. Bypass and isolation shall be possible under all conditions including when the automatic transfer switch is removed from service.

B. Operation: The bypass-isolation switch shall have provisions for operation by one person through the movement of a maximum of two handles at a common dead front panel in no more than 15 seconds. Provide a lock, which must energize to unlock the bypass switch, to prevent bypassing to a dead source. Provide means to prevent simultaneous connection between normal and emergency sources.

1. Bypass to normal (or emergency): Operation of bypass handle shall allow direct connection of the load to the normal (or emergency) source, without load interruption or by using a break-before-make design, or provide separate load interrupter contacts to momentarily interrupt the load.
    a. Ensure continuity of auxiliary circuits necessary for proper operation of the system.
    b. A red indicating lamp shall light when the automatic transfer switch is bypassed.
    c. Bypassing source to source: If the power source is lost while in the bypass position, bypass to the alternate source shall be achievable without re-energization of the automatic transfer switch service and load connections.
2. Isolation: Operation of the isolating handle shall isolate all live power conductors to the automatic transfer switch without interruption of the load.
    a. Interlocking: Provide interlocking as part of the bypass- isolation switch to eliminate personnel-controlled sequence of operation, and to prevent operation to the isolation position until the bypass function has been completed.
    b. Padlocking: Include provisions to padlock the isolating handle in the isolated position.
    c. Visual verification: The isolation blades shall be visible in the isolated position.
3. Testing: It shall be possible to test (normal electrical operation) the automatic transfer switch and engine–generator(s) with the isolation contacts closed and the load bypassed without interruption of power to the load.

C. Ratings: The electrical capabilities and ratings of the bypass-isolation switch shall be compatible with those of the associated automatic transfer switch, including any required additional withstand tests.

2.4 REMOTE ANNUNCIATOR AND CONTROL SYSTEM

A. Include the following functions for indicated automatic transfer switches:
   1. Indication of sources available, as defined by actual pickup and dropout settings of automatic transfer switch controls.
   2. Indication of automatic transfer switch position.
   3. Indication of automatic transfer switch in test mode.
   4. Indication of failure of communication link.
   5. Key-switch or user-code access to control functions of panel.
   6. Control of automatic transfer switch test initiation.
   7. Control of automatic transfer switch operation in either direction.
   8. Control of time-delay bypass for transfer to normal source.

B. Malfunction of remote annunciator and control system or communication link shall not affect functions of automatic transfer switches. Automatic transfer switch sensing, controlling, or operating functions shall not depend on remote annunciator and control system for proper operation.

C. Remote annunciation and control system shall include the following features:
   1. Touchscreen type operator interface.
   2. Control and indication means grouped together for each automatic transfer switch.
   3. Label each indication and control group. Indicate the automatic transfer switch it controls, the location of the automatic transfer switch, and the identity of the load that it serves.
   4. Digital Communication Capability: Matched to that of automatic transfer switches supervised.
   5. Mounting: Steel cabinet, flush or surface mounted, as shown on the drawings.

D. Provide connection into BMS system to provide required annunciation as noted above to the local electrical shop and boiler plant.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install automatic transfer switches and associated remote components in accordance with the NEC, as shown on the drawings, and manufacturer’s instructions.

B. Anchor automatic transfer switches with rustproof bolts, nuts, and washers not less than 12 mm (1/2 inch) diameter, in accordance with manufacturer’s instructions, and as shown on drawings.

C. Mount automatic transfer switches on concrete slab. Unless otherwise indicated, the slab shall be at least 100 mm (4 inches) thick. The top of the concrete slab shall be approximately 100 mm (4 inches) above finished floor. Edges above floor shall have 12.5 mm (1/2 inch) chamfer. The slab shall be of adequate size to project at least 6 inches beyond the equipment. Provide conduit turnups and cable entrance space required by the equipment to be mounted. Seal voids around conduit openings in slab with water- and oil-resistant caulking or sealant. Cut off and bush conduits 75 mm (3 inches) above slab surface. Concrete work shall be as specified in Section 03 30 00, CAST-IN-PLACE CONCRETE.

D. Anchor remote control and/or annunciator panel to wall.

3.2 ACCEPTANCE CHECKS AND TESTS

A. An authorized representative of the automatic transfer switch manufacturer shall technically supervise and participate during all of the field adjustments and tests. Major adjustments and field tests shall be witnessed by the COR. The manufacturer’s representative shall certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer’s recommendations.

B. Provide field testing that includes the following:

1. Transition from normal power to emergency power at full load.
2. Simulation of loss of normal power two times within 30 minutes.
3. Simulation of transfer back to normal power.

C. Perform manufacturer's required field tests 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. Confirm correct application of manufacturer's recommended lubricants.
      d. Verify appropriate anchorage, required area clearances, and correct alignment.
      e. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey after energization.
      f. Verify grounding connections.
      g. Verify ratings of sensors.
      h. Vacuum-clean enclosure interior. Clean enclosure exterior.
      i. Exercise all active components.
      j. Verify that manual transfer warning signs are properly placed.
      k. Verify the correct operation of all sensing devices, alarms, and indicating devices.
   2. Electrical tests:
      a. Perform insulation-resistance tests.
      b. After energizing circuits, demonstrate the interlocking sequence and operational function for each automatic transfer switch at least three times.
         1) Test bypass-isolation unit functional modes and related automatic transfer switch operations.
         2) Power failure of normal source shall be simulated by opening upstream protective device. This test shall be performed a minimum of five times.
         3) Power failure of emergency source with normal source available shall be simulated by opening upstream protective device for emergency source. This test shall be performed a minimum of five times.
         4) Low phase-to-ground voltage shall be simulated for each phase of normal source.
         5) Operation and settings shall be verified for specified automatic transfer switch operational feature, such as override time delay, transfer time delay, return time delay, engine shutdown time delay, exerciser, auxiliary contacts, and supplemental features.
         6) Verify pickup and dropout voltages by data readout or inspection of control settings.
         7) Verify that bypass and isolation functions perform correctly, including the physical removal of the automatic transfer switch while in bypass mode.
      c. Ground-fault tests: Verify that operation of automatic transfer switches shall not cause nuisance tripping or alarms of ground fault protection on either source.
      d. When any defects are detected, correct the defects and repeat the tests as requested by the COR at no additional cost to the Government.

3.3 FIELD SETTINGS VERIFICATION

A. The automatic transfer switch settings shall be verified in the field by an authorized representative of the manufacturer.

3.4 FOLLOW-UP VERIFICATION

A. Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that the automatic transfer switches are in good operating condition and properly performing the intended function.

3.5 INSTRUCTION

A. Furnish the services of a factory-trained technician for one 4-hour training period for instructing personnel in the maintenance and operation of the automatic transfer switches, on the dates requested by the COR.

END OF SECTION

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.

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.

D. Section 26 42 00 CATHODIC PROTECTION: Requirements for protection of buried ferrous equipment from galvanic corrosion.

E. Section 26 43 13, SURGE PROTECTIVE DEVICES: Surge protective device installed at the electrical service entrance.

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 II structures. Copper materials are required.
   1. Class II conductors: Copper.
   2. Class II air terminals: Solid copper, 460 mm (18 inches) long, not less than 12.7 mm (1/2 inch) diameter, with sharpnickel-plated points.
   3. Ground rods: Copper-clad stee, 0.75 in (19 mm) diameter by 3 m (10 feet) long.
   4. Ground plates: Solid copper, not less than 20 gauge.
   5. Bonding plates: Bronze, 50 square cm (8 square inches).
   6. Through roof connectors: Solid copper riser bar, length and type as required to accommodate roof structure and flashing requirements.
   7. Down conductor guards: Stiff copper or brass.
   8. 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.
   9. 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.
   10. 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. Install the down conductors within the concealed cavity of exterior walls where practical. Run the down conductors to the exterior at elevations below the finished grade.

E. Where down conductors are subject to damage or are accessible near grade, protect with down conductor guards to 2.4 m (8 feet) above grade. Bond down conductors guards to down conductor at both ends.

F. Make connections of dissimilar metal with bimetallic type fittings to prevent electrolytic action.

G. Install ground rods and ground plates not less than 600 mm (2 feet) deep and a distance not less than 900 mm (3 feet) nor more than 2.5 m (8 feet) from the nearest point of the structure. Exothermically weld the down conductors to ground rods and ground plates in the presence of the COR.

H. Bond down conductors to metal main water piping where applicable.

I. Bond down conductors to building structural steel.

J. Connect roof conductors to all metallic projections and equipment above the roof as indicated on the drawings.

K. Connect exterior metal surfaces, located within 900 mm (3 feet) of the conductors, to the conductors to prevent flashovers.

L. Maintain horizontal or downward coursing of main conductor and insure that all bends have at least an 200 mm (8 inches) radius and do not exceed 90 degrees.

M. Conductors shall be rigidly fastened every 900 mm (3 feet) along the roof and down to the building to ground.

N. 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.

O. Install air terminal bases, cable holders and other roof-system supporting means without piercing membrane or metal roofs.

P. 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.

Q. Down conductors coursed on or in reinforced concrete columns or on structural steel columns shall be connected to the reinforcing steel or the structural steel member at its upper and lower extremities. In the case of long vertical members an additional connection shall be made at intervals not exceeding 30 M (100 feet).

R. A counterpoise or ground ring, where shown, shall be of No. 1/0 copper cable having suitable resistance to corrosion and shall be laid around the perimeter of the structure in a trench not less than 600 mm (2 feet) deep at a distance not less than 900 mm (3 feet) nor more than 2.5 M (8 feet) from the nearest point of the structure.

S. 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.

T. 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.

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.

END OF SECTION

SECTION 26 43 13
SURGE PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, and connection of Type 2 Surge Protective Devices, as defined in NFPA 70, and indicated as SPD in this section.

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 23 00, LOW-VOLTAGE SWITCHGEAR: For factory-installed or external SPD.

C. Section 26 24 13, DISTRIBUTION SWITCHBOARDS: For factory-installed or external SPD.

D. Section 26 24 16, PANELBOARDS: For factory-installed or external SPD.

E. Section 26 26 00, POWER DISTRIBUTION UNITS FOR STATIC UNINTERRUPTIBLE POWER SYSTEMS: For factory-installed or external SPD.

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 and device nameplate data.
   2. Manuals:
      a. Submit, simultaneously with the shop drawings, companion copies of 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 manufacturer that the SPD conforms to the requirements of the drawings and specifications.
      b. Certification by the Contractor that the SPD has been properly installed.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplement and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.

B. Institute of Engineering and Electronic Engineers (IEEE):

IEEE C62.41.2-02	Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits
IEEE C62.45-08	Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits

C. National Fire Protection Association (NFPA):

70-23	National Electrical Code (NEC)

D. Underwriters Laboratories, Inc. (UL):

UL 1283-17	Electromagnetic Interference Filters
UL 1449-21	Surge Protective Devices

PART 2 - PRODUCTS

2.1 SWITCHGEAR/SWITCHBOARD SPD

A. Integrally Mounted.

B. General Requirements:
1. Comply with IEEE and UL.
2. Modular design with field-replaceable modules, or non-modular design.
3. Fuses, rated at 200 kA interrupting capacity.
4. Bolted compression lugs for internal wiring.
5. Integral disconnect switch.
6. Redundant suppression circuits.
7. LED indicator lights for power and protection status.
8. Audible alarm, with silencing switch, to indicate when protection has failed.
9. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device.
10. Four-digit transient-event counter.

C. Surge Current per Phase: Minimum 240kA per phase.

2.2 PANELBOARD SPD

A. Integrally Mounted.

B. General Requirements:
1. Comply with UL 1449 and IEEE C62.41.2.
2. Modular design with field-replaceable modules,.
3. Fuses, rated at 200 kA interrupting capacity.
4. Bolted compression lugs for internal wiring.
5. Integral disconnect switch.
6. Redundant suppression circuits.
7. LED indicator lights for power and protection status.
8. Audible alarm, with silencing switch, to indicate when protection has failed.
9. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device.
10. Four-digit transient-event counter.

C. Surge Current per Phase: Minimum 120kA per phase.

2.3 ENCLOSURES

A. Enclosures: NEMA 1.

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. Factory-installed SPD: Switchgear, switchboard, or panelboard manufacturer shall install SPD at the factory.

C. Field-installed SPD: Contractor shall install SPD with conductors or buses between SPD and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
   1. Provide a circuit breaker as a dedicated disconnecting means for TVSS as shown on drawings.

D. Do not perform insulation resistance tests on switchgear, switchboards, panelboards, or feeders with the SPD connected. Disconnect SPD before conducting insulation resistance tests, and reconnect SPD immediately after insulation resistance tests are complete.

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 that disconnecting means and feeder size and maximum length to SPD corresponds to approved shop drawings.
      d. Verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method.
      e. Vacuum-clean enclosure interior. Clean enclosure exterior.
      f. Verify the correct operation of all sensing devices, alarms, and indicating devices.

3.3 FOLLOW-UP VERIFICATION

A. After completion of acceptance checks and tests, the Contractor shall show by demonstration in service that SPD are in good operating condition and properly performing the intended function.

3.4 INSTRUCTION

A. Provide the services of a factory-trained technician for one 2-hour training period for instructing personnel in the maintenance and operation of the SPD, on the date requested by the COR.

END OF SECTION

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 02 41 00, DEMOLITION: Removal and disposal of lamps and ballasts.

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.

2.2 BALLASTS

2.3 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. 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 LED.
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.

2.4 LED EXIT LIGHT FIXTURES

A. Exit light fixtures shall meet applicable requirements of NFPA and UL.

B. Housing and door shall be die-cast aluminum.

C. For general purpose exit light fixtures, door frame shall be hinged, with latch. For vandal-resistant exit light fixtures, door frame shall be secured with tamper-resistant screws.

D. Finish shall be satin or fine-grain brushed aluminum.

E. There shall be no radioactive material used in the fixtures.

F. Fixtures:
1. Inscription panels shall be cast or stamped aluminum a minimum of 2.25 mm (0.090 inch) thick, stenciled with 150 mm (6 inch) high letters, baked with red color stable plastic or fiberglass. Lamps shall be luminous Light Emitting Diodes (LED) mounted in center of letters on red color stable plastic or fiberglass.
2. Double-Faced Fixtures: Provide double-faced fixtures where required or as shown on drawings.
3. Directional Arrows: Provide directional arrows as part of the inscription panel where required or as shown on drawings. Directional arrows shall be the "chevron-type" of similar size and width as the letters and meet the requirements of NFPA 101.

G. Voltage: Multi-voltage (120 – 277V).

2.5 LED LIGHT FIXTURES

A. General:

1. LED light fixtures shall be in accordance with IES, NFPA, UL, as shown on the drawings, and as specified.
2. LED light fixtures shall be Reduction of Hazardous Substances (RoHS)-compliant.
3. LED drivers shall include the following features unless otherwise indicated:
   a. Minimum efficiency: 85% at full load.
   b. Minimum Operating Ambient Temperature: -20˚ C. (-4˚ F.)
   c. Input Voltage: 120 - 277V (±10%) at 60 Hz.
   d. Integral short circuit, open circuit, and overload protection.
   e. Power Factor: ≥ 0.95.
   f. Total Harmonic Distortion: ≤ 20%.
   g. Comply with FCC 47 CFR Part 15.
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 surface mounting fluorescent fixtures to suspended ceilings:
   a. In addition to being secured to any required outlet box, fixtures shall be bolted to a grid ceiling system at four points spaced near the corners of each fixture. The bolts shall be not less than 6 mm (1/4 inch) secured to channel members attached to and spanning the tops of the ceiling structural grid members. Non-turning studs may be

attached to the ceiling structural grid members or spanning channels by special clips designed for the purpose, provided they lock into place and require simple tools for removal.

b. In addition to being secured to any required outlet box, fixtures shall be bolted to ceiling structural members at four points spaced near the corners of each fixture. Pre-positioned 6 mm (1/4 inch) studs or threaded plaster inserts secured to ceiling structural members shall be used to bolt the fixtures to the ceiling. In lieu of the above, 6 mm (1/4 inch) toggle bolts may be used on new or existing ceiling provided the plaster and lath can safely support the fixtures without sagging or cracking.

5. 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.
6. 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.

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, and Section 02 41 00, DEMOLITION.

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 theCOT. Observe for visually detectable flicker over full dimming range, and replace defective components at no cost to the Government.
   b. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Government. Burn-in period to be 40 hours minimum, unless specifically recommended otherwise by the lamp manufacturer. Burn-in dimmed fluorescent and compact fluorescent lamps for at least 100 hours at full voltage, unless specifically recommended otherwise by the lamp manufacturer. Replace any lamps and ballasts which fail during burn-in.

3.3 FOLLOW-UP VERIFICATION

A. Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that the lighting systems are in good operating condition and properly performing the intended function.

END OF SECTION

SECTION 26 56 00
EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, and connection of exterior fixtures, poles, and supports. The terms “lighting fixtures”, “fixture” and “luminaire” are used interchangeably.

1.2 RELATED WORK

A. Section 09 06 00, SCHEDULE FOR FINISHES: Finishes for exterior light poles and luminaires.

B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.

C. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Low voltage power and lighting wiring.

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 fault currents.

E. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits, fittings, and boxes for raceway systems.

F. Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION: Underground handholes and conduits.

G. Section 26 09 23, LIGHTING CONTROLS: Controls for exterior lighting.

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.
      k. Submit site plan showing all exterior lighting fixtures with fixture tags consistent with Lighting Fixture Schedule as shown on drawings. Site plan shall show computer generated point–by-point illumination calculations. Include lamp lumen and light loss factors used in calculations.
   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 exterior 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 Association of State Highway and Transportation Officials (AASHTO):

LRFDLTS-17	Structural Supports for Highway Signs, Luminaires and Traffic Signals

C. American Concrete Institute (ACI):

318-19	Building Code Requirements for Structural Concrete

D. American National Standards Institute (ANSI):

H35.1/H35 1M-17	American National Standard Alloy and Temper Designation Systems for Aluminum

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

A123/A123M-17	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
A153/A153M-16	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
B108/B108M-19	Aluminum-Alloy Permanent Mold Castings
C1089-19	Spun Cast Prestressed Concrete Poles

F. Federal Aviation Administration (FAA):

AC 70/7460-IL-20	Obstruction Marking and Lighting
AC 150/5345-43J-19	Specification for Obstruction Lighting Equipment

G. Illuminating Engineering Society of North America (IESNA):

RP-8-21	Roadway Lighting
LM-72-20	Directional Positioning of Photometric Data
LM-79-19	Approved Method for the Electrical and Photometric Measurements of Solid-Sate Lighting Products
LM-80-21	Approved Method for Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays and Modules
TM-15-20	Luminaire Classification System for Outdoor Luminaires

H. National Electrical Manufacturers Association (NEMA):

C78.41-16	Electric Lamps – Guidelines for Low-Pressure Sodium Lamps
C78.42-09(R2016)	Electric Lamps – Guidelines for High-Pressure Sodium Lamps
C78.43-17	Electric Lamps – Single-Ended Metal-Halide Lamps
C78.1381-98	Electric Lamps – 70-Watt M85 Double-Ended Metal-Halide Lamps
C81.61-19	Electrical Lamp Bases – Specifications for Bases (Caps) for Electric Lamps
C82.4-17	Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type)
C136.3-20	For Roadway and Area Lighting Equipment – Luminaire Attachments
C136.17-05(S2017)	Roadway and Area Lighting Equipment – Enclosed Side-Mounted Luminaires for Horizontal-Burning High-Intensity-Discharge Lamps – Mechanical Interchangeability of Refractors
ICS 2-00(R2020)	Controllers, Contactors and Overload Relays Rated 600 Volts
ICS 6-93(R2016)	Enclosures

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
773-16	Plug-In, Locking Type Photocontrols for Use with Area Lighting
773A-16	Nonindustrial Photoelectric Switches for Lighting Control
1029-94	High-Intensity-Discharge Lamp Ballasts
1598-21	Luminaires
8750-15	Light Emitting Diode (LED) Equipment for Use in Lighting Products

1.6 DELIVERY, STORAGE, AND HANDLING

A. Provide manufacturer's standard provisions for protecting pole finishes during transport, storage, and installation. Do not store poles on ground. Store poles so they are at least 305 mm (12 inches) above ground level and growing vegetation. Do not remove factory-applied pole wrappings until just before installing pole.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Luminaires, materials and equipment shall be in accordance with NEC, UL, ANSI, and as shown on the drawings and specified.

2.2 LUMINAIRES

A. Luminaires shall be weatherproof, heavy duty, outdoor types designed for effi cient light utilization, adequate dissipation of lamp and ballast heat, and safe cleaning and relamping.

B. Illumination distribution patterns, BUG ratings and cutoff types as defined by the IESNA shall be as shown on the drawings.

C. Lenses shall be frame-mounted, heat-resistant, borosilicate glass, with prismatic refractors, unless otherwise shown on the drawings. Attach the frame to the luminaire housing by hinges or chain. Use heat and aging-resistant, resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

D. Pre-wire internal components to terminal strips at the factory.

E. Bracket-mounted luminaires shall have leveling provisions and clamp-type adjustable slip-fitters with locking screws.

F. Materials shall be rustproof. Latches and fittings shall be non-ferrous metal.

G. Provide manufacturer's standard finish, as scheduled on the drawings. Where indicated on drawings, match finish process and color of pole or support materials. Where indicated on drawings, provide finishes as indicated in Section 09 06 00, SCHEDULE FOR FINISHES.

H. Luminaires shall carry factory labels, showing complete, specific lamp and ballast information.

2.3 LAMPS

A. LED sources shall meet the following requirements:
   1. Operating temperature rating shall be between -40 degrees C (-40 degrees F) and 50 degrees C (120 degrees F).
   2. The manufacturer shall have performed reliability tests on the LEDs luminaires complying with Illuminating Engineering Society (IES) LM79 for photometric performance and LM80 for lumen maintenance and L70 life.

B. Mercury vapor lamps shall not be used.

2.4 LED DRIVERS

A. LED drivers shall meet the following requirements:
   1. Drivers shall have a minimum efficiency of 85%.
   2. Starting Temperature: -40 degrees C (-40 degrees F).
   3. Input Voltage: 120 to 480 (±10%) volt.
   4. Power Supplies: Class I or II output.
   5. Surge Protection: The system must survive 250 repetitive strikes of “C Low” (C Low: 6kV/1.2 x 50 µs, 10kA/8 x 20 µs) waveforms at 1-minute intervals with less than 10% degradation in clamping voltage. “C Low” waveforms are as defined in IEEE/ASNI C62.41.2-2002, Scenario 1 Location Category C.
   6. Power Factor (PF): ≥ 0.90.
   7. Total Harmonic Distortion (THD): ≤ 20%.
   8. Comply with FCC Title 47 CFR Part 18 Non-consumer RFI/EMI Standards.
   9. Drivers shall be reduction of hazardous substances (ROHS)-compliant.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install lighting in accordance with the NEC, as shown on the drawings, and in accordance with manufacturer’s recommendations.

B. Pole Foundations:
   1. Excavate only as necessary to provide sufficient working clearance for installation of forms and proper use of tamper to the full depth of the excavation. Prevent surface water from flowing into the excavation. Thoroughly compact backfill with compacting arranged to prevent pressure between conductor, jacket, or sheath, and the end of conduit.

2. Set anchor bolts according to anchor-bolt templates furnished by the pole manufacturer.
3. Install poles as necessary to provide a permanent vertical position with the bracket arm in proper position for luminaire location.
4. After the poles have been installed, shimmed, and plumbed, grout the spaces between the pole bases and the concrete base with non-shrink concrete grout material. Provide a plastic or copper tube, of not less than 9 mm (0.375-inch) inside diameter through the grout, tight to the top of the concrete base to prevent moisture weeping from the interior of the pole.

C. Install lamps in each luminaire.

D. Adjust luminaires that require field adjustment or aiming.

3.2 GROUNDING

A. Ground noncurrent-carrying parts of equipment, including metal poles, luminaires, mounting arms, brackets, and metallic enclosures, as specified in Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS. Where copper grounding conductor is connected to a metal other than copper, provide specially-treated or lined connectors suitable and listed for this purpose.

3.3 ACCEPTANCE CHECKS AND TESTS

A. Verify operation after installing luminaires and energizing circuits.

END OF SECTION

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 (106 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. 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.

13. Grounding Electrode Conductor: (GEC) Conductor connected to earth grounding electrode.
14. Grounding Electrode System: Electrodes through which an effective connection to earth is established, including supplementary, communications system grounding electrodes and GEC.
15. Grounding Equalizer or Backbone Bonding Conductor (BBC): Conductor that interconnects elements of telecommunications grounding infrastructure.
16. 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.
17. Microducts: All forms of air blown fiber pathways.
18. Ohm: A unit of restive measurement.
19. Received Signal Strength Indication (RSSI): A measurement of power present in a received RF signal.
20. Service Provider Demarcation Point (SPDP): Not owned by LEC or service provider, but designated by Government as point within facility considered the DEMARC.
21. Sound (SND): Changing air pressure to audible signals over given time span.
22. System: Specific hardware, firmware, and software, functioning together as a unit, performing task for which it was designed.
23. Telecommunications Bonding Backbone (TBB): Conductors of appropriate size (minimum 53.49 mm2 [1/0 AWG]) stranded copper wire, that connect to Grounding Electrode System and route to telecommunications main grounding busbar (TMGB) and circulate to interconnect various TGBs and other locations shown on drawings.
24. 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.
25. 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.
   3. The most recently published version of each referenced document shall apply.

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	Flexible Metal Conduit
5	Surface Metal Raceway and Fittings
6	Rigid Metal Conduit
44	Thermoset-Insulated Wires and Cables
50	Enclosures for Electrical Equipment
65	Wired Cabinets
83	Thermoplastic-Insulated Wires and Cables
96	Lightning Protection Components
96A	Installation Requirements for Lightning Protection Systems
360	Liquid-Tight Flexible Steel Conduit
444	Communications Cables
467	Grounding and Bonding Equipment
486A-486B	Wire Connectors
486C	Splicing Wire Connectors
486D	Sealed Wire Connector Systems
486E	Standard for Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors
493	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	Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape
514A	Metallic Outlet Boxes
514B	Fittings for Cable and Conduit
514C	Nonmetallic Outlet Boxes, Flush-Device Boxes and Covers

651	Schedule 40 and 80 Rigid PVC Conduit
651A	Type EB and A Rigid PVC Conduit and HDPE Conduit
797	Electrical Metallic Tubing
884	Underfloor Raceways and Fittings
1069	Hospital Signaling and Nurse Call Equipment
1242	Intermediate Metal Conduit
1449	Standard for Transient Voltage Surge Suppressors
1479	Fire Tests of Through-Penetration Fire Stops
1480	Speaker Standards for Fire Alarm, Emergency, Commercial and Professional use
1666	Standard for Wire/Cable Vertical (Riser) Tray Flame Tests
1685	Vertical Tray Fire Protection and Smoke Release Test for Electrical and Fiber Optic Cables
1861	Communication Circuit Accessories
1863	Standard for Safety, communications Circuits Accessories
1865	Standard for Safety for Vertical-Tray Fire Protection and Smoke-Release Test for Electrical and Optical-Fiber Cables
2024	Standard for Optical Fiber Raceways
2024	Standard for Cable Routing Assemblies and Communications Raceways
2196	Standard for Test of Fire Resistive Cable
60950	Information Technology Equipment Safety

D. Industry Standards:

1. Advanced Television Systems Committee (ATSC):

A/53 Part 1	ATSC Digital Television Standard, Part 1, Digital Television System
A/53 Part 2	ATSC Digital Television Standard, Part 2, RF/Transmission System Characteristics
A/53 Part 3	ATSC Digital Television Standard, Part 3, Service Multiplex and Transport System Characteristics
A/53 Part 4	ATSC Digital Television Standard, Part 4, MPEG-2 Video System Characteristics
A/53 Part 5	ATSC Digital Television Standard, Part 5, AC-3 Audio System Characteristics
A/53 Part 6	ATSC Digital Television Standard, Part 6, Enhanced AC-3 Audio System Characteristics

2. American Institute of Architects (AIA) Guidelines for Design & Construction of Health Care Facilities.
3. American Society of Mechanical Engineers (ASME):

A17.1	Safety Code for Elevators and Escalators Includes Requirements for Elevators, Escalators, Dumbwaiters, Moving Walks, Material Lifts, and Dumbwaiters with Automatic Transfer Devices
17.3	Safety Code for Existing Elevators and Escalators
17.4	Guide for Emergency Personnel

17.5	Elevator and Escalator Electrical Equipment

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

B1	Standard Specification for Hard-Drawn Copper Wire
B8	Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
D1557	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort 56,000 ft-lbf/ft3 (2,700 kN-m/m3)
D2301	Standard Specification for Vinyl Chloride Plastic Pressure Sensitive Electrical Insulating Tape
B258-02	Standard Specification for Standard Nominal Diameters and Cross-Sectional Areas of AWG Sizes of Solid Round Wires Used as Electrical Conductors
D709-01	Standard Specification for Laminated Thermosetting Materials
D4566	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	Network Equipment and Power Grounding, Environmental, and Physical Design Requirements
ATT-TP-76300	Merged AT&T Affiliate Companies Installation Requirements
ATT-TP-76305	Common Systems Cable and Wire Installation and Removal Requirements - Cable Racks and Raceways
ATT-TP-76306	Electrostatic Discharge Control
ATT-TP-76400	Detail Engineering Requirements
ATT-TP-76402	AT&T Raised Access Floor Engineering and Installation Requirements
ATT-TP-76405	Technical Requirements for Supplemental Cooling Systems in Network Equipment Environments
ATT-TP-76416	Grounding and Bonding Requirements for Network Facilities
ATT-TP-76440	Ethernet Specification
ATT-TP-76450	Common Systems Equipment Interconnection Standards for AT&T Network Equipment Spaces
ATT-TP-76461	Fiber Optic Cleaning
ATT-TP-76900	AT&T Installation Testing Requirement
ATT-TP-76911	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	Data Center Design and Implementation Best Practices
ANSI/BICSI 004	Information Technology Systems Design and Implementation Best Practices for Healthcare Institutions and Facilities
ANSI/NECA/BICSI 568	Standard for Installing Commercial Building Telecommunications Cabling
NECA/BICSI 607	Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings
ANSI/BICSI 005	Electronic Safety and Security (ESS) System Design and Implementation Best Practices

8. Electronic Components Assemblies and Materials Association,(ECA).

ECA EIA/RS-270	Tools, Crimping, Solderless Wiring Devices – Recommended Procedures for User Certification
EIA/ECA 310-E	Cabinets, and Associated Equipment

9. Facility Guidelines Institute: 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	Telecommunications Cable, Filled Polyolefin Insulated Copper Conductor, S-87-640 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	Broadband Twisted Pair Cable Aircore, Polyolefin Insulated, Copper Conductors
S-99-689	Broadband Twisted Pair Cable Filled, Polyolefin Insulated, Copper Conductors
ICEA S-102-700	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	National Electrical Safety Code (NESC)

C62.41.2	
Cor 1 IEEE	Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits 4)
C62.45	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	IEEE the New IEEE Standards Dictionary of Electrical and Electronics Terms
602	IEEE Recommended Practice for Electric Systems in Health Care Facilities
1100	IEEE Recommended Practice for Powering and Grounding Electronic Equipment

12. International Code Council:

AC193	Mechanical Anchors in Concrete Elements

13. International Organization for Standardization (ISO):

ISO/TR 21730	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	Enclosures for Electrical Equipment (1,000V Maximum)
ANSI C62.61	American National Standard for Gas Tube Surge Arresters on Wire Line Telephone Circuits
ANSI/NEMA FB 1	Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing EMT) and Cable
ANSI/NEMA OS 1	Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
NEMA SB 19	NEMA Installation Guide for Nurse Call Systems
TC 3	Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing
NEMA VE 2	Cable Tray Installation Guidelines

15. National Fire Protection Association (NFPA):

70E	Standard for Electrical Safety in the Workplace
70	National Electrical Code (NEC)
72	National Fire Alarm Code
75	Standard for the Fire Protection of Information Technological Equipment
76	Recommended Practice for the Fire Protection of Telecommunications Facilities
77	Recommended Practice on Static Electricity

90A	Standard for the Installation of Air Conditioning and Ventilating Systems
99	Health Care Facilities Code
101	Life Safety Code
241	Safeguarding construction, alternation and Demolition Operations
255	Standard Method of Test of Surface Burning Characteristics of Building Materials
262	Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces
780	Standard for the Installation of Lightning Protection Systems
1221	Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems
5000	Building Construction and Safety Code

16. Society for Protective Coatings (SSPC):

SSPC SP 6/NACE No.3	Commercial Blast Cleaning

17. Society of Cable Telecommunications Engineers (SCTE):

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

18. Telecommunications Industry Association (TIA):

TIA-120 Series	Telecommunications Land Mobile communications (APCO/Project 25)
TIA TSB-140	Additional Guidelines for Field-Testing Length, Loss and Polarity of Optical Fiber Cabling Systems
TIA-155	Guidelines for the Assessment and Mitigation of Installed Category 6 Cabling to Support 10GBASE-T
TIA TSB-162-A	Telecommunications Cabling Guidelines for Wireless Access Points
TIA-222-G	Structural Standard for Antenna Supporting Structures and Antennas
TIA/EIA-423-B	Electrical Characteristics of Unbalanced Voltage Digital Interface Circuits
TIA-455-C	General Requirements for Standard Test Procedures for Optical Fibers, Cables, Transducers, Sensors, Connecting and Terminating Devices, and other Fiber Optic Components
TIA-455-53-A	FOTP-53 Attenuation by Substitution Measurements for Multimode Graded-Index Optical Fibers in Fiber Assemblies (Long Length)
TIA-455-61-A	FOTP-61 Measurement of Fiber of Cable Attenuation Using an OTDR
TIA-472D000-B	Fiber Optic Communications Cable for Outside Plant Use

ANSI/TIA-492-B	62.5-µ Core Diameter/125-um Cladding Diameter Class 1a Graded-Index Multimode Optical Fibers
ANSI/TIA-492AAAB-A	50-um Core Diameter/125-um Cladding Diameter Class IA Graded-Index Multimode Optically Optimized American Standard Fibers
TIA-492CAAA	Detail Specification for Class IVa Dispersion- Unshifted Single-Mode Optical Fibers
TIA-492E000	Sectional Specification for Class IVd Nonzero-Dispersion Single-Mode Optical Fibers for the 1,550 nm Window
TIA-526-7-B	Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant – OFSTP-7
TIA-526.14-A	Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant – SFSTP-14
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 with addendums and erratas
TIA-569	Revision/Edition C Telecommunications Pathways and Spaces
TIA-574	Position Non-Synchronous Interface between Data Terminal equipment and Data Circuit Terminating Equipment Employing Serial Binary Interchange
TIA/EIA-590-A	Standard for Physical Location and Protection of Below Ground Fiber Optic Cable Plant
TIA-598-D	Optical Fiber Cable Color Coding
TIA-604-10-B	Fiber Optic Connector Intermateablility Standard
ANSI/TIA-606-B	Administration Standard for Telecommunications Infrastructure
TIA-607-B	Generic Telecommunications Bonding and Grounding (Earthing) For Customer Premises
TIA-613	High Speed Serial Interface for Data Terminal Equipment and Data Circuit Terminal Equipment
ANSI/TIA-758-B	Customer-owned Outside Plant Telecommunications Infrastructure Standard
ANSI/TIA-854	A Full Duplex Ethernet Specification for 1000 Mb/s (1000BASE-TX) Operating over Category 6 Balanced Twisted-Pair Cabling
ANSI/TIA-862-A	Building Automation Systems Cabling Standard

TIA-942-A	Telecommunications Infrastructure Standard for Data Centers
TIA-1152	Requirements for Field Testing Instruments and Measurements for Balanced Twisted Pair Cabling
TIA-1179	Healthcare Facility Telecommunications Infrastructure Standard

1.4 SINGULAR NUMBER

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

1.5 RELATED WORK

A. Specification Order of Precedence: FAR Clause 52.236-21, VAAR Clause 852.236-71.
   1. Field Cutting and Patching: Section 09 91 00, PAINTING.
   2. Additional submittal requirements: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
   3. Availability and source of references and standards specified in applicable publications: Section 01 42 19, REFERENCE STANDARDS.
   4. Control of environmental pollution and damage for air, water, and land resources: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.
   5. Requirements for non-hazardous building construction and demolition waste: Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT.
   6. General requirements and procedures to comply with various federal mandates and U.S. Department of Veterans Affairs (VA) policies for sustainable design: Section 01 81 13,SUSTAINABLE DESIGN REQUIREMENTS.
   7. Closures of openings in walls, floors, and roof decks against penetration of flame, heat, and smoke or gases in fire resistant rated construction: Section 07 84 00, FIRESTOPPING.
   8. Sealant and caulking materials and their application: Section 07 92 00, JOINT SEALANTS.
   9. General electrical requirements that are common to more than one section of Division 26: Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
   10. Electrical conductors and cables in electrical systems rated 600 V and below: Section 26 05 21, LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW).
   11. Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents: Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
   12. Conduit and boxes: Section 26 05 33, RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS.
   13. Wiring devices: Section 26 27 26, WIRING DEVICES.
   14. Underground ducts, raceways, and pull boxes: Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION.
   15. General requirements common to more than one section in Division 28: Section 28 05 00, COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY.
   16. Conductors and cables for electronic safety and security systems: Section 28 05 13, CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY.
   17. Low impedance path to ground for electronic safety and security system ground fault currents: Section 28 05 26, GROUNDING AND BONDING FOR SECURITY SYSTEMS.
   18. 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.
   19. Physical Access Control System field-installed controllers connected by data transmission network: Section 28 13 00, PHYSICAL ACCESS DETECTION.

20. Intrusion sensors and detection devices, and communication links to perform monitoring, alarm, and control functions: Section 28 16 00, INTRUSION DETECTION EQUIPMENT AND SYSTEMS.
21. Video surveillance system cameras, data transmission wiring, and control stations with associated equipment: Section 28 23 00, VIDEO SURVEILLANCE EQUIPMENT AND SYSTEMS.
22. 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.
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. 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.

G. Test Equipment List:
   1. Supply test equipment of accuracy better than parameters to be tested.
   2. Submit test equipment list including make and model number:
      a. ANSI/TIA-1152 Level IV twisted pair cabling test instrument.
      b. Fiber optic insertion loss power meter with light source.
      c. Optical time domain reflectometer (OTDR).
      d. Volt-Ohm meter.
      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.

H. Submittal Drawings:
   1. Telecommunications Space Plans/Elevations: Provide enlarged floor plans of telecommunication spaces indicating layout of equipment and devices, including receptacles and grounding provisions. Submit detailed plan views and elevations of telecommunication spaces showing racks, termination blocks, and cable paths. Include following rooms:
      a. Telecommunications rooms.
      b. Data Center.
   2. Logical Drawings: Provide logical riser or schematic drawings for all systems.
      a. Provide riser diagrams systems and interconnection drawings for equipment assemblies; show termination points and identify wiring connections.
   3. Access Panel Schedule on Submittal Drawings: Coordinate and prepare a location, size, and function schedule of access panels required to fully service equipment.

I. Provide sustainable design submittals.

J. Furnish electronic certified test reports to COR prior to final inspection and not more than 90 days after completion of tests.

1.8 CLOSEOUT SUBMITTALS

A. Provide following closeout submittals prior to project closeout date:
   1. Warranty certificate.
   2. Evidence of compliance with requirements such as low voltage certificate of inspection.
   3. Project record documents.
   4. Instruction manuals and software that are a part of system.

B. Maintenance and Operation Manuals: Submit in accordance with Section 01 00 00, GENERAL REQUIREMENTS.
   1. Prepare a manual for each system and equipment specified.
   2. Furnish on portable storage drive in PDF format or equivalent accepted by COR.
   3. Furnish complete manual as specified in specification section, fifteen days prior to performance of systems or equipment test.
   4. Furnish remaining manuals prior to final completion.
   5. Identify storage drive "MAINTENANCE AND OPERATION MANUAL" and system name.
   6. Include name, contact information and emergency service numbers of each subcontractor installing system or equipment and local representatives for system or equipment.
   7. Provide a Table of Contents and assemble files to conform to Table of Contents.
   8. Operation and Maintenance Data includes:
      a. Approved shop drawing for each item of equipment.
      b. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of equipment.
      c. A control sequence describing start-up, operation, and shutdown.
      d. Description of function of each principal item of equipment.
      e. Installation and maintenance instructions.
      f. Safety precautions.
      g. Diagrams and illustrations.
      h. Test Results and testing methods.
      i. Performance data.
      j. Pictorial "exploded" parts list with part numbers. Emphasis to be placed on use of special tools and instruments. Indicate sources of supply, recommended spare parts, and name of servicing organization.
      k. Warranty documentation indicating end date and equipment protected under warranty.
      l. Appendix; list qualified permanent servicing organizations for support of equipment, including addresses and certified personnel qualifications.

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

b. Inputs and outputs of equipment identified according to labels installed on cables and equipment
c. Device locations with labels.
d. Conduit.
e. Head-end equipment.
f. Wiring diagram.
g. Labeling and administration documentation.

5. Submit Record Wiring Diagrams within five business days after final cable testing.
6. Deliver Record Wiring Diagrams as CAD files in .dwg and/or .rvt formats as determined by COR.
7. Deliver four complete sets of electronic record wiring diagrams to COR on portable storage drive.

D. Service Qualifications: Submit name and contact information of service organizations providing service to this installation within 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. 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; black letters imprinted with “CAUTION BURIED FIBER OPTIC LINE BELOW”.

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.

F. Re-Enterable Encapsulating Compound: Product maintaining chemical stability of closure.

G. Provide gel-filled splice cases in accordance with RUS Bull 345-72.

2.7 ACCESS PANELS

A. Panels: 304 mm x 304 mm (12 inches by 12 inches), or size allowed by location to provide optimum access to equipment for maintenance and service.

B. Provide access panels and doors as required to allow service of materials and equipment that require inspection, replacement, repair or service.

C. Provide access panels where items installed require access and are concealed in floor, wall, furred space or above ceiling; ceilings consisting of lay-in or removable splined tiles do not require access panels.

D. Provide access panels with same fire rating classification as surface penetrated.

PART 3 EXECUTION

3.1 PREPARATION

A. Penetrations and Sleeves:
   1. Lay out penetration and sleeve openings in advance, to permit provision in work.
   2. Set sleeves in forms before concrete is poured.
   3. Set sleeves prior to installation of structure for passage of pipes, conduit, ducts, etc.
   4. Provide sleeves and packing materials at penetrations of foundations, walls, slabs, partitions, and floors.
   5. Make sleeves that penetrate outside walls, basement slabs, footings, and beams waterproof.

6. Fill slots, sleeves and other openings in floors or walls if not used.
   a. Fill spaces in openings after installation of conduit or cable.
   b. Provide fill for floor penetrations to prevent passage of water, smoke, fire, and fumes.
   c. Provide fire resistant fill in rated floors and walls, to prevent passage of air, smoke and fumes.
7. Install sleeves through floors watertight and extend minimum 50.8 mm (2 inches) above floor surface.
8. Match and set sleeves flush with adjoining floor, ceiling, and wall finishes where raceways passing through openings are exposed in finished rooms.
9. Annular space between conduit and sleeve must be minimum 6 mm (1/4 inch).
10. Do not provide sleeves for slabs-on-grade, unless specified or indicated otherwise.
11. Comply with requirements for firestopping, for sleeves through rated fire walls and smoke partitions.
12. Do not support piping risers or conduit on sleeves.
13. Identify unused sleeves and slots for future installation.
14. Provide core drilling if walls are poured or otherwise constructed without sleeves and wall penetration is required; do not penetrate structural members.

B. Core Drilling:
1. Avoid core drilling whenever possible.
2. Coordinate openings with other trades and utilities, and prevent damage to structural reinforcement.
3. Investigate existing conditions in vicinity of required opening prior to coring, including an x-ray of floor if determined necessary by competent person or COR.
4. Protect areas from damage.

C. Verification of In-Place Conditions:
1. Verify location, use and status of all material, equipment, and utilities that are specified, indicated, or determined necessary for removal.
   a. Verify materials, equipment, and utilities to be removed are inactive, not required, or in use after completion of project.
   b. Replace with equivalent any material, equipment and utilities that were removed by contractor that are required to be left in place.
2. Existing Utilities: Do not interrupt utilities serving facilities occupied by Government or others unless permitted under following conditions and then only after arranging to provide temporary utility services, according to requirements indicated:
   a. Notify COR in writing at least 14 days in advance of proposed utility interruptions.
   b. Do not proceed with utility interruptions without Government's written permission.

D. Provide suspended platforms, strap hangers, brackets, shelves, stands or legs for floor, wall and ceiling mounting of equipment as required.

E. Provide steel supports and hardware for installation of hangers, anchors, guides, and other support hardware.

F. Obtain and analyze catalog data, weights, and other pertinent data required for coordination of equipment support provisions and installation.

G. Verify site conditions and dimensions of equipment to ensure access for proper installation of equipment without disassembly that would void warranty.

3.2 INSTALLATION - GENERAL

A. Coordinate systems, equipment, and materials installation with other building components.

B. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings.

C. Conform to VAAR 852.236.91 arrangements indicated, recognizing that work may be shown in diagrammatic form or have been impracticable to detail all items because of variances in manufacturers' methods of achieving specified results.

D. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed in both exposed and un-exposed spaces.

E. Install equipment according to manufacturers' written instructions.

F. Install wiring and cabling between equipment and related devices.

G. Install cabling, wiring, and equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with minimum interference of adjacent other installations.

H. Provide access panel or doors where units are concealed behind finished surfaces.

I. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for wiring, cabling, and equipment installations.

J. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide maximum headroom and access for service and maintenance as possible.

K. Install systems, materials, and equipment giving priority to systems required to be installed at a specified slope.

L. Avoid interference with structure and with work or other trades, preserving adequate headroom and clearing doors and passageways to satisfaction of COR and code requirements.

M. Install equipment and cabling to distribute equipment loads on building structural members provided for equipment support under other sections; install and support roof-mounted equipment on structural steel or roof curbs as appropriate.

N. Provide supplementary or miscellaneous items, appurtenances, devices and materials for a complete installation.

3.3 EQUIPMENT INSTALLATION

A. Locate equipment as close as practical to locations shown on drawings.

B. Note locations of equipment requiring access on record drawings.

C. Access and Access Panels: Verify access panel locations and construction with COR.

D. Inaccessible Equipment:
   1. Where Government determines that contractor has installed equipment not conveniently accessible for operation and maintenance, equipment must be removed and reinstalled as directed and without additional cost to Government.
   2. Refer to Section 27 11 00, TELECOMMUNICATIONS ROOM FITTINGS for communication equipment cabinet assembly.
   3. Refer to Section 27 11 00, TELECOMMUNICATIONS ROOM FITTINGS for equipment labeling.

3.4 EQUIPMENT IDENTIFICATION

A. Install an identification sign which clearly indicates information required for use and maintenance of equipment.

B. Secure identification signs with screws.

3.5 CUTTING AND PATCHING

A. Perform cutting and patching according to contract general requirements and as follows:
   1. Remove samples of installed work as specified for testing.
   2. Perform cutting, fitting, and patching of equipment and materials required to uncover existing infrastructure in order to provide access for correction of improperly installed existing or new work.
   3. Remove and replace defective work.
   4. Remove and replace non-conforming work.

B. Cut, remove, and legally dispose of selected equipment, components, and materials, including removal of material, equipment, devices, and other items indicated to be removed and items made obsolete by new work.

C. Provide and maintain temporary partitions or dust barriers adequate to prevent spread of dust and dirt to adjacent areas.

D. Protect adjacent installations during cutting and patching operations.

E. Protect structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

F. Patch finished surfaces and building components using new materials specified for original installation and experienced installers.

3.6 FIELD QUALITY CONTROL

A. Provide work according to VAAR 852.236.91 and FAR clause 52.236-5.

B. Provide minimum clearances and work required for compliance with NFPA 70, National Electrical Code (NEC), and manufacturers' instructions; comply with additional requirements indicated for access and clearances.

C. Verify all field conditions and dimensions that affect selection and provision of materials and equipment, and provide any disassembly, reassembly, relocation, demolition, cutting and patching required to provide work specified or indicated, including relocation and reinstallation of existing wiring and equipment.
   1. Protect facility, equipment, and wiring from damage.

D. Submit written notice that:
   1. Project has been inspected for compliance with documents.
   2. Work has been completed in accordance with documents.

E. Non-Conforming Work: Conduct project acceptance inspections, final completion inspections, substantial completion inspections, and acceptance testing and demonstrations after verification of system operation and completeness by Contractor.

F. For project acceptance inspections, final completion inspections, substantial completion inspections, and testing/demonstrations that require more than one site visit by COR or design professional to verify project compliance for same material or equipment, Government reserves right to obtain compensation from contractor to defray cost of additional site visits that result from project construction or testing deficiencies and incompleteness, incorrect information, or non-compliance with project provisions.
   1. COR will notify contractor, of hourly rates and travel expenses for additional site visits, and will issue an invoice to Contractor for additional site visits.
   2. Contractor is not be eligible for extensions of project schedule or additional charges resulting from additional site visits that result from project construction or testing deficiencies/incompleteness, incorrect information, or non-compliance with Project provisions.

G. Tests:
   1. Interim inspection is required at approximately 50 percent of installation.
   2. Request inspection ten working days prior to interim inspection start date by notifying COR in writing; this inspection must verify equipment and system being provided adheres to installation, mechanical and technical requirements of construction documents.
   3. Inspection to be conducted by OEM and factory-certified contractor representative, and witnessed by COR, facility and SMCS 0050P2H3 representatives.
   4. Check each item of installed equipment to ensure appropriate NRTL listing labels and markings are fixed in place.
   5. Verify cabling terminations in DEMARC, MCR, TER, SCC, ECC, TRs and head end rooms, workstation locations and TCO adhere to color code for T568B pin assignments and cabling connections are in compliance with TIA standards.

6. Visually confirm minimum Category 6A 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. 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. Buried conduit duct locations.
    b. Hand holes.
    c. DEMARC.
    d. TR interconnections.
    e. System interfaces in locations listed herein.
    f. Communications circulating ground system.
    g. UPS areas.
    h. Each general floor areas.
    i. 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. 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.

END OF SECTION

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

A. Section Includes:
   1. Required Bonding Busbars.
   2. Supplemental Bonding Networks.
   3. Telecommunications Bonding Conductors.
   4. Joining Requirements.
   5. 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.

1.6 REFERENCE STANDARDS

A. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

B. TIA-607 - Telecommunications Bonding and Grounding (Earthing) for Customer Premises; 2024e.

C. UL 497 - Standard for Protectors for Paired-Conductor Communications Circuits; Current Edition, Including All Revisions.

D. UL 497A - Standard for Secondary Protectors for Communications Circuits; Current Edition, Including All Revisions.

PART 2 PRODUCTS

2.1 BONDING BUSBARS.

A. 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.

B. 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.

C. 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” length.

D. 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.

E. 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).

A. The TBB bonds the facility Primary Bonding Busbar (PBB) to telecommunications space Secondary Bonding Busbars (SBBs).

B. Material. Stranded copper wire with a green jacket (or per NEC depending on size), run as a continuous conductor.

C. Size. The TBB shall be sized to meet the requirements of ANSI/TIA-607-D and will be as straight as practicable avoiding bends.

D. 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.

- - - E N D - - -

END OF SECTION

SECTION 27 05 33
CONDUITS AND BACKBOXES FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.1 DESCRIPTION

A. This section specifies conduit, fittings, and boxes to form raceway systems for communications cabling.

1.2 RELATED WORK

A. Bedding of conduits: Section 31 20 00, EARTH MOVING.

B. Sealing around penetrations to maintain integrity of fire rated construction: Section 07 84 00, FIRESTOPPING.

C. Fabrications for deflection of water away from building envelope at penetrations: Section 07 60 00, FLASHING AND SHEET METAL.

D. Sealing around conduit penetrations through building envelope to prevent moisture migration into building: Section 07 92 00, JOINT SEALANTS.

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

F. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.

1.3 SUBMITTALS

A. In accordance with Section 27 05 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.

1.4 REFERENCE STANDARDS

A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2020.

B. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S); 2020.

C. ANSI C80.5 - American National Standard for Electrical Rigid Metal Conduit - Aluminum (ERMC-A); 2025.

D. ANSI C80.6 - American National Standard for Electrical Intermediate Metal Conduit; 2018.

E. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.

F. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.

G. UL 6A - Electrical Rigid Metal Conduit-Aluminum, Red Brass, and Stainless Steel; Current Edition, Including All Revisions.

H. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances; Current Edition, Including All Revisions.

I. UL 467 - Grounding and Bonding Equipment; Current Edition, Including All Revisions.

J. UL 514B - Conduit, Tubing, and Cable Fittings; Current Edition, Including All Revisions.

K. UL 514C - Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers; Current Edition, Including All Revisions.

L. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings; Current Edition, Including All Revisions.

M. UL 651A - High Density Polyethylene (HDPE) Conduit; Current Edition, Including All Revisions.

N. UL 797 - Electrical Metallic Tubing-Steel; Current Edition, Including All Revisions.

O. UL 1242 - Electrical Intermediate Metal Conduit-Steel; Current Edition, Including All Revisions.

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. Direct Burial Plastic Conduit: Conform to UL 651 and UL 651A, heavy wall PVC, or high density polyethylene (HDPE).

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. Direct Burial Plastic Conduit Fittings: Provide fittings meeting requirements of UL 514C and NEMA TC3, and as recommended by conduit manufacturer.

5. 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.

6. 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. 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. 2-Gang Tile Box:

a. Flush backbox type for installation in block walls.

b. Minimum 92 mm (3-5/8 inches) deep.

H. 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 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 maximum 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 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. 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.
18. Do not use aluminum conduits in wet locations.
19. Unless otherwise indicated on drawings or specified herein, conceal conduits within finished walls, floors and ceilings.
20. 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)**

21. 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. 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.

H. 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.

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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END OF SECTION

SECTION 27 05 36
CABLE TRAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION:

A. This section specifies requirements for telecommunications cabling cable tray and raceway equipment.

1.2 SUMMARY

A. Section Includes:
   1. Cable Tray.
   2. Ladder Rack.

1.3 REFERENCES

A. VA Infrastructure Standard for Telecommunications Spaces.

1.4 RELATED WORK:

A. Grounding and bonding: Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.

1.5 SUBMITTALS:

A. Submit in accordance with Section 27 05 00, COMMON WORK RESULTS FOR COMMUNICATIONS SYSTEMS.

PART 2 - PRODUCTS

2.1 CABLE TRAY.

A. Design. Wire basket with tray insert. Maximum 2” x 4” wire mesh construction. Constructed of round, smooth wire with continuous top side to minimize cable sheath damage.

B. Finish. Coated to prevent rust.

C. Size. Cable tray shall be sized to hold the maximum expected cable load at not more than 40% fill and not more than 6” maximum cable depth.

D. Accessories. Provide and install the following components and accessories as necessary to achieve the design:
   1. Overhead mounting equipment (thread-rod, unistrut, nuts, washers, etc.) suitable for the supporting structural elements.
   2. Tray section splicing hardware.
   3. Tray insert.
   4. Cable waterfalls.
   5. Ground strap kits.
   6. Bend radius limiters.

2.2 LADDER RACK.

A. Design. Ladder rack system shall be a modular system of ladder, turns, splices, supports, and accessories able to be assembled with couplers.

B. Finish. Coated to prevent rust.

C. Materials. Ladder rack shall be manufactured from steel and extruded aluminum. Stringers will be 3/8” by 1-1/2” steel. Cross members will be 1” x 1/2". Steel elements shall have a minimum 0.065” wall thickness.

D. Size. Ladder rack shall be sized as indicated on the drawings.

E. Accessories. Provide and install the following components and accessories as necessary to achieve the design:
   1. Overhead mounting equipment (thread-rod, unistrut, nuts, washers, etc.) suitable for the supporting structural elements.

2. Ladder rack section couplers (splices).
3. Ladder rack radius bends.
4. Ground strap kits.

PART 3 - EXECUTION

3.1 IMPLEMENTION:

A. Cable tray shall be used in horizontal applications. Ladder rack is used in vertical applications, unless otherwise indicated on the drawings.

B. Cable tray and ladder rack sections shall be bonded together with bonding conductors and the system bonded to the bonding busbar in the space.

C. Support horizontal cable tray not less than every 5’ (shorter spans if recommended by the equipment manufacturer).

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END OF SECTION

SECTION 27 05 53
IDENTIFICATION FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

A. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

B. TIA-606 - Administration Standard for Telecommunications Infrastructure; 2021d.

1.2 DESCRIPTION:

A. This section specifies labeling and identification requirements for information technology (IT) equipment cabinets, racks, and cabling.
   1. SUMMARY

B. Section Includes:

C. Equipment and component labels.

D. Labeling implementation requirements.
   1. REFERENCES
      a. VA Infrastructure Standard for Telecommunications Spaces.
   2. RELATED WORK:
      a. Server cabinets and network racks: Section 27 11 16, COMMUNICATIONS CABINETS, RACKS, FRAMES, AND ENCLOSURES.
      b. Cable management equipment: Section 27 11 23, COMMUNICATIONS CABLE MANAGEMENT AND LADDER RACK.
      c. Copper UTP cabling: Section 27 13 13, COMMUNICATIONS COPPER BACKBONE CABLING.
      d. Fiber optic cabling: Section 27 13 23, COMMUNICATIONS OPTICAL FIBER BACKBONE CABLING.
   3. SUBMITTALS:
      a. Submit in accordance with Section 27 05 00, COMMON WORK RESULTS FOR COMMUNICATIONS SYSTEMS.

PART 2 - PRODUCTS

2.1 EQUIPMENT AND COMPONENT LABELS.

A. AMaterials. Materials used for labeling equipment, components, and telecommunications cabling shall be appropriate for the installation environment, durable and permanent, and heat-resistant if necessary for labeling in high-temperature environments.

PART 3 - EXECUTION

3.1 IMPLEMENTION:

A. Governing Standard. Labeling and identification of equipment, components, and telecommunications cabling shall be based on ANSI/TIA-606-C, Administration Standard for Telecommunications Infrastructure, and NFPA 70, National Electrical Code, as modified by guidance in the VA Infrastructure Standard for Telecommunications Spaces.

B. All passive infrastructure equipment, components, and telecommunications cabling installed shall be labeled at the time of installation.

C. Telecommunications cable labeling shall include delivery of complete and accurate connection documentation (where each cable terminates at each end) matching the installed labels.

D. Label locations shall be as specified in the VA Infrastructure Standard for Telecommunications Spaces.

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END OF SECTION

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.

END OF SECTION

SECTION 27 10 00
STRUCTURED CABLING

PART 1 - GENERAL

1.1 DESCRIPTION:

A. This section specifies requirements for telecommunications structured cabling systems.

1.2 SUMMARY

A. Section Includes:
   1. Computer Room Backbone Structured Cabling.
   2. Computer Room Horizontal Structured Cabling.
   3. Facility Backbone Structured Cabling.
   4. Facility Horizontal Structured Cabling.

1.3 REFERENCES

A. VA Infrastructure Standard for Telecommunications Spaces.

1.4 RELATED WORK:

A. Cabling labeling and identification: Section 27 05 53, IDENTIFICATION FOR COMMUNICATIONS SYSTEMS.

B. Cable termination locations and equipment: Section 27 11 19, COMMUNICATIONS TERMINATION BLOCKS AND PATCH PANELS.

1.5 SUBMITTALS:

A. Submit in accordance with Section 27 05 00, COMMON WORK RESULTS FOR COMMUNICATIONS SYSTEMS.

PART 2 - PRODUCTS

2.1 COMPUTER ROOM BACKBONE STRUCTURED CABLING.

A. Backbone structured cabling in the computer room environment (first level backbone) connects the Main Distribution Areas (MDAs) to the Horizontal Distribution Areas (HDAs).

B. Install first level backbone structured cabling in overhead cable tray and fiber raceway systems following diverse path routing.

C. All cabling used shall be pre-terminated and procured to the specific length required by the design (horizontal and vertical paths) with no more than 1 meter of excess length on each end.

D. Terminate first level backbone structured cabling in the top RU positions of each network cabinet, working downward, with patch panel equipment mounted on the front rails.

E. Mirror distribution on the A-side and B-side MDA and HDA elements.
   1. In MDA network cabinets:
      a. Install angled UTP patch panel(s) for each backbone UTP patch panel in the same-side HDA in the computer room beginning in RU45.
      b. Install an angled panel cover on the lowest UTP patch panel.
      c. Install a blanking panel in the RU below the UTP patch panels.
      d. Install fiber optic distribution cabinets to support the backbone fiber distribution from each HDA.
      e. Install a blanking panel in the RU below the fiber optic distribution cabinet(s).
   2. In HDA network cabinets:
      a. Install fiber optic distribution cabinet(s) and populate with fiber optic distribution cassettes starting in RU45.
      b. Install a blanking panel in the RU below the last fiber cabinet.
      c. Install UTP patch panel(s) below the blanking panel.
      d. Install a blanking panel in the RU below the last UTP patch panel.

F. Install UTP cables between the same-side MDAs and HDAs.

G. Install 12- or 24-strand multimode fiber optic cables between each fiber cassette in the HDA to either the same-side MDA or the opposite side MDA as appropriate.

2.2 COMPUTER ROOM HORIZONTAL STRUCTURED CABLING.

A. Horizontal structured cabling in the computer room environment connects the Equipment Distributors (EDs) in the server cabinets to each supported Horizontal Distribution Area (HDA).

B. Install horizontal structured cabling in overhead cable tray and fiber raceway systems following diverse path routing.

C. All cabling used shall be pre-terminated and procured to the specific length required by the design (horizontal and vertical paths) with no more than 1 meter of excess length on each end.

D. In the server cabinets, terminate horizontal structured cabling in EDs located in the top 5U of each cabinet, with patch panel equipment mounted on the rear rails.
   1. Install fiber optic distribution cabinet(s) starting in RU45 and populate with fiber optic distribution cassettes to support the requirement.
   2. Install a blanking panel in the RU below the last fiber cabinet.
   3. Install copper UTP patch panel(s) below the blanking panel.

E. In the HDAs, terminate horizontal structured cabling in the RU positions immediately below the first level backbone structured cabling equipment of each network cabinet, working downward, with patch panel equipment mounted on the front rails.
   1. Install fiber optic distribution cabinet(s) and populate with fiber optic distribution cassettes to support each server cabinet.
   2. Install a blanking panel in the RU below the fiber optic distribution cabinet(s).

F. Install 12- or 24-strand multimode fiber optic cables between the server cabinet ED and both HDAs.

G. Install UTP cables between the server cabinet ED and both HDAs.

2.3 FACILITY BACKBONE STRUCTURED CABLING.

A. Backbone structured cabling (inter-building and intra-building first level backbone) connects the Entrance Rooms to the Main Distribution Areas (MDAs) in the computer room, and connects the Main Distribution Areas to each Telecommunications Room (TR). This specification describes facility backbone structured cabling when the Entrance Rooms and computer room are in the same building, connected entirely by environmentally conditioned pathways (no outside plant pathways are transited).

B. Interior to each telecommunications space, install facility backbone structured cabling in overhead cable tray and fiber raceway systems.

C. All facility backbone structured cabling shall be redundant and follow diverse path routing.

D. Facility backbone cabling shall be field-terminated (fusion spliced).

E. In the Entrance Room, MDA, and TR network racks or cabinets designated for facility backbone distribution, install fiber optic distribution cabinets as required for the quantity of fibers installed.

F. Between the Entrance Room and the computer room:
   1. Provide 2 diversely routed paths of backbone cabling from the Entrance Room. One path will terminate on the A-side MDA and one path will terminate on the B-side MDA.
   2. Install a minimum of 24 strands of multimode fiber optic cabling and 12 strands of single-mode fiber optic cabling per path.
   3. Populate the fiber optic distribution cabinets on each end with a sufficient quantity of multimode OM4 and single-mode OS1 fiber optic splice cassettes per path.

G. Between each MDA and each TR:
   1. No zone/intermediate distribution areas (ZDAs/IDAs) intermediate cross-connects (ICCs) shall be used. All facility backbone cabling between the MDAs and TRs shall be run directly and continuously.

2. Provide 2 diversely routed paths of backbone cabling, one from the A-side MDA and one from the B-side MDA.
3. Where the TR is located in the same building as the computer room MDAs (does not transit outside plant pathways) and the path distance is less than 400 meters, install a minimum of 24 strands of multimode fiber optic cabling and 12 strands of single-mode fiber optic cabling per path.
    a. Populate the fiber optic distribution cabinets on each end with a sufficient quantity of multimode OM4 and single-mode OS1 fiber optic splice cassettes per path.
4. Where the TR is located in a different building as the computer room (transits outside plant pathways) or the path distance is greater than 400m, install a minimum of 24 strands of single-mode fiber optic cabling per path.
    a. Populate the fiber optic distribution cabinets on each end with a sufficient quantity of single-mode OS2 fiber optic splice cassettes per path.

2.4 FACILITY HORIZONTAL STRUCTURED CABLING.

A. Facility horizontal structured cabling (horizontal distribution) connects the Telecommunications Room (TR) to each end-user Work Area Outlet (WAO).

B. Interior to each TR, install horizontal distribution structured cabling in overhead cable tray systems.

C. All horizontal distribution structured cabling shall have a minimum of 2 cables per WAO.

D. Horizontal distribution structured cabling may be field-terminated.

E. In each TR install sufficient UTP patch panels to support the quantity of WAOs in the TR's serving zone.
    1. Plan network racks such that patch panels and horizontal cable managers are located in the top 1/3 (RU31-45), switching equipment in the middle 1/3 (RU16-30), and power distribution and other services in the bottom 1/3 (RU1-15).

F. Install a minimum of 2 UTP cables between the TR UTP patch panels and each work area faceplate.

G. Each typical end-user receptacle shall be constructed of a single-gang workbox with one connector chassis, a minimum of two non-proprietary Category 6A 8P8C media interface connectors (RJ-45), and a four-position keystone faceplate.
    1. Modular plug terminated links (MPTL) are permitted to service wireless access points (WAPs), cameras, and other Power over Ethernet (PoE) devices where mating will be very infrequent.

PART 3 - EXECUTION

3.1 IMPLEMENTION:

A. 100% construction drawing sets shall include drawings detailing the computer room and facility/campus structured cabling systems, including:
    1. Cable media performance categories for each type of run.
    2. Cabling and equipment quantities.
    3. Elevation drawings showing equipment placement in individual enclosures.
    4. Full interconnection diagram for all structured cabling.
    5. Port map and cable label matrices.

B. All cabling and equipment shall be labeled per the requirements of the VA Infrastructure Standard for Telecommunications Spaces.

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END OF SECTION

SECTION 27 11 16
COMMUNICATIONS CABINETS, RACKS, FRAMES, AND ENCLOSURES

PART 1 - GENERAL

1.1 DESCRIPTION:

A. This section specifies Information Technology (IT) equipment enclosures for use in VA telecommunications spaces.

1.2 SUMMARY

A. Section Includes:
   1. Server Cabinets.
   2. Network Channel Racks.
   3. Network Cabinets.
   4. Telecommunications Enclosures.
   5. Pathway Racks.

1.3 REFERENCES

A. VA Infrastructure Standard for Telecommunications Spaces.

1.4 RELATED WORK:

A. Cabling termination equipment, rack-mounted: Section 27 11 19, COMMUNICATIONS TERMINATION BLOCKS AND PATCH PANELS.

B. Cable management equipment: Section 27 05 36, CABLE TRAYS FOR COMMUNICATIONS SYSTEMS.

C. Power distribution equipment: Section 27 11 26, COMMUNICATIONS RACK MOUNTED POWER PROTECTION AND POWER STRIPS.

D. Grounding and bonding equipment: Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.

E. Labeling and identification requirements: Section 27 05 53, IDENTIFICATION FOR COMMUNICATIONS SYSTEMS.

1.5 SUBMITTALS:

A. Submit in accordance with Section 27 05 00, COMMON WORK RESULTS FOR COMMUNICATIONS SYSTEMS.

PART 2 - PRODUCTS

2.1 SERVER CABINETS.

A. Height. Cabinets shall provide 45 standard rack units (RU) of space (45U) for mounting equipment.

B. Dimensions. Nominal dimensions for server cabinets are 84” (2134mm) tall, 23.6” (600mm) wide, and 48” (1220mm) deep, including side panels and doors. Minimum depth is 46” (1168mm). Maximum width is 24”. See drawings for additional details and requirements.

C. Doors and Panels.
   1. Front Door. Provide a single locking, latched, hinged metal front door for the server cabinet with minimum 75% open perforated design for airflow.
   2. Rear Door. Provide a single ocking, latched, hinged metal rear door for the server cabinet.
      a. If a vertical exhaust duct (VED, “chimney”) is specified for the server cabinet, the rear door shall be solid.
      b. If no VED is specified, the rear door shall be perforated with a minimum of 75% open design for airflow.
   3. Side Panels. Provide removable, locking solid metal side panels. Side panels shall have cable pass-through cut-outs protected with brushed grommets on each side, aligned on each side to allow Rack PDU cables to pass between enclosures to Zone PDUs.

D. Locks. All locks on a server cabinet shall be keyed the same. Provide two keys per cabinet.

E. Color. The cabinet and all components shall be white in color.

F. Equipment Mounting Rack. The cabinet shall provide an EIA-310-E compliant 19” racking system with front and rear rails using standard 3/8” x 3/8” square hole mounting.
   1. Rear Rails. Position rear rails with a minimum of 6” of clearance between the rails and the rear doors to accommodate rear-mounted angled patch panels and up to four (4) vertical rack PDUs.

G. Components. The cabinet shall be supplied with the following standard equipment:
   a. Air dams for left and right of the front rails.
   b. Finger cable managers.
   c. Bottom panel with brushed grommets.
   d. Top panel with brushed grommets.
   e. Toolless mounting brackets for vertical Rack PDUs.
   f. 45U of 1RU blanking panels.

H. Vertical Exhaust Duct. Provide a vertical exhaust duct (VED, or “chimney”) matched to the height of the cabinet and facility horizontal return duct.

2.2 NETWORK CHANNEL RACKS.

A. Height. Racks shall provide 45 standard rack units (RU) of space (45U) for mounting equipment.

B. Dimensions. Nominal dimensions for network racks are 86” (2184mm) tall, 24” (610mm) wide, and 40” (1220mm) deep (30”/762mm between front and rear mounting rails).

C. Side Panels. The rack shall have integral metal side panels (a “channel” rack) constructed with a cable management pattern of staggered shapes (circles, hexagons, etc.) to allow for connection points for cable management accessories.

D. Security Doors. Provide locking, latched, hinged metal doors and mounting hardware for the network rack. Doors shall be perforated with a minimum of 50% open design for airflow.
   1. 1. Locks. All locks on a network rack shall be keyed the same. Provide two keys per cabinet.

E. Color. The rack and all components shall be white in color.

F. Equipment Mounting Rack. The rack shall provide an EIA-310-E compliant 19” racking system with front and rear rails using standard 3/8” x 3/8” square hole mounting.

G. Components. The rack shall be supplied with the following standard equipment:
   a. Toolless mounting brackets for vertical Rack PDUs.
   b. 30U of 1RU blanking panels.
   c. Vertical cable managers with doors on both left and right of the rack (size commensurate with the requirement).
   d. Cable management accessories as necessary to maintain cable bend radii, uniformity, and neatness (e.g. d-rings, spools, bend radius limiters, finger cable managers, waterfalls, etc.).

2.3 NETWORK CABINETS.

A. Height. Cabinets shall provide 45 standard rack units (RU) of space (45U) for mounting equipment.

B. Dimensions. Nominal dimensions for server cabinets are 84” (2134mm) tall, 40” (1016mm) wide, and 48” (1220mm) deep, including side panels and doors. Minimum depth is 46” (1168mm). See drawings for additional details and requirements.

C. Doors and Panels.
   1. Front Door. Provide a single locking, latched, hinged metal front door for the server cabinet with minimum 75% open perforated design for airflow.

2. Rear Door. Provide a single locking, latched, hinged metal rear door for the server cabinet.
    a. If a vertical exhaust duct (VED, “chimney”) is specified for the server cabinet, the rear door shall be solid.
    b. If no VED is specified, the rear door shall be perforated with a minimum of 75% open design for airflow.
3. Side Panels. Provide removable, locking solid metal side panels. Side panels shall have cable pass-through cut-outs protected with brushed grommets on each side, aligned on each side to allow Rack PDU and communications cables to pass between enclosures to Zone PDUs.

D. Locks. All locks on a server cabinet shall be keyed the same. Provide two keys per cabinet.

E. Color. The cabinet and all components shall be white in color.

F. Equipment Mounting Rack. The cabinet shall provide an EIA-310-E compliant 19” racking system with front and rear rails using standard 3/8” x 3/8” square hole mounting.

G. Components. The cabinet shall be supplied with the following standard equipment:
    a. Air dams for left and right of the front rails.
    b. Bottom panel with brushed grommets.
    c. Top panel with brushed grommets.
    d. Toolless mounting brackets for vertical Rack PDUs.
    e. 45U of 1RU blanking panels.
    f. Cable management accessories as necessary to maintain cable bend radii, uniformity, and neatness (e.g. d-rings, spools, bend radius limiters, finger cable managers, waterfalls, etc.).

H. Vertical Exhaust Duct. Provide a vertical exhaust duct (VED, or “chimney”) matched to the height of the cabinet and facility horizontal return duct.

2.4 TELECOMMUNICATIONS ENCLOSURES (TE).

A. Telecommunications Enclosures (TEs) are swing-out wall-mounted enclosures.

B. Height. TEs shall provide 26 standard rack units (RU) of space for mounting equipment.

C. Dimensions. Nominal dimensions for server cabinets are 48” (1220mm)tall, 24” (610mm) wide, and 30” (760mm) deep.

D. Doors and Panels.
1. Front Door. TEs shall have a single locking, latched, hinged metal front door with a tempered glass front.
2. Rear Panel. TEs shall have a latched, hinged metal rear door that mounts to the wall, allowing the body of the TE to be swung open for rear equipment access. If latched exterior to the body of the TE, the latch shall be locking.
    a. Cabling Cutouts. The top and bottom surfaces of the rear panel shall have cabling cutouts to accommodate telecommunications cabling entering the TE. Edge-protection grommets for the cabling cutouts shall be provided.
    b. Power Cutout. The rear panel shall have a cutout on the rear mounting surface allowing power to be installed internal to the TE.
3. Locks. All locks on a TE shall be keyed the same. Provide two keys per TE.

E. Load Rating. The TE shall support 300lb (136kg) of total weight.

F. Color. The cabinet and all components shall be white in color.

G. Equipment Mounting Rack. The cabinet shall provide an EIA-310-E compliant 19” racking system with front and rear rails using standard threaded #12-24 hole mounting.

H. Components. The cabinet shall be supplied with the following standard equipment:
    a. 1U shelf (two per TE).
    b. Vertical cable management kits (one per each full 12U of TE height).

c. Fan kit to evacuate heat generated by active equipment (two per TE).
d. Filter kit for fans (two per TE).

2.5 PATHWAY RACKS.

A. Height. Pathway racks shall provide a minimum of 5 standard rack units (RU) of space (5U) for mounting Equipment Distributor equipment.

B. Dimensions. Nominal dimensions for pathway racks are 12.6” tall, 23.6” wide, and 9” deep.

C. Mounting. Pathway racks shall mount to standard basket-style cable tray.

D. Color. Pathway racks shall be white in color.

E. Equipment Mounting Rack. The cabinet shall provide an EIA-310-E compliant 19” racking system with rails using standard 3/8” x 3/8” square hole mounting.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Casters on floor-mounted enclosures shall be retracted and the enclosures leveled and stabilized.

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END OF SECTION

SECTION 27 11 19
COMMUNICATIONS TERMINATION BLOCKS AND PATCH PANELS

PART 1 - GENERAL

1.1 DESCRIPTION:

A. This section specifies cable termination and management equipment to be mounted in information technology (IT) equipment cabinets and racks.

1.2 SUMMARY

A. Section Includes:
   1. Copper UTP Patch Panels.
   2. Fiber Optic Distribution Cassettes.
   3. Fiber Optic Splice Cassettes.
   4. Horizontal Cable Managers.
   5. Blanking Panels.

1.3 REFERENCES

A. VA Infrastructure Standard for Telecommunications Spaces.

1.4 RELATED WORK:

A. Server cabinets and network racks: Section 27 11 16, COMMUNICATIONS CABINETS, RACKS, FRAMES, AND ENCLOSURES.

B. Cable management equipment: Section 27 11 23, COMMUNICATIONS CABLE MANAGEMENT AND LADDER RACK.

C. Labeling and identification requirements: Section 27 05 53, IDENTIFICATION FOR COMMUNICATIONS SYSTEMS.

D. Copper UTP cabling: Section 27 13 13, COMMUNICATIONS COPPER BACKBONE CABLING.

E. Copper UTP cabling termination: Section 27 13 13.13, COMMUNICATIONS COPPER CABLE SPLICING AND TERMINATIONS.

F. Fiber optic cabling: Section 27 13 23, COMMUNICATIONS OPTICAL FIBER BACKBONE CABLING.

G. Fiber optic cabling termination: Section 27 13 23.13, COMMUNICATIONS OPTICAL FIBER SPLICING AND TERMINATIONS.

1.5 SUBMITTALS:

A. Submit in accordance with Section 27 05 00, COMMON WORK RESULTS FOR COMMUNICATIONS SYSTEMS.

PART 2 - PRODUCTS

2.1 COPPER (UTP) PATCH PANELS.

A. Form Factor. 1U, 19” rack-mountable. Default form factor for patch panels shall be angled to extend not less than 4” (104mm) forward from the mounting rail.

B. Capacity. 48 copper 8P8C ports in groupings of 6.

C. Interface. Copper (UTP) patch panels shall accept pre-terminated single 8P8C keystone jacks and 6-jack cassettes.

D. Accessories. Provide each patch panel installation with the following accessories.
   1. Angled panel cover. Specify angled panel covers at the top and bottom of each stack of angled patch panels. Covers shall mount to the same RU rail positions as the top and bottom patch panels.
   2. Rear cable manager tray. Specify one rear cable manager tray per patch panel. Trays shall mount to the same RU rail positions as the patch panel.

2.2 FIBER OPTIC DISTRIBUTION CASSETTES.

A. Fiber optic distribution cassettes are used in structured cabling in the computer room to connect Main Distribution Areas (MDAs), Horizontal Distribution Areas (HDAs), and Equipment Distributors (EDs) where pre-terminated cable is used.

B. Form Factor. Designed to install in rack-mounted fiber optic distribution cabinet.

C. Connections. The rear connection shall accept 12-strand multi-fiber push-on (MPO) connectors or 24-strand multi-fiber push-on (MPO) connectors as indicated on the drawings. Adapters on the front of the cassette shall accept 6 duplex Lucent connector (LC) fiber pairs.

D. Polarity. Provide type A polarity cassettes.

2.3 FIBER OPTIC SPLICE CASSETTES.

A. Fiber optic splice cassettes are used in backbone structured cabling connecting the Entrance Rooms to the Main Distribution Areas (MDAs) in the computer room, and the MDAs to Telecommunications Rooms (TRs) where field-terminated (fusion spliced) cable is used.

B. Form Factor. Designed to install in rack-mounted fiber optic distribution cabinet.

C. Connections. Adapters on the front of the cassette shall accept 6 duplex Lucent connector (LC) fiber pairs.

D. Design. Splice cassette modules shall be self-contained to integrate fiber adapter bulkhead and splice holders. No additional splice trays shall be necessary. Each module shall provide 12 or 24 fiber splice connections as indicated on the drawings.

E. Fiber Type. Provide multimode OM4 and single-mode OS2 splice cassettes as required by the quantity of each type of fiber installed.

2.4 HORIZONTAL CABLE MANAGERS.

A. Form Factor. 1U or 2U as indicated on the drawings, 19” rack-mountable.

B. Door. Horizontal cable managers shall have a double-hinged front cover to protect installed cables.

C. Fingers. 6-port spacing (five fingers).

2.5 BLANKING PANELS.

A. Form Factor. 1U, 19” rack-mountable, flat.

B. Transition. Blanking panel shall have a transition cover from angled front to flat front.

C. Quantity. Provide blanking panels to fill 75% of all RUs in all server cabinets and network cabinets.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Not used.

END OF SECTION

SECTION 27 11 26
COMMUNICATIONS RACK MOUNTED POWER PROTECTION AND POWER STRIPS

PART 1 GENERAL

1.1 DESCRIPTION

A. This section specifies power distribution equipment and interconnections supporting equipment deployed in telecommunications spaces (entrance rooms, computer rooms, and telecommunications rooms).

1.2 SUMMARY

A. Section Includes:
   1. Zone Power Distribution Units (zPDUs).
   2. Rack-Mounted Uninterruptible Power Supply (UPS) Units.
   3. Rack Power Distribution Units (rPDUs).
   4. Equipment Power Cords.

1.3 REFERENCES

A. VA Infrastructure Standard for Telecommunications Spaces.

1.4 RELATED WORK

A. General electrical requirements that are common to more than one section in Division 27: Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.

B. IT equipment enclosures: Section 27 11 16, COMMUNICATIONS CABINETS, RACKS, FRAMES, AND ENCLOSURES

1.5 SUBMITTALS

A. Submit in accordance with Section 27 05 00, COMMON WORK RESULTS FOR COMMUNICATIONS SYSTEMS.

B. For each type of product:
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for rack-mounted power protection and power strips.
      a. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

PART 2 PRODUCTS

2.1 ZONE POWER DISTRIBUTION UNITS (ZONE PDU)

A. A. Provide components from a single manufacturer.eConnect intelligent PDUs combines remote rack-level (cabinet-level) power monitoring and control, environmental monitoring and access control via a single appliance, software and network Ethernet connection. eConnect Monitored PDU provides rack-level power monitoring. Monitored Pro PDU provides rack and device (outlet) level power monitoring. Switched provides rack level power monitoring and individual outlet control. Switched Pro provides rack level power monitoring, outlet level power monitoring and outlet level control.

B. B. 60 Amp Zone PDU:
   a. Description: Zone PDU with A/B redundant 3-phase 60A input circuits and three (3) pairs of A/B redundant L21-20R outlets allowing each supported Standard Density (5kW) enclosure to operate at full density rating.
   b. Input Connection: Dual 60A three-phase 208V hard-wired, with junction box and five-wire (L+L+L+N+G) DIN copper terminal blocks accommodating 4AWG conductors. Power cord 10’ (3m) length.
   c. Output Connection: Three (3) pairs of A/B (redundant) L21-20R outlets.
   d. Power Capacity: 43.2kW (21.6kW redundant at full load); 5.7kW fully-rated at each L21-20R outlet.

e. Enclosure: Fully self-contained.
f. Mounting: 1” rack-mount.

C. C. 30 Amp Zone PDU:
a. Description: Zone PDU with A/B redundant 3-phase 30A input circuits and two (2) pairs of A/B redundant L21-20R outlets allowing each supported Standard Density (5kW) enclosure to operate at partial density rating.
b. Input Connection: Dual 30A three-phase 208V L21-30P. Power cord 10’ (3m) length.
c. Output Connection: Two (2) pairs of A/B (redundant) L21-20P outlets.
d. Power Capacity: 21.6kW (10.8kW redundant at full load); combined 8.6kW rated output through each A/B pair of L21-20R outlets.
e. Enclosure: Fully self-contained.
f. Mounting: 1” rack-mount.

2.2 RACK-MOUNTED UNINTERRUPTIBLE POWER SUPPLY (UPS) UNITS

A. Provide components from a single manufacturer.

B. BDescription: 5kW three-phase 208V 20A rack-mounted UPS with L21-20 input and output connections.

C. Input Connection: Single input NEMA L21-20P plug (twistlock three-phase five wire L+L+L+N+G). Power cord minimum 3’ (1m) length.(twistlock three-phase five wire L+L+L+N+G). Power cord 10’ (3m) length. (twistlock three-phase five wire L+L+L+N+G). Power cord 10’ (3m) length. (twistlock three-phase five wire L+L+L+N+G). Power cord 10’ (3m) length. (twistlock three-phase five wire L+L+L+N+G). Power cord 10’ (3m) length.(twistlock three-phase five wire L+L+L+N+G). Power cord 10’ (3m) length.

D. Output Connection: Single output NEMA L21-20R receptacle.

E. Power Capacity: 5kW

F. Enclosure: Fully self-contained.

G. Mounting: 19” rack mount.

H. Battery Capacity: Ten minutes at 70% load (3.5kW).

I. Cooling: Fan-cooled, front air entry, rear exhaust.

2.3 RACK POWER DISTRIBUTION UNITS (RACK PDUS)

A. Provide components from a single manufacturer.

B. Description: Metered/monitored three-phase 208V 20A vertical Rack Power Distribution Unit (Rack PDU), 5.7kW, with IEC60320 outlets.

C. Input Connection: Single input NEMA L21-20P plug (twistlock three-phase five wire L+L+L+N+G). Power cord 10’ (3m) length.

D. Output Connections.
a. For Computer Room applications: Minimum 30 each C13 and 6 each C19. Outlets grouped in phase-grouping banks (A-B, B-C, C-A) or alternating to assist with phase balancing. Outlets labelled with associated phase-grouping bank. Outlets lock to standard power cords and are capable of accepting Z-lock power cords.

E. Power Capacity: 5.7kW rated.

F. Enclosure: Fully self-contained.

G. Mounting: Toolless mounting, orientation vertical at rear of enclosure, taking up zero RU spaces. Up to two Rack PDUs must be able to be installed on each side for High Density (10kW) enclosures.

H. Mounting Hardware: As required to connect to the specific enclosure make/model.

I. Number of RPDUs: 2 for Standard Density (up to 5kW) enclosures, 4 for High Density (10kW) enclosures.

J. Control Module: Field-replaceable, modular control module with metering and monitoring capabilities.
   a. For Computer Room applications: A minimum of 12 control modules shall be able to be daisy-chained together to a single IP address output for network monitoring of all metered and monitored data.

K. Metering: Local display provides input line currents (Amperage). Additional metering items (voltage, power, energy, power factor) across the unit or at individual outlets, is acceptable.

L. Monitoring: RJ45 Ethernet port allows connection to an external monitoring system. Supports SNMP v3 with SSL Encryption.

2.4 EQUIPMENT POWER CORDS

A. Description: International Electrotechnical Commission (IEC) standard 60320 power cords that supply electrical power to IT equipment from Rack PDUs using standardized coupler and inlet connectors.

B. Voltage: UL-rated 208V (minimum).

C. Amperage: 10A (C13/C14 and C14/C15) and 15A or16A (C19/C20).

D. Securement: Locking configuration to match Rack PDU. A-Lock may be used if Rack PDUs have integral locking. Z-lock required where Rack PDUs do not have integral locking.

E. Color: A-side power cord black. B-side power cord distinctly different color (white or gray preferred).

PART 3 EXECUTION

3.1 INSTALLATION

A. DEFINITION: Sides (left/right) of the enclosure are as when viewed from the rear (hot aisle) of the enclosure for the purposes of this section.

B. Zone PDUs.
   a. Install Zone PDUs only in enclosures that require them.
   b. Zone PDUs shall not be installed in enclosures supported by busbar power distribution.
   c. Install Zone PDUs beginning in RU position 1 or the first open RU position above any rack-mounted UPS unit, at the bottom of the 19” rack, on the rear rails of the enclosure.
   d. Connect the Zone PDU power cords to the upstream branch circuit supporting the enclosures.

C. Rack-Mounted UPS Units.
   a. Install rack-mounted UPS units only in enclosures that require them. Rack-mounted UPS units shall not be installed downstream of another UPS system (cascaded).
   b. Where non-redundant UPS power is required to support the enclosure, install the rack-mounted UPS unit in the A side power distribution.
   c. Install rack-mounted UPS units beginning in RU position 1, at the bottom of the 19” rack, with the exhaust ports facing the rear of the enclosure. No other equipment should be installed below the rack-mounted UPS units.
   d. Connect the rack-mounted UPS unit power cord to the appropriate (A side) power receptacle on the upstream Zone PDU.

D. Rack PDUs.
   a. Install Rack PDUs in matched A/B pairs only.
   b. Install A side Rack PDUs on the left side of the enclosure and B side Rack PDUs on the right side of the enclosure, interior to the rear enclosure door.

c. Connect the Rack PDU power cord to the upstream rack-mounted UPS unit (where present) or the appropriate power receptacle on the upstream Zone PDU.

E. Equipment Power Cords.
   a. Connect black power cord to A-side Rack PDU. Connect color-distinct power cord to B-side Rack PDU.
   b. Connect both power cords to same power bank and outlet location on supporting Rack PDUs (mirrored).
   c. Connect power cords to power banks to improve phase balancing on Rack PDUs.
   d. Ensure power cords are securely locked into IT equipment inlets and Rack PDU receptacles.
   e. Install power cords in a neat and organized manner. Lash power cords to horizontal and vertical cable management equipment with hook-and-loop connectors.

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END OF SECTION

SECTION 27 13 13.13
COMMUNICATIONS COPPER CABLE SPLICING AND TERMINATIONS

PART 1 - GENERAL

1.1 DESCRIPTION:

A. This section specifies requirements for terminations of copper (UTP) cabling.

1.2 SUMMARY

A. Section Includes:
   1. Termination Requirements.
   2. Splicing.

1.3 REFERENCES

A. VA Infrastructure Standard for Telecommunications Spaces.

1.4 RELATED WORK:

A. Termination equipment: Section 27 11 19, COMMUNICATIONS TERMINATION BLOCKS AND PATCH PANELS.

B. Copper (UTP) cabling requirements: Section 27 13 13, COMMUNICATIONS COPPER BACKBONE CABLING.

C. Copper (UTP) cabling requirements: Section 27 15 13, COMMUNICATIONS COPPER HORIZONTAL CABLING.

1.5 SUBMITTALS:

A. Submit in accordance with Section 27 05 00, COMMON WORK RESULTS FOR COMMUNICATIONS SYSTEMS.

PART 2 - PRODUCTS

2.1 NOT USED.

PART 3 - EXECUTION

3.1 TERMINATION REQUIREMENTS.

A. Terminate copper (UTP) cabling used for data communications per TIA 568B.

B. Connections shall be made to equipment certified to performance category 6A.

C. Pre-terminated connections are preferred for computer room structured cabling applications. Field termination for non-computer room applications is acceptable.

3.2 SPLICING.

A. Splicing of copper (UTP) cabling is prohibited.

-END OF SECTION

SECTION 27 13 13
COMMUNICATIONS COPPER BACKBONE CABLING

PART 1 - GENERAL

1.1 DESCRIPTION:

A. This section specifies requirements for telecommunications copper (UTP) backbone and horizontal cabling in structured cabling systems in computer rooms.

1.2 SUMMARY

A. Section Includes:
   1. Copper (UTP) Backbone Cables.

1.3 REFERENCES

A. VA Infrastructure Standard for Telecommunications Spaces.

1.4 RELATED WORK:

A. Computer room structured cabling: Section 27 10 00, STRUCTURED CABLING.

B. Termination equipment: Section 27 11 19, COMMUNICATIONS TERMINATION BLOCKS AND PATCH PANELS.

C. Cable labeling requirements: Section 27 05 53, IDENTIFICATION FOR COMMUNICATIONS SYSTEMS.

1.5 SUBMITTALS:

A. Submit in accordance with Section 27 05 00, COMMON WORK RESULTS FOR COMMUNICATIONS SYSTEMS.

PART 2 - PRODUCTS

2.1 COPPER (UTP) BACKBONE CABLES.

A. Copper (UTP) backbone and horizontal cables are used in computer room structured cabling to connect Main Distribution Areas (MDAs), Horizontal Distribution Areas (HDAs), and server cabinet Equipment Distributors (EDs).

B. Performance Category. Copper (UTP) backbone cables shall meet the Category 6A performance requirements. Category 6A connectors are required.

C. Performance Specifications. Meets or exceeds TIA-EIA-568-C.2-10 and TSB-155.

D. Limited Power (LP) Certification. UL Listed as x-LP (0.5A).

E. Termination. Factory pre-terminated TIA 568B.

F. Testing. Factory certified to meet performance category requirements per TIA 568-C.2.

G. Conductor Size. 22-24AWG.

H. Jacket Rating. Communications Multipurpose Cable, Plenum (CMP) shall be specified if any portion of the cable passes through an NEC-defined plenum. Communications Multipurpose Cable, Riser (CMR) shall be specified for all other applications. CMP may be used as a substitute for CMR.

I. Bundling and Construction. Copper (UTP) backbone cables shall be provided in 6-cable bundles with individual 8P8C media interface connectors (RJ-45 ‘jacks’) or 6-jack cassettes designed to fit in copper (UTP) patch panels.

J. Color. A-side 8P8C media interface connectors (RJ-45) shall be blue. B-side 8P8C connectors shall be yellow.

K. Length. Backbone cabling used shall be procured to the specific length required by the design (horizontal and vertical paths) with no more than 2 feet of excess length.

PART 3 - EXECUTION

3.1 IMPLEMENTATION.

A. All cabling and equipment shall be labeled per the requirements of the VA Infrastructure Standard for Telecommunications Spaces.

B. Install first level backbone and horizontal structured cabling in the computer room in cable tray and fiber raceway systems following diverse path routing.

1. - - - E N D - - -

END OF SECTION

SECTION 27 15 13
COMMUNICATIONS COPPER HORIZONTAL CABLING

PART 1 - GENERAL

1.1 DESCRIPTION:

A. This section specifies requirements for telecommunications copper (UTP) horizontal distribution cabling outside of the computer room. For copper (UTP) horizontal cabling in structured cabling systems in the computer room, see Section 27 13 13 Communications Copper Backbone Cabling.

1.2 SUMMARY

A. Section Includes:
   1. Copper (UTP) Horizontal Cables.

1.3 REFERENCES

A. VA Infrastructure Standard for Telecommunications Spaces.

1.4 RELATED WORK:

A. Computer room structured cabling: Section 27 10 00, STRUCTURED CABLING.

B. Termination equipment: Section 27 11 19, COMMUNICATIONS TERMINATION BLOCKS AND PATCH PANELS.

C. Cable labeling requirements: Section 27 05 53, IDENTIFICATION FOR COMMUNICATIONS SYSTEMS.

1.5 SUBMITTALS:

A. Submit in accordance with Section 27 05 00, COMMON WORK RESULTS FOR COMMUNICATIONS SYSTEMS.

PART 2 - PRODUCTS

2.1 COPPER (UTP) HORIZONTAL CABLES.

A. Copper (UTP) horizontal cables connect the Telecommunications Room (TR) to each end-user Work Area Outlet (WAO) (horizontal distribution).

B. Performance Category. Copper (UTP) horizontal cables shall meet the Category 6A performance requirements. Category 6A connectors are required.

C. Performance Specifications. Meets or exceeds TIA-EIA-568-C.2-10 and TSB-155.

D. Limited Power (LP) Certification. UL Listed as x-LP (0.5A).

E. Termination. Field terminated TIA 568B.

F. Testing. Following installation, each cable shall be field certified to meet performance category requirements per TIA 568-C.2.

G. Conductor Size. 22-24AWG.

H. Jacket Rating. Communications Multipurpose Cable, Plenum (CMP) shall be specified if any portion of the cable passes through an NEC-defined plenum. Communications Multipurpose Cable, Riser (CMR) shall be specified for all other applications. CMP may be used as a substitute for CMR.

I. Construction. Copper Clad Aluminum (CCA) cable is not permitted.

J. Length. The maximum distance for UTP horizontal cables is limited to 295 feet.

PART 3 - EXECUTION

3.1 IMPLEMENTATION.

A. All cabling and equipment shall be labeled per the requirements of the VA Infrastructure Standard for Telecommunications Spaces.

B. Interior to the TR, install horizontal copper (UTP) structured cabling in overhead cable tray.

- - - E N D - - -

END OF SECTION

SECTION 27 16 19
COMMUNICATIONS PATCH CORDS, STATION CORDS, AND CROSS CONNECT WIRE

PART 1 - GENERAL

1.1 DESCRIPTION:

A. This section specifies requirements for telecommunications patch cords.

1.2 SUMMARY

A. Section Includes:
   1. Copper (UTP) Patch Cables.
   2. Fiber Optic Patch Cables.

1.3 REFERENCES

A. VA Infrastructure Standard for Telecommunications Spaces.

1.4 RELATED WORK:

A. Termination equipment: Section 27 11 19, COMMUNICATIONS TERMINATION BLOCKS AND PATCH PANELS.

B. Cable labeling requirements: Section 27 05 53, IDENTIFICATION FOR COMMUNICATIONS SYSTEMS.

1.5 SUBMITTALS:

A. Submit in accordance with Section 27 05 00, COMMON WORK RESULTS FOR COMMUNICATIONS SYSTEMS.

PART 2 - PRODUCTS

2.1 COPPER (UTP) PATCH CABLES.

A. Performance Category. Patch cables shall meet the Category 6A performance requirements. Category 6A connectors are required.

B. Termination Method. Factory pre-terminated TIA 568B.

C. Conductor Size. 22-28AWG. Where 28AWG patch cords are specified, the overall horizontal channel distance is reduced.

D. Length. Patch cords of the shortest appropriate length shall be used.

2.2 FIBER OPTIC PATCH CABLES.

A. Construction. Fiber patch cords shall be constructed of pairs (2-strands) of multimode laser-enhanced 50/125µm fiber.

B. Performance Category. Multimode patch cords shall meet the OM4 performance requirements.

C. Connectors. Duplex Lucent connector (LC) connectors are required. Where polarity requirements are not known, reversible polarity duplex LC connectors are specified on one end.

D. Termination Method. Factory pre-terminated.

E. Length. Patch cords of the shortest appropriate length shall be used.

PART 3 - EXECUTION

3.1 IMPLEMENTATION.

A. Patch cords shall not be used to connect equipment in different server cabinets.

B. Patch cords shall be neatly installed using cable management equipment and following cable management principles.

C. Upon installation patch cords shall be labeled in accordance with the requirements of the VA Infrastructure Standard for Telecommunications Spaces.

END OF SECTION

SECTION 27 78 00
CLOSEOUT SUBMITTALS FOR COMMUNICATIONS

PART 1 GENERAL

1.1 DESCRIPTION

A. This section includes submittal requirements for communications installations and applies to all sections of Division 27. This section is intended to supplement 27 05 00 Common Work Results for Communications until such time as that section can be coordinated and republished.

1.2 REFERENCES

A. VA Infrastructure Standard for Telecommunications Spaces.

1.3 RELATED WORK

A. General requirements: Section 01 00 00, GENERAL REQUIREMENTS.

B. Submittal requirements: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Assign a single communications project manager to serve as point of contact for Government, contractor, and design professional.

B. Contact the project Contracting Officer's Representative (COR) to have reviewers from the VA Office of Information Technology (OIT) Data Center & Infrastructure Engineering team assigned to review project submittals and designs.

1.5 SUBMITTALS

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

B. Government preapproval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office(s) that will review the submittal for the Government.

C. Submittal Drawings (G): All drawings shall utilize current equipment and telecommunications space nomenclature. G: Data Center & Infrastructure Operations (DCIE), local site Facility Management Service (FMS), local site Office of Information Technology (OIT), Healthcare Environment and Facilities Program (HEFP), others as necessary.

1. Telecommunications Space Plans/Elevations: Provide enlarged floor plans of telecommunication spaces indicating layout of equipment and devices, including electrical receptacles and grounding provisions. Submit detailed plan views and elevations of telecommunication spaces showing enclosures, termination equipment, supporting electrical and mechanical infrastructure equipment, and cable paths. Include following rooms:
   a. Telecommunications Rooms (TRs).
   b. Computer Room.
2. Cable Plant Distribution Plans: Provide facility and campus plan drawings showing inside plant and outside plant diverse path distribution pathways, distances, media types, and equipment.
3. Computer Room Structured Cabling Plans: Provide logical, schematic, and plan drawings of the structured cabling system in the facility computer room showing diverse path distribution pathways, distances, media types, and equipment.
4. Logical Drawings: Provide logical riser or schematic drawings for cable plant and grounding/bonding systems. Show termination points and identify wiring connections.
5. IT Equipment Enclosure Elevation Drawings: Provide elevation drawings of racks and cabinets in all telecommunications spaces showing passive equipment layouts, grounding and bonding details, and power distribution equipment details.

D. Submittal Components (G): Provide manufacturer's cut sheets or similar for each element below showing conformance with Division 27 and VA Infrastructure Standard for Telecommunications Spaces salient characteristics and requirements. G: Data Center & Infrastructure Operations (DCIE), local site Facility Management Service (FMS), local site Office of Information Technology (OIT), Healthcare Environment and Facilities Program (HEFP), others as necessary.

1.	Bonding Busbars (Primary, Secondary, Rack)
2.	Overvoltage Surge Protectors
3.	Wire Basket Cable Tray and Accessories
4.	Server Cabinets and Accessories
5.	Network Channel Racks or Network Cabinets and Accessories
6.	Telecommunications Enclosures and Accessories
7.	Copper UTP Patch Panels and Accessories
8.	Fiber Distribution Panels and Accessories
9.	Horizontal Cable Managers
10.	Blanking Panels
12.	Power Distribution Units (PDUs)
13.	Rack-Mounted Uninterruptible Power Supply (UPS) Units
14.	Temperature/Humidity Sensors
15.	Copper UTP Backbone (Trunk) Cables
16.	Multimode Optical Fiber Backbone Cables (data center backbone)
17.	Single Mode Optical Fiber Backbone Cable Media (campus backbone)
19.	Copper UTP Horizontal Cable Media
20.	Copper UTP Patch Cords
21.	Fiber Optic Patch Cords

E. Provide parts list including quantity of spare parts.

F. Provide manufacturer product information. Government reserves the right to require a list of installations where products have been in operation.

G. Submittals are required for all equipment anchors and supports, including seismic support design.

H. Furnish electronic certified test reports to COR prior to final inspection and not more than 90 days after completion of tests.

1.6 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 (as appropriate for each item):
    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.

1.7 QUALITY ASSURANCE

A. System Supplier Qualifications: System supplier must be authorized by OEM to warranty installed equipment.

B. 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.

C. 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.

1.8 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 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.

1.9 FIELD CONDITIONS

A. Where variations from documents are requested in accordance with Section 01 00 00, GENERAL CONDITIONS and Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, connecting work and related components must include additions or changes to equipment, components, and installation methods.

1.10 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 NOT USED.

PART 3 EXECUTION

3.1 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. 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.

D. Install equipment according to manufacturers' written instructions.

E. 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.

F. Provide supplementary or miscellaneous items, appurtenances, devices and materials for a complete installation.

3.2 FIELD QUALITY CONTROL

A. 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.

B. Conduct project acceptance inspections, final completion inspections, substantial completion inspections, and acceptance testing and demonstrations after verification of system operation and completeness by Contractor.

C. Interim Inspection:
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 and technical requirements of construction documents.
3. Where applicable, check each item of installed (special telecommunications system) equipment to ensure appropriate NRTL listing labels and markings are fixed in place.

4. Verify cabling terminations in telecommunications spaces and end-user Work Area Outlets (WAOs) adhere to T568B pin assignments and cabling connections are in compliance with TIA standards.
5. Visually confirm minimum performance category cable marking of backbone, horizontal, and patch cabling for both copper UTP and fiber optic cabling.
6. Review communications bonding system in each telecommunications space.
7. Review cable tray installation practices.
8. Provide results of interim inspections to COR.
9. If major or multiple deficiencies are discovered, additional interim inspections may 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.
10. Facility COR will ensure test documents become a part of system's official documentation package.

3.3 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.

3.4 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.

END OF SECTION

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 extension to the existing 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 extension to the existing 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 extension to the existing ESS, installed, programmed, configured, documented, and tested. The security system shall include but not limited to: physical access control, intrusion detection, and video assessment and surveillance. Operator training shall not be required as part of the Security Contractors scope and shall be provided by the Owner. The Security Contractor shall still be required to provide necessary maintenance and troubleshooting manuals as well as submittals as identified herein. The work shall include the procurement and installation of electrical wire and cables, the installation and testing of all system components. Inspection, testing, demonstration, and acceptance of equipment, software, materials, installation, documentation, and workmanship, shall be as specified herein. The Contractor shall provide all associated installation support, including the provision of primary electrical input power circuits.

E. Repair Service Replacement Parts On-site service during the warranty period shall be provided as specified under "Emergency Service". The Contractor shall guarantee all parts and labor for a term of one (1) year, unless dictated otherwise in this specification from the acceptance date of the system as described in Part 5 of this Specification. The Contractor shall be responsible for all equipment, software, shipping, transportation charges, and expenses associated with the service of the system for one (1) year. The Contractor shall provide 24-hour telephone support for the software program at no additional charge to the owner. Software support shall include all software updates that occur during the warranty period.

F. Section Includes:
   1. Description of Work for Electronic Security Systems,
   2. Electronic security equipment coordination with relating Divisions,
   3. Submittal Requirements for Electronic Security,
   4. Miscellaneous Supporting equipment and materials for Electronic Security,
   5. Electronic security installation requirements.

1.2 RELATED WORK

A. Section 01 00 00 - GENERAL REQUIREMENTS. For General Requirements.

B. Section 07 84 00 - FIRESTOPPING. Requirements for firestopping application and use.

C. Section 08 71 00 - DOOR HARDWARE. Requirements for door installation.

D. Section 26 05 11 - REQUIREMENTS FOR ELECTRICAL INSTALLATIONS. Requirements for connection of high voltage.

E. Section 26 05 21 - LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW). Requirements for power cables.

F. Section 26 05 33 – RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS. Requirements for infrastructure.

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 BOXES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for infrastructure.

J. Section 28 08 00 - COMMISIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS. Requirements for Commissioning.

K. Section 28 13 00 - PHYSICAL ACCESS CONTROL SYSTEMS (PACS). For physical access control integration.

L. Section 28 16 00 - INTRUSION DETECTION SYSTEM (IDS). Requirements for alarm systems.

M. Section 28 23 00 - VIDEO SURVEILLANCE. Requirements for security camera systems.

1.3 DEFINITIONS

A. AGC: Automatic Gain Control.

B. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.

C. BICSI: Building Industry Consulting Service International.

D. CCD: Charge-coupled device.

E. Central Station: A PC with software designated as the main controlling PC of the security access system. Where this term is presented with initial capital letters, this definition applies.

F. Channel Cable Tray: A fabricated structure consisting of a one-piece, ventilated-bottom or solid-bottom channel section.

G. Controller: An intelligent peripheral control unit that uses a computer for controlling its operation. Where this term is presented with an initial capital letter, this definition applies.

H. CPU: Central processing unit.

I. Credential: Data assigned to an entity and used to identify that entity.

J. DGP: Data Gathering Panel – component of the Physical Access Control System capable to communicate, store and process information received from readers, reader modules, input modules, output modules, and Security Management System.

K. DTS: Digital Termination Service: A microwave-based, line-of-sight communications provided directly to the end user.

L. EMI: Electromagnetic interference.

M. EMT: Electric Metallic Tubing.

N. ESS: Electronic Security System.

O. File Server: A PC in a network that stores the programs and data files shared by users.

P. GFI: Ground fault interrupter.

Q. IDC: Insulation displacement connector.

R. Identifier: A credential card, keypad personal identification number or code, biometric characteristic, or other unique identification entered as data into the entry-control database for the purpose of identifying an individual. Where this term is presented with an initial capital letter, this definition applies.

S. I/O: Input/Output.

T. Intrusion Zone: A space or area for which an intrusion must be detected and uniquely identified, the sensor or group of sensors assigned to perform the detection, and any interface equipment between sensors and communication link to central-station control unit.

U. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).

V. LAN: Local area network.

W. LCD: Liquid-crystal display.

X. LED: Light-emitting diode.

Y. Location: A Location on the network having a PC-to-Controller communications link, with additional Controllers at the Location connected to the PC-to-Controller link with RS-485 communications loop. Where this term is presented with an initial capital letter, this definition applies.

Z. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.

AA. M-JPEG: Motion – Joint Photographic Experts Group.

BB. MPEG: Moving picture experts group.

CC. NEC: National Electric Code

DD. NEMA: National Electrical Manufacturers Association

EE. NFPA: National Fire Protection Association

FF. NTSC: National Television System Committee.

GG. NRTL: Nationally Recognized Testing Laboratory.

HH. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).

II. PACS: Physical Access Control System; A system comprised of cards, readers, door controllers, servers and software to control the physical ingress and egress of people within a given space

JJ. PC: Personal computer. This acronym applies to the Central Station, workstations, and file servers.

KK. PCI Bus: Peripheral component interconnect; a peripheral bus providing a high-speed data path between the CPU and peripheral devices (such as monitor, disk drive, or network).

LL. PDF: (Portable Document Format.) The file format used by the Acrobat document exchange system software from Adobe.

MM. RCDD: Registered Communications Distribution Designer.

NN. RFI: Radio-frequency interference.

OO. RIGID: Rigid conduit is galvanized steel tubing, with a tubing wall that is thick enough to allow it to be threaded.

PP. RS-232: An TIA/EIA standard for asynchronous serial data communications between terminal devices. This standard defines a 25-pin connector and certain signal characteristics for interfacing computer equipment.

QQ. RS-485: An TIA/EIA standard for multipoint communications.

RR. Solid-Bottom or Non-ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal side rails, and a bottom without ventilation openings.

SS. SMS: Security Management System – A SMS is software that incorporates multiple security subsystems (e.g., physical access control, intrusion detection, closed circuit television, intercom) into a single platform and graphical user interface.

TT. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.

UU. Trough or Ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal rails and a bottom having openings sufficient for the passage of air and using 75 percent or less of the plan area of the surface to support cables.

VV. UPS: Uninterruptible Power Supply

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 100miles of the project site. The local facility shall include sufficient spare parts inventory to support the service requirements associated with this contract. The facility shall also include appropriate diagnostic equipment to perform diagnostic procedures. The COR reserves the option of surveying the company's facility to verify the service inventory and presence of a local service organization.

2. The Contractor shall provide proof project superintendent with BICSI Certified Commercial Installer Level 1, Level 2, or Technician to provide oversight of the project.
3. Cable installer must have on staff a Registered Communication Distribution Designer (RCDD) certified by Building Industry Consulting Service International. The staff member shall provide consistent oversight of the project cabling throughout design, layout, installation, termination and testing.

D. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within eight hours of receipt of notification that service is needed. Submit name and address of service organizations.

1.5 GENERAL ARRANGEMENT OF CONTRACT DOCUMENTS

A. The Contract Documents supplement to this specification indicates approximate locations of equipment. The installation and/or locations of the equipment and devices shall be governed by the intent of the design; specification and Contract Documents, with due regard to actual site conditions, recommendations, ambient factors affecting the equipment and operations in the vicinity. The Contract Documents are diagrammatic and do not reveal all offsets, bends, elbows, components, materials, and other specific elements that may be required for proper installation. If any departure from the contract documents is deemed necessary, or in the event of conflicts, the Contractor shall submit details of such departures or conflicts in writing to the owner or owner’s representative for his or her comment and/or approval before initiating work.

B. Anything called for by one of the Contract Documents and not called for by the others shall be of like effect as if required or called by all, except if a provision clearly designed to negate or alter a provision contained in one or more of the other Contract Documents shall have the intended effect. In the event of conflicts among the Contract Documents, the Contract Documents shall take precedence in the following order: the Form of Agreement; the Supplemental General Conditions; the Special Conditions; the Specifications with attachments; and the drawings.

1.6 SUBMITTALS

A. 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.
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) Camera
    (c) Electric Transfer Hinge
    (d) 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.
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.
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.

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. System Configuration and Data Entry:
a. The contractor is responsible for providing all system configuration and data entry for the SMS and subsystems. 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) All other security subsystems shown in the contract documents.

b. Refer to Part 3 for system programming requirements and planning guidelines.

3. 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. 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.

4. 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".
5. 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.
6. 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.
7. 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

8. 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. Card Readers

L. Approvals will be based on complete submission of manuals together with shop drawings.

M. 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.

N. 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.

1.7 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. The most recently published version of each document listed below shall apply.

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	Access Control: Access Control Guideline Dye Sublimation Printing Practices for PVC Access Control Cards
CP-01	Control Panel Standard-Features for False Alarm Reduction
PIR-01	Passive Infrared Motion Detector Standard - Features for Enhancing False Alarm Immunity
TVAC	CCTV to Access Control Standard - Message Set for System Integration

D. American National Standards Institute (ANSI)/Electronic Industries Alliance (EIA):

330	Electrical Performance Standards for CCTV Cameras
375A	Electrical Performance Standards for CCTV Monitors

E. American National Standards Institute (ANSI):

ANSI S3.2	Method for measuring the Intelligibility of Speech over Communications Systems

F. American Society for Testing and Materials (ASTM)

B1	Standard Specification for Hard-Drawn Copper Wire
B3	Standard Specification for Soft or Annealed Copper Wire
B8	Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
C1238	Standard Guide for Installation of Walk-Through Metal Detectors
D2301	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	ADA Standards for Accessible Design

I. Department of Veterans Affairs:

VHA National CAD Standard Application Guide
VA BIM Guide, V1.0

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	Cable and Wire, Electrical (Power, Fixed Installation)

M. Government Accountability Office (GAO):

GAO-03-8	Security Responsibilities for Federally Owned and Leased Facilities

N. Homeland Security Presidential Directive (HSPD):

HSPD	Policy for a Common Identification Standard for Federal Employees and Contractors

O. Institute of Electrical and Electronics Engineers (IEEE):

81	IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
802.3af	Power over Ethernet Standard
802.3at	Power over Ethernet (PoE) Plus Standard
C2	National Electrical Safety Code
C62.41	IEEE Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits
C95.1	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	Installing Closed Circuit Television (CCTV) Systems

R. National Electrical Manufactures Association (NEMA):

250	Enclosures for Electrical Equipment (1000 Volts Maximum)
TC-3	PVC Fittings for Use with Rigid PVC Conduit and Tubing
FB1	Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable

S. National Fire Protection Association (NFPA):

70	National Electrical Code (NEC)
731	Standards for the Installation of Electric Premises Security Systems
99	Health Care Facilities

T. National Institute of Justice (NIJ)

0601.02	Standards for Walk-Through Metal Detectors for use in Weapons Detection
0602.02	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	Security CAD Symbols Standards

Y. Underwriters Laboratories, Inc. (UL):

1	Flexible Metal Conduit
5	Surface Metal Raceway and Fittings
6	Rigid Metal Conduit
44	Thermoset-Insulated Wires and Cables
50	Enclosures for Electrical Equipment
83	Thermoplastic-Insulated Wires and Cables
294	The Standard of Safety for Access Control System Units
305	Standard for Panic Hardware
360	Liquid-Tight Flexible Steel Conduit
444	Safety Communications Cables
444	Safety Communications Cables
464	Audible Signal Appliances
467	Electrical Grounding and Bonding Equipment
486A	Wire Connectors and Soldering Lugs for Use with Copper Conductors
486C	Splicing Wire Connectors
486D	Insulated Wire Connector Systems for Underground Use or in Damp or Wet Locations
486E	Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors
493	Thermoplastic-Insulated Underground Feeder and Branch Circuit Cable
514A	Metallic Outlet Boxes

514B	Fittings for Cable and Conduit
51	Schedule 40 and 80 Rigid PVC Conduit
609	Local Burglar Alarm Units and Systems
634	Standards for Connectors with Burglar-Alarm Systems
636	Standard for Holdup Alarm Units and Systems
639	Standard for Intrusion-Detection Units
651	Schedule 40 and 80 Rigid PVC Conduit
651A	Type EB and A Rigid PVC Conduit and HDPE Conduit
752	Standard for Bullet-Resisting Equipment
797	Electrical Metallic Tubing
827	Central Station Alarm Services
1037	Standard for Anti-theft Alarms and Devices
1635	Digital Alarm Communicator System Units
1076	Standards for Proprietary Burglar Alarm Units and Systems
1242	Intermediate Metal Conduit
1479	Fire Tests of Through-Penetration Fire Stops
1981	Central Station Automation System
2058	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 expansion to the existing 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 communications transmission equipment and data transmission media (DTM), security system sensors, physical access control equipment, 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. 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 arrival on site]. 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.

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.

1.12 EQUIPMENT AND MATERIALS

A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, for which replacement parts shall be available.

B. When more than one unit of the same class of equipment is required, such units shall be the product of a single manufacturer.

C. Equipment Assemblies and Components:
   1. Components of an assembled unit need not be products of the same manufacturer.
   2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
   3. Components shall be compatible with each other and with the total assembly for the intended service.
   4. Constituent parts which are similar shall be the product of a single manufacturer.

D. Factory wiring shall be identified on the equipment being furnished and on all wiring diagrams.

E. When Factory Testing Is Specified:
   1. The Government shall have the option of witnessing factory tests. The contractor shall notify the VA through the COR a minimum of 15 working days prior to the manufacturers making the factory tests.
   2. Four copies of certified test reports containing all test data shall be furnished to the COR prior to final inspection and not more than 90 days after completion of the tests.
   3. When equipment fails to meet factory test and re-inspection is required, the contractor shall be liable for all additional expenses, including expenses of the Government.

1.13 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.

1.14 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.

1.15 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.

1.16 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. The extension to the existing 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.

B. All equipment and materials for the system will be compatible with the existing installed systems to ensure correct operation.

2.2 EQUIPMENT ITEMS

A. 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 40 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.

2.3 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, fiber-optic, and twisted pair cable reels, conduit, cable tray, and/or cable duct bundles, wire rolls, physical installation hardware shall be turned over to the Contracting Officer. The following sections outline the minimum required installation sub-kits to be used:
   2. System Grounding:

a. The grounding kit shall include all cable and installation hardware required. All head end equipment and power supplies shall be connected to earth ground via internal building wiring, according to the NEC.
b. This includes, but is not limited to:
    1) Control Cable Shields
    2) Data Cable Shields
    3) Conduits
    4) Cable Duct blocks
    5) Power Panels
    6) Grounding
    7) Connector Panels

3. 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.
4. 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.
5. 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.
6. 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.
7. 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 DEMONSTRATING 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 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. 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 existing Security Management System (SMS) and subsystems [(e.g., video matrix switch, digital video recorders, intrusion devices. System programming for existing SMS servers shall not be conducted at the project site.

B. Level of Effort for Programming
   1. The Contractor shall perform and complete system programming (including all data entry) at an offsite location using the Contractor's own copy of the SMS software. The Contractor's copy of the SMS software shall be of the Owners current version. Once system programming has been completed, the Contractor shall deliver the data to the

COR on data entry forms and an approved electronic medium, utilizing data from the contract documents. The completed forms shall be delivered to the COR for review and approval at least 90 calendar days prior to the scheduled date the Contractor requires it. The Contractor shall not upload system programming until the COR has provided written approval. The Contractor is responsible for backing up the system prior to uploading new programming data. Additional programming requirements are provided as follows:

a. Programming for Existing SMS Servers: The contractor shall perform all related system programming except for personnel data as noted. The contractor will not be responsible for uploading personnel information (e.g., ID Cards backgrounds, names, access privileges, access schedules, personnel groupings). The contractor shall anticipate a weekly coordination meeting and working alongside of COR to ensure data uploading is performed without incident of loss of function or data loss. System programming for SMS servers shall be performed by using the Contractor's own server and software. These servers shall not be connected to existing devices or systems at any time.

2. The Contractor shall identify and request from the COR, any additional data needed to provide a complete and operational expansion/modification to the existing system as described in the contract documents.

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. 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. The inspection and test will be conducted by a factory-certified contractor representative and witnessed by a Government Representative. The results of the inspection will be officially recorded by a designated Government Representative and maintained on file by the COR, until completion of the entire project. The results will be compared to the Acceptance Test results.

D. 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. The Contractor shall test all security systems and equipment, and provide written proof of a 100% operational system before a date is established for the system acceptance test. Documentation package for CFT shall include completed (fully annotated details of test details) for each device and system tested, and annotated loading sheets documenting complete testing to COR approval. CFT test documentation package shall conform to submittal requirements outlined in this Section. The Contractor's field testing procedures shall be identical to the COR's acceptance testing procedures. The Contractor shall provide the COR with a written listing of all equipment and software indicating all equipment and components have been tested and passed. The Contractor shall deliver a written report to the COR stating the installed complete system has been calibrated, tested, and is ready to begin performance verification testing; describing the results of the functional tests, diagnostics, and calibrations; and the report shall also include a copy of the approved acceptance test procedure. Performance verification testing shall not take place until written notice by contractor is received certifying that a contractors field test was successful.

E. 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 extension/modification to the existing 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 Inputs To Existing Software
        3) All Cabling System Matrices
        4) All Cable Testing Documents
        5) 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.

F. 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.

END OF SECTION

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 extension to the existing 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 SUBMITTAL

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. The most recently published version of each document listed below shall apply.

B. American Society of Testing Material (ASTM):

D2301	Standard Specification for Vinyl Chloride Plastic Pressure Sensitive Electrical Insulating Tape

C. Federal Specifications (Fed. Spec.):

A-A-59544	Cable and Wire, Electrical (Power, Fixed Installation)

D. National Fire Protection Association (NFPA):

70	National Electrical Code (NEC)

E. Underwriters Laboratories, Inc. (UL):

44	Thermoset-Insulated Wires and Cables
83	Thermoplastic-Insulated Wires and Cables
467	Electrical Grounding and Bonding Equipment
486A	Wire Connectors and Soldering Lugs for Use with Copper Conductors
486C	Splicing Wire Connectors
486D	Insulated Wire Connector Systems for Underground Use or in Damp or Wet Locations
486E	Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors
493	Thermoplastic-Insulated Underground Feeder and Branch Circuit Cable
514B	Fittings for Cable and Conduit
1479	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 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 6A 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. 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 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 6A.
   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, complying with UL 1666.

2.3 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 6A. 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.

2.4 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.

2.5 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.

2.6 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, 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.

2.7 IDENTIFICATION PRODUCTS

A. Comply with UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.8 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. Cable will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

2.9 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.

2.10 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. 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 not permitted.
   3. Signaling Line Circuits: Power-limited fire alarm cables shall not 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 "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.

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.

END OF SECTION

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 extension to the existing 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 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. The most recently published version of each document listed below shall apply.

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

B1	Standard Specification for Hard-Drawn Copper Wire
B3	Standard Specification for Soft or Annealed Copper Wire

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

C. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

81	IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
C2	National Electrical Safety Code

D. National Fire Protection Association (NFPA):

70	National Electrical Code (NEC)
99	Health Care Facilities

E. Underwriters Laboratories, Inc. (UL):

44	Thermoset-Insulated Wires and Cables
83	Thermoplastic-Insulated Wires and Cables
467	Grounding and Bonding Equipment
486A-486B	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 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. 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. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts.
      a. a) Pipe Connectors: Clamp type, sized for pipe.
   4. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 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.

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 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.

3.6 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 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."

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:
   1. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.

C. Grounding system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION

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 extension to the existing 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 - COMMISIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS. Requirements for commissioning - systems readiness checklists, and training.

1.3 DEFINTIONS

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: Liquid tight flexible metal conduit.

G. LFNC: Liquid tight 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 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. 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. The most recently published version of each document listed below shall apply.

B. National Electrical Manufacturers Association (NEMA):

TC-3	PVC Fittings for Use with Rigid PVC Conduit and Tubing
FB1	Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable

C. National Fire Protection Association (NFPA):

70	National Electrical Code (NEC)

D. Underwriters Laboratories, Inc. (UL):

1	Flexible Metal Conduit
5	Surface Metal Raceway and Fittings
6	Rigid Metal Conduit
50	Enclosures for Electrical Equipment
360	Liquid-Tight Flexible Steel Conduit
467	Grounding and Bonding Equipment
514A	Metallic Outlet Boxes
514B	Fittings for Cable and Conduit
514C	Nonmetallic Outlet Boxes, Flush-Device Boxes and Covers
651	Schedule 40 and 80 Rigid PVC Conduit
651A	Type EB and A Rigid PVC Conduit and HDPE Conduit
797	Electrical Metallic Tubing
1242	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.

2.3 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. 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.

2.4 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.

2.5 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.

2.6 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."

2.7 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.

1. Sealing Elements: EPDMinterlocking 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:Stainless steel. Include two for each sealing element.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.8 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.

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. Furred or Suspended Ceilings and in Walls:
   1. 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.
   2. Align and run conduit parallel or perpendicular to the building lines.
   3. 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.
   4. 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. 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.

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. 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)

J. Furnish and install 19 mm (3/4 inch) thick fire retardant plywood specifiedon the wall of communication closets where shown on drawings . Mount the plywood with the bottom edge 300 mm (one foot) above the finished floor.

K. 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.

END OF SECTION

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 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 28 Sections for additional Contractor training requirements.

END OF SECTION

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 extension to the existing Physical Access Control System, hereinafter referred to as the PACS.

B. PACS shall provide secure and reliable identification of Federal employees and contractors by utilizing credential authentication per FIPS-201.

C. 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.

D. For locations where secure side processing is not applicable the tamper switches and certified cryptographic processing shall be provided per FIPS-140-2.

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 21 - LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW). Requirements for power cables.

G. Section 26 05 33 – RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS. Requirements for infrastructure.

H. 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.

I. Section 28 05 13 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for conductors and cables.

J. Section 28 05 26 - GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY. Requirements for grounding of equipment.

K. Section 28 05 28.33 - CONDUITS AND BOXES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for infrastructure.

L. Section 28 08 00 - COMMISIONING OF ELECTRONIC SAFETY AND SECURITY. For requirements for commissioning, systems readiness checklists, and training.

M. Section 28 16 00 - INTRUSION DETECTION SYSTEM (IDS). Requirements for alarm systems.

N. Section 28 23 00 - VIDEO SURVEILLANCE. Requirements for security camera systems.

O. 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 extension and modification to the existing PACS as shown. The Contractor shall also provide certification as required.

B. The extention to the existing security system will be installed and tested to ensure all components are fully compatible with the existing system.

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 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, Section 02 41 00, DEMOLITION, 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. 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.

F. 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.

G. 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.

H. 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 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. 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.

I. 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 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.

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.

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.
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".

J. 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

K. 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.

L. 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. System Configuration and Data Entry:
   a. The contractor is responsible for providing all modifications to the existing system configuration and data entry for the existing SMS and subsystems. 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) All other security subsystems shown in the contract documents.
   b. Refer to Part 3 for system programming requirements and planning guidelines.
3. 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.

M. 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. 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.
4. 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.
5. 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.
6. 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.
7. 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”.
8. 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.

9. 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.
10. 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
11. 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).

N. FIPS 201 Compliance Certificates
   1. Provide Certificates for all software components and device types utilizing credential verification. Provide certificates for:
      a. Card Readers

O. Approvals will be based on complete submission of manuals together with shop drawings.

P. 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. The most recently published version of each document listed below shall apply.

B. American National Standards Institute (ANSI)/ Security Industry Association (SIA):

AC	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

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	Installing Closed Circuit Television (CCTV) Systems

H. National Electrical Manufactures Association (NEMA):

250	Enclosures for Electrical Equipment (1000 Volts Maximum)

I. National Fire Protection Association (NFPA):

70	National Electrical Code

J. Underwriters Laboratories, Inc. (UL):

294	The Standard of Safety for Access Control System Units
305	Standard for Panic Hardware

639-	Standard for Intrusion-Detection Units
752	Standard for Bullet-Resisting Equipment
827	Central Station Alarm Services
1076	Standards for Proprietary Burglar Alarm Units and Systems
1981	Central Station Automation System
2058	High Security Electronic Locks

K. Homeland Security Presidential Directive (HSPD):

HSPD	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)

R. ADA Standards for Accessible Design

S. Section 508 of the Rehabilitation Act of 1973

1.6 DEFINITIONS

A. 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.

B. 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.

C. Access Control: A function or a system that restricts access to authorized persons only.

D. API Application Programming Interface

E. 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: [M-04-04]
   1. Level 1: LITTLE OR NO confidence
   2. Level 2: SOME confidence
   3. Level 3: HIGH confidence
   4. Level 4: VERY HIGH confidence

F. 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.

G. 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.

H. Authorization: A process that associates permission to access a resource or asset with a person and the person's identifier(s).

I. 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.

J. Biometric: An authenticator produced from measurable qualities of a living person.

K. CAC EP – CAC End Point with end point PIV applet

L. CAC NG – CAC Next Generation with transitional PIV applet

M. 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.

N. CCTV: Closed-circuit television.

O. 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.

P. 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.

Q. CPU: Central processing unit.

R. Credential: Data assigned to an entity and used to identify that entity.

S. File Server: A PC in a network that stores the programs and data files shared by users.

T. FIPS Federal Information Processing Standards

U. FRAC – First Responder Authentication Credential

V. HSPD Homeland Security Presidential Directive

W. I/O: Input/Output.

X. 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.

Y. IEC International Electrotechnical Commission

Z. AA. ISO International Organization for Standardization

AA. KB Kilobyte

BB. kbit/s Kilobits / second

CC. LAN: Local area network.

DD. LED: Light-emitting diode.

EE. Legacy CAC – Contact only Common Access Card with v1 and v2 applets

FF. 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.

GG. NIST: National Institute of Standards and Technology

HH. PACS: Physical Access Control System

II. PC/SC: Personal Computer / Smart Card

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. PIV: Personal Identification Verification

NN. PIV-I – PIV Interoperable credential

OO. PPS: Protocol and Parameters Selection

PP. RF: Radio frequency.

QQ. ROM: Read-only memory. ROM data are maintained through losses of power.

RR. 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.

SS. RS-485: An TIA/EIA standard for multipoint communications.

TT. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.

UU. TPDU: Transport Protocol Data Unit

VV. TWIC – Transportation Worker Identification Credential

WW. UPS: Uninterruptible power supply.

XX. Vcc: Voltage at the Common Collector

YY. WAN: Wide area network.

ZZ. AAA. WAV: The digital audio format used in Microsoft Windows.

AAA. Wiegand: Patented magnetic principle that uses specially treated wires embedded in the credential card.

BBB. Windows: Operating system by Microsoft Corporation.

CCC. Workstation: A PC with software that is configured for specific limited security system functions.

1.7 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.

1.8 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 arrival on site. 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.

1.9 PERFORMANCE REQUIREMENTS

A. All processing of authentication information must occur on the “safe side” of a door.

B. 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.

C. System Response to Alarms: Field device network shall provide a system end-to-end response time of 1second(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.

D. 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.

E. References to industry and trade association standards and codes are minimum installation requirement standards.

F. 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. 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.

1.11 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 extension to the existing 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 in the sections below and shall be compatible with the existing PACS system.

2.2 CARD READERS

A. Power: Card reader shall be powered from its associated Controller, including its standby power source.

B. Response Time: Card reader shall respond to passage requests by generating a signal that is sent to the Controller. Response time shall be [800] ms or less, from the time the card reader finishes reading the credential card until a response signal is generated.

C. 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.

D. 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.

E. 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.

F. Will be fully programmable and addressable, locally and remotely, and hardwired to the system.

G. Shall be individually home run to the main panel.

H. 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

I. 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.

J. Shall be housed in an aluminum bezel with a wide lead-in for easy card entry.

K. Shall contain read head electronics, and a sender to encode digital door control signals.

L. LED’s shall be utilized to indicate card reader status and access status.

M. 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.

N. 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.

O. Shall have a minimum of two programmable inputs and two programmable outputs.

P. 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.

Q. 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.

R. 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 time1 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.

S. 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

2.3 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.

2.4 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. 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).

2.5 WIRES AND CABLES

A. Comply with Division 28 Section "CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY."

B. 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.

C. 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.

D. RS-485 communications require 2 twisted pairs, with a distance limitation of 4000 feet (1220 m).

E. 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.

F. 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.

G. 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.

H. 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.

I. 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.

J. 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.

K. 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.

L. 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.

M. 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.

N. 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.

O. 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.

P. 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.

Q. 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.

R. 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.

S. 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.

T. 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 extension and modification to the existing 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. Set up groups, linking, and list inputs and outputs for each Controller.
   4. Complete system diagnostics and operation verification.
   5. Prepare a specific plan for system testing, startup, and demonstration.
   6. Develop acceptance test concept and, on approval, develop specifics of the test.
   7. 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 6A rating of components and that ensure Category 6A 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 extension to the existing 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 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.

F. 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.

G. 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.

H. 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.

I. 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.

J. 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.

K. 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.

L. SMS:

1. Program the existing SMS to ensure it is in fully operation.

M. 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 flushed mounted and all appropriate hardware shall be provided to ensure the unit is installed in an enclosed conduit system.

N. 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.

O. 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).

P. 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.

Q. 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.

R. 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. Configure and test existing software and databases for the complete and proper operation of systems involved.

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:Owner will 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 6 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.

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 DEMONSTRATING 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 OF SECTION

SECTION 28 16 00
INTRUSION DETECTION SYSTEM

PART 1 – GENERAL

1.1 DESCRIPTION

A. Provide and install a complete extension to the existing Intrusion Detection System, hereinafter referred to as IDS, as specified in this section.

B. Related Sections include the following:
   1. Division 28 Section "VIDEO SURVEILLANCE" for closed-circuit television cameras that are used as devices for video motion detection.
   2. Division 28 Section "CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY" for cabling between central-station control units and field-mounted devices and controllers.

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 21 - LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW). 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 - COMMISIONING OF ELECTRONIC SAFETY AND SECURITY. Requirements for commissioning - systems readiness checklists, and training.

K. Section 28 13 00 - PHYSICAL ACCESS CONTROL SYSTEMS (PACS). Requirements for physical access control integration.

L. Section 28 23 00 - VIDEO SURVEILLANCE. Requirements for security camera systems.

M. 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 extension and modification to the existing IDS 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 with the existing IDS system.

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.

1.4 DEFINITIONS

A. 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.

B. I/O: Input/Output.

C. 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.

D. LED: Light-emitting diode.

E. NEC: National Electric Code

F. NEMA: National Electrical Manufacturers Association

G. NFPA: National Fire Protection Association

H. NRTL: Nationally Recognized Testing Laboratory.

I. 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.

J. PIR: Passive infrared.

K. RF: Radio frequency.

L. Standard Intruder: A person who weighs 45 kg (100 lb.) or less and whose height is 1525 mm (60 in) or less; dressed in a long-sleeved shirt, slacks, and shoes.

M. Standard-Intruder Movement: Any movement, such as walking, running, crawling, rolling, or jumping, of a "standard intruder" in a protected zone.

N. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.

O. UPS: Uninterruptible Power Supply

P. UTP: Unshielded Twisted Pair

1.5 SUBMITTALS

A. Refer to Section 28 05 00, Part1.

B. Submit below items in conjunction with Master Specification Sections 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, and Section 02 41 00, DEMOLITION.

C. Provide certificates of compliance with Section 1.3, Quality Assurance.

D. Provide a shop drawing 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.

E. 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 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. Drawing sheets that will be plotted on the individual floor plans or site 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 IDS, provide the sensor ID, sensor type and housing model number.
6. Detail and elevation drawings for all devices that define how they were installed and mounted.

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. 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. The most recently published version of each document listed below shall apply.

B. American National Standards Institute (ANSI)/Security Industry Association (SIA):

PIR-01	Passive Infrared Motion Detector Standard - Features for Enhancing False Alarm Immunity

CP-01	Control Panel Standard-Features for False Alarm Reduction

C. Department of Justice American Disability Act (ADA)

28 CFR Part 36	2010 ADA Standards for Accessible Design

D. Federal Communications Commission (FCC):

(47 CFR 15) Part 15	Limitations on the Use of Wireless Equipment/Systems

E. National Electrical Manufactures Association (NEMA):

250	Enclosures for Electrical Equipment (1000 Volts Maximum)

F. National Fire Protection Association (NFPA):

70	National Electrical Code
731	Standards for the Installation of Electric Premises Security Systems

G. Underwriters Laboratories, Inc. (UL):

464	Audible Signal Appliances
609	Local Burglar Alarm Units and Systems
634	Standards for Connectors with Burglar-Alarm Systems
639	Standards for Intrusion Detection Units
1037	Standard for Anti-theft Alarms and Devices
1635	Digital Alarm Communicator System Units

H. Uniform Federal Accessibility Standards (UFAS), 19841.

1.7 COORDINATION

A. Coordinate arrangement, mounting, and support of intrusion detection system 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.

1.8 EQUIPMENT AND MATERIALS

A. General
   1. All equipment associated within the IDS shall be 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.
   2. All equipment shall operate on a 120 volts alternating current (VAC); 60 Hz AC power system unless documented otherwise in subsequent sections listed within this specification.

3. The extension to the existing 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.

4. All equipment and materials for the system will be compatible to ensure functional operation in accordance with requirements.

1.9 WARRANTY OF CONSTRUCTION.

A. Warrant IDS work subject to the Article “Warranty of Construction” of FAR 52.246-21.

B. Demonstration and training shall be performed prior to system acceptance.

PART 2 – PRODUCTS

2.1 SYSTEM COMPONENT REQUIREMENTS

A. Compatibility: Detection devices and their communication features, and connecting wiring shall be selected and configured with accessories for full compatibility with the PACS data gathering panels.

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 Lines 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 Lines: Comply with requirements as recommended by manufacturer for type of line being protected.

C. Interference Protection: Components shall be unaffected by radiated RFI and electrical induction of 15 V/m over a frequency range of 10 to 10,000 MHz and conducted interference signals up to 0.25-V RMS injected into power supply lines at 10 to 10,000 MHz.

D. Tamper Protection: Tamper switches on detection devices, controllers, annunciators, pull boxes, junction boxes, cabinets, and other system components shall initiate a tamper-alarm signal when unit is opened or partially disassembled and when entering conductors are cut or disconnected. Central-station control-unit alarm display shall identify tamper alarms and indicate locations.

E. Self-Testing Devices: Automatically test themselves periodically, but not less than once per hour, to verify normal device functioning and alarm initiation capability. Devices transmit test failure to central-station control unit.

F. Antimasking Devices: Automatically check operation continuously or at intervals of a minute or less, and use signal-processing logic to detect blocking, masking, jamming, tampering, or other operational dysfunction. Devices transmit detection of operational dysfunction to central-station control unit as an alarm signal.

G. Addressable Devices: Transmitter and receivers shall communicate unique device identification and status reports to central-station control unit.

H. Remote-Controlled Devices: Individually and remotely adjustable for sensitivity and individually monitored at central-station control unit for calibration, sensitivity, and alarm condition.

2.2 ENCLOSURES

A. Interior Sensors: Enclosures that protect against dust, falling dirt, and dripping noncorrosive liquids.

B. Interior Electronics: NEMA 250, Type 12.

2.3 EQUIPMENT ITEMS

A. General:
   1. All requirements listed below are the minimum specifications that need to be met in order to comply with the IDS.
   2. All IDS sensors shall conform to UL 639, Intrusion Detection Standard.

B. IDS Components: The extension and modification to the existing IDS shall consist of, but not be limited to, the following components:
   1. Interior Detection Devices (Sensors)
   2. Power Supply
   3. Enclosures

2.4 INTERIOR DETECTION DEVICES (SENSORS)

A. The extension to the existing IDS shall consist of additional interior detection devices that are capable of:
   1. Locating intrusions at individually protected asset areas or at an individual portal;
   2. Locating intrusions within a specific area of coverage;
   3. Locating failures or tampering of individual sensors or components.

B. Provide and adjust for devices so that coverage is maximized in the space or area it is installed in. For large rooms where multiple devices are required, ensure device coverage is overlapping.

C. Detection sensitivity shall be set up to ensure maximum coverage of the secure area is obtained while at the same time limiting excessive false alarms due to the environment and impact of small animals. All detection devices shall be anti-masking with exception of video motion detection.

D. Dual sensor technology shall be used when possible. Sensor technology shall not be of the same type that is easily defeated by a single method. This will reduce the amount of false alarms.

E. Interior Environmental Conditions: Systems shall be able to operate in environmentally protected interior areas and shall meet operational performance requirements for the following ambient conditions:
   1. If components are installed in unheated areas they shall be able to operate in temperatures as low as -17 C (0 F);
   2. Interior Sensor Environmental Characteristics:

Temperatures	0 to 50 C (32F to 120 F)
Pressure	Sea Level to 4573m (15,000 ft.) above sea level
Humidity	5% - 95%
Fungus	Components of non-fungus nutrient materials
Acoustical Noise	Suitable for high noise environments above 100db

F. Passive Infrared Motion Sensors (PIR)
   1. These sensors shall detect an intruder presence by monitoring the level of infrared energy emitted by objects within a protected zone and meet ANSI PIR-01 Passive Infrared Motion Detector Standards Features for Enhancing False Alarm Immunity. An alarm shall be initiated when motion and temperature changes within set patterns are detected as follows.

2. The detector shall provide multiple detection zones distributed at a variety of angles and distance.
3. Sensors shall be passive in nature; no transmitted energy shall be required for detection.
4. Sensors shall be sensitive to infrared energy emitted at wavelengths corresponding to human body and other objects at ambient temperatures.
5. Sensors shall not alarm in response to general area thermal variations and shall be immune to radio frequency interference.
6. Sensors shall not be susceptible to changes in temperature due to an air conditioner being turned on or off.
7. Sensors shall be housed in a tamper-alarmed enclosure.
8. Sensor detectors shall include motion analyzer processing, adjustable lens, and walk test LED's visible from any angle.
9. Sensors shall provide some means of indicating an alarm condition during installation and calibration. A means of disabling the indication shall be provided within the sensor enclosure.
10. Sensor detectors shall include a motion monitoring verification circuit that will signal trouble or alarm if the detector fails to detect motion for an extended period.
11. PIR Technical Characteristics:

Power	Six (6) – 12 VDC 25 mA continuous current draw 38 mA peaks
Alarm Velocity	1500 mm (Five (5) ft.) at a velocity of 30 mm (0.1 ft.) per second, and one (1) step per second, assuming 150 mm (6 in.) per step. Also, faster than 30 mm (1 foot) per second, up to 3000 mm (10 feet) per second
Maximum detection range	10.6 m (35 ft.)
Frequency range- non activation or setup use	26 to 950 MHz using a 50 watt transmitter located 1 ft. from the unit or attached wiring
Infrared detection	1 1/2°C (3°F) different from the background temperature
Detection Pattern	180 degrees for volumetric units, non PIR 360
PIR 360°Detection Pattern	Programmable 60 detection zones including one directly below
Mounting	Ceiling and walls
Ceiling heights	2.4 m (Eight (8) ft.) – 5.4 m (18 ft)
Sensitivity adjustments	Three (3) levels

2.5 POWER SUPPLY

A. A power supply shall only be utilized if the existing control panel(s) is unable to support the increased load requirements of the IDS system.

B. All power supplies shall be UL rated and able to adequately power two entry control devices on a continuous base without failure.

PART 3 - EXECUTION

3.1 INSTALLATION

A. IDS installation shall be in accordance with Underwriters Laboratories (UL) 639 Standards for Intrusion Detection Units and UL 634 Standards for Connectors with Burglar Alarm Systems, and appropriate manufacture's installation manuals for each type of IDS.

B. The Contractor shall install all system components including VA furnished equipment, and appurtenances in accordance with the manufacturer's instructions and shall furnish all necessary connectors, terminators, interconnections, services, and adjustments required for a complete and operable system.

C. The extension to the existing IDS 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 designed as a computer network.

D. For programming purposes, the Contractor shall refer to the manufacturer's requirements and Contracting Officer instructions for correct system operations.

E. Product Delivery, Storage and Handling:
   1. Delivery: Deliver materials to the job site in OEM's original unopened containers, clearly labeled with the OEM's name, equipment model and serial identification numbers, and UL logo. The Contracting Officer may inventory the IDS equipment at the time of delivery and reject items that do not conform to this requirement.
   2. Storage and Handling: Store and protect equipment in a manner that will preclude damage as directed by the Contracting Officer.

F. Cleaning and Adjustments:
   1. Cleaning: Subsequent to installation, clean each system component of dust, dirt, grease, or oil incurred during installation in accordance to manufacture instructions.
   2. Prepare for system activation by following manufacturer's recommended procedures for adjustment, alignment, or synchronization. Prepare each component in accordance with appropriate provisions of the component's installation, operations, and maintenance instructions.

G. Unique IDS Installation Components:
   1. Passive Infrared Detectors: (PIR)
      a. The protective beam shall be focused in a straight line.
      b. Installed beam distance from transmitter to receiver shall not exceed 80% of the manufacturer's maximum recommended rating.
      c. Mirrors may be used to extend the beam or to establish a network of beams. Each mirror used shall not lower the rated maximum system range by more than 50%.

3.2 WIRING INSTALLATION

A. Wiring Method: Install wiring in metal raceways according to Section 28 05 28.33 "CONDUITS AND BOXES FOR ELECTRONIC SAFETY AND SECURITY." Conceal raceway except in unfinished spaces and as indicated. Minimum conduit size shall be 3/4 inch (20 mm). Control and data transmission wiring shall not share conduit with other building wiring systems.

B. Wiring Method: Install wiring in raceways except in accessible indoor ceiling spaces and in interior hollow gypsum board partitions where cable may be used. Conceal raceways and wiring except in unfinished spaces and as indicated. Minimum conduit size shall be 3/4 inch (20 mm). Control and data transmission wiring shall not share conduit with other building wiring systems.

C. Wiring Method: Cable, concealed in accessible ceilings, walls, and floors when possible.

D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Use lacing bars and distribution spools. Separate power-limited and non-power-limited conductors as recommended in writing by manufacturer. Install conductors parallel with or at right angles to sides and back of enclosure. Connect conductors that are terminated, spliced, or interrupted in

any enclosure associated with intrusion system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

E. Wires and Cables:
   1. Conductors: Size as recommended in writing by system manufacturer, unless otherwise indicated.
   2. 120-V Power Wiring: Install according to Division 26 Section "LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES," unless otherwise indicated.
   3. Control and Signal Transmission Conductors: Install unshielded, twisted-pair cable, unless otherwise indicated or if manufacturer recommends shielded cable, according to Division 28 Section "CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY."
   4. Computer and Data-Processing Cables: Install according to Division 28 Section "CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY."
   5. Television Signal Transmission Cables: Install according to Division 28 Section "CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY."

F. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

G. Install power supplies and other auxiliary components for detection devices at controllers, unless otherwise indicated or required by manufacturer. Do not install such items near devices they serve.

H. Identify components with engraved, laminated-plastic or metal nameplate for central-station control unit and each terminal cabinet, mounted with corrosion-resistant screws.

3.3 GROUNDING

A. Ground system components and conductor and cable shields to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

3.4 STARTUP AND TESTING

A. 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.

3.5 COMMISIONING

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 TESTS 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.

END OF SECTION

SECTION 28 23 00
VIDEO SURVEILLANCE

PART 1 – GENERAL

1.1 DESCRIPTION

A. Provide and install a complete extension to the existing Video Surveillance System, which is identified as the Security Surveillance Television hereinafter referred to as the SSTV System as specified in this section.

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 21 - LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW). 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 - COMMISIONING 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.

L. Section 28 16 00 - INTRUSION DETECTION SYSTEM (IDS). Requirements for alarm systems.

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 extension and modification to the existing SSTV 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 with the existing system.

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 Security Surveillance Television's (SSTV) 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 SSTV. 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 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, and Section 02 41 00, Demolition Drawings.

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 SSTVSystems, 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. 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.

F. 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.

G. 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. The most recently published version of each document listed below shall apply.

B. American National Standards Institute (ANSI)/Electronic Industries Alliance (EIA):

330	Electrical Performance Standards for CCTV Cameras
375A	Electrical Performance Standards for CCTV Monitors

C. Institute of Electrical and Electronics Engineers (IEEE):

C62.41	IEEE Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits
802.3af	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	Installing Closed Circuit Television (CCTV) Systems

F. National Fire Protection Association (NFPA):

70	Article 780-National Electrical Code

G. Federal Information Processing Standard (FIPS):

140-2	Security Requirements for Cryptographic Modules

H. Underwriters Laboratories, Inc. (UL):

983	Standard for Surveillance Camera Units
3044	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 SSTV 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. 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.

B. 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.

C. Tamper Protection: Tamper switches on pull boxes, junction boxes, and other system components shall initiate a tamper-alarm signal when unit is opened or partially disassembled.

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.
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 SSTV 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 SSTV 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 existing system by a unique user defined name, with minimum of twenty (20) characters. The use of codes or mnemonics identifying the SSTV 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. Will be fitted with AI/DC lenses to ensure the image quality under different light conditions.
10. Dummy or fake cameras will not be utilized at any time.
11. Appropriate signage shall be designed, provided, and posted that notifies people that an area is under camera surveillance.

2.3 AUTOMATIC COLOR DOME CAMERA - ANALOG

A. The camera shall be a high-resolution color video camera with wide dynamic range capturing capability.

B. Comply with UL 639.

C. Signal-to-Noise Ratio: Not less than 50 dB, with the camera AGC off.

D. White Balance: Auto-tracing white balance, with manually settable fixed balance option.

E. Motion Detector: Built-in digital.

F. Megapixel High Definition Integrated Digital Network Camera
1. The network camera shall offer dual video streams with up to 3.1 megapixel resolution (2048 x 1536) in progressive scan format.
2. An alarm input and relay output shall be built in for integration with hard wired external sensors.
3. The network camera shall be capable of firmware upgrades through a network using a software-based device utility.
4. The network camera shall offer auto back focus (ABF) functionality through a push button on the camera. ABF parameters shall also be configurable through a standard Web browser interface.
5. The network camera shall offer a video output port providing an NTSC/PAL analog video output signal for adjusting field of view and focus at the camera.
6. The network camera shall provide advanced low-light capabilities for color and day/night models with sensitivity down to 0.12 lux in color and 0.03 lux in black-white (B-W).
7. The network camera shall have removable IR cut filter mechanism for increased sensitivity in low-light installations. The sensitivity of IR cut filter removal shall be configurable through a Web browser.
8. The network camera shall support two simultaneous, configurable video streams. H.264 and MJPEG compression formats shall be available for primary and secondary streams with selectable unicast and multicast protocols. The streams shall be configurable in a variety of frame rates and bit rates.
9. The network camera shall support industry standard Power over Ethernet (PoE)
10. IEEE 802.3af to supply power to the camera over the network.
11. The network camera shall use a standard Web browser interface for remote administration and configuration of camera parameters.
12. The network camera shall have a window blanking feature to conceal user-defined privacy areas that cannot be viewed by an operator. The network camera shall support up to four blanked windows. A blanked area shall appear on the screen as a solid gray window.
13. The network camera shall support standard IT protocols.
14. The network camera shall support open architecture best practices with a published API available to third-party network video recording and management systems.
15. Megapixel High Definition Integrated Digital Network Camera Technical Specifications:

Imaging Device	1/3-inch, effective
Imager Type	CMOS, Progressive scan
Maximum Resolution	2048 x 1536
Signal-to-Noise Ratio	50 dB

Auto Iris Lens Type	DC drive
Electronic Shutter Range	1~1/100,000 sec
Wide Dynamic Range	60 dB
White Balance Range	2,000° to 10,000°K
Sensitivity	f/1.2; 2,850K; SNR >24dB Color (1x/33ms) 0.50 lux Color SENS (15x/500 ms) 0.12 lux Mono SENS (15x/500 ms) Mono (1x/33ms)0.25 lux 0.03 lux
Dome Attenuation	Clear Zero light loss Smoke f/1.0 light loss
Compression	H.264 in base profile and MJPEG
Video Streams	Up to 2 simultaneous streams, the second Stream variable based on the setup of the primary stream
Frame Rate	Up to 30, 25, 24, 15, 12.5, 12, 10, 8, 7.5, 6.5, 4, 3, 2, and 1 (depending upon coding, resolution, and stream configuration
Available Resolutions	3.1 MPx2048 x 1536; 4:3 aspect ratio; 2.0 ips max., 10.0 Mbps bit rate for MJPEG; 3.0 ips max., 2.6 Mbps bit rate H.264 2.1 MPx1920 x 1080; 16:9 aspect ratio: 15.0 ips max.,10.0 Mbps bit rate for MJPEG; 5.0 ips max., 2.7 Mbps bit rate H.264 3.1.9 MPx1600 x 1200; 4:3 aspect ratio; 15.0 ips max.,10.0 Mbps bit rate for MJPEG; 6.0 ips max., 2.6 Mbps bit rate H.264 1.3 MPx1280 x 1024; 5:4 aspect ratio; 15.0 ips max.,10.0 Mbps bit rate for MJPEG; 8.0 ips max., 2.5 Mbps bit rate H.264 1.2 MPx1280 x 960; 4:3 aspect ratio; 15.0 ips max., 9.8 Mbps bit rate for MJPEG; 9.8 ips max., 8.5 Mbps bit rate H.264 6.0.9 MPx1280 x 720; 16:9 aspect ratio; 30.0 ips max.,10.0 Mbps bit rate for MJPEG; 12.5 ips max., 2.5 Mbps bit rate H.264 0.5 MPx800 x 600; 4:3 aspect ratio; 30.0 ips max., 5.8 Mbps bit rate for MJPEG; 25.0 ips max., 2.0 Mbps bit rate H.264 8.0.3 MPx640 x 480; 4:3 aspect ratio; 30.0 ips max., 3.7 Mbps bit rate for MJPEG; 30.0 ips max.,1.6 Mbps bit rate H.264

	0.1 MPx320 x 240; 4:3 aspect ratio; 30.0 ips max., 0.9 Mbps bit rate for MJPEG; 30.0 ips max., 0.4 Mbps bit rate H.264 Additional640 x 512, 640 x 352, 480 x 368, 480 x 272, 320 x 256, 320 x 176
Supported Protocols	TCP/IP, UDP/IP (Unicast, Multicast IGMP), UPnP, DNS, DHCP, RTP, RTSP, NTP,IPv4, SNMP, QoS, HTTP, HTTPS, LDAP(client), SSH, SSL, STMP, FTP, MDNS(Bonjour), and 802.1x (EAP)
Security Access	Password protected
Software Interface	Web browser view and setup, up to 16 cameras
Connectors	RJ-45 for 100Base-TX, Auto MDI/MDI-X
Cable	Cat5 cable or better for 100Base-TX
Input Voltage	24 VAC or PoE (IEEE802.3af class 3)
Power Consumption	6 W
Current Consumption	PoE <200 mA maximum 24 VAC <295 mA nominal; <390 mA maximum
Alarm Input	10 VDC maximum, 5 mA maximum
Alarm Output	0 to 15 VDC maximum, 75 mA maximum
Lens Mount	CS mount, adjustable
Pan/Tilt Adjustment	Pan 368° Tilt 160° (10° to 170°) Rotate 355°

16. Accessories
    a. Pendant mount
    b. Wall mount for pendant
    c. Corner adapter for wall mount
17. Recommended Lenses
    a. Megapixel lens, varifocal, 2.2~6.0 mm, f/1.3~2.0
    b. Megapixel lens, varifocal, 2.8~8.0 mm,f/1.1~1.9
    c. Megapixel lens, varifocal, 2.8~12.0 mm, f/1.4~2.7
    d. Megapixel lens, varifocal, 15.0~50.0 mm, f/1.5~2.1

G. CAMERA HOUSINGS AND MOUNTS
1. This section pertains to all interior housings, domes, and applicable wall, ceiling, and cornermounts associated with the housing. Housings and mounts shall be specified in accordance to the type of cameras used.
2. All cameras and lenses shall be enclosed in a tamper resistant housing. Any additional mounting hardware required to install the camera housing at its specified location shall be provided along with the housing.
3. The camera and lens contained inside the housing shall be installed on a camera mount. All additional mounting hardware required to install the camera housing at its specified location shall be provided along with the housing.

4. Shall be manufactured in a manner that are capable of supporting a maximum of three (3) cameras with housings, and meet environmental requirements for the geographical area the camera support equipment is being installed on or within.
5. Environmentally Sealed
    a. Shall be designed in manner that it provides a condensation free environment for correct camera operation.
    b. Shall be operated in a 100 percent condensing humidity atmosphere.
6. All electrical and signal cables required for correct operations shall be supplied in a hardened carrier system from the controller to the camera.
7. The mounting bracket shall be adjustable to allow for the housing weight of the camera and the housing unit it is placed in.
8. Accessibility to the camera and mounts shall be taken into consideration for maintenance and service purposes.

H. Indoor Mounts
1. Ceiling Mounts:
    a. This enclosure and mount shall be installed in a finished or suspended ceiling.
    b. The enclosure and mount shall be fastened to the finished ceiling, and shall not depend on the ceiling tile grid for complete support.
    c. Suspended ceiling mounts shall be low profile, and shall be suitable for replacement of 610mm x 610mm (2 foot by 2 foot) ceiling tiles.
2. Wall Mounts:
    a. The enclosure shall be installed in manner that it matches the existing décor and placed at a height that it will be unobtrusive, unable to cause personal harm, and prevents tampering and vandalism.
    b. The mount shall contain a manual pan/tilt head that will provide 360 degrees of horizontal and vertical positioning from a horizontal position, and has a locking bar or screw to maintain its fixed position once it has been adjusted.

I. Interior Domes
1. The interior dome shall be a pendant mount, pole mount, ceiling mount, surface mount, or corner mounted equipment.
2. The lower portion of the dome that provides camera viewing shall be made of black opaque acrylic and shall have a light attenuation factor of no more that 1 f-stop.

2.4 WIRES AND CABLES

A. Shall meet or exceed the manufactures recommendation for power and signal.

B. Will be carried in an enclosed conduit system, utilizing electromagnetic tubing (EMT) to include the equivalent in rigid galvanized steel (RGS) or 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 40 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. 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.

J. 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.

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 extension and modification to the existing 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. 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 extension an d modification to the existing system.

C. The extension and modification to the existing SSTVSystem will be designed, engineered, installed, and tested to ensure all components are fully compatible.

D. 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.

E. The complete extension to the existing SSTV System shall be comprised of, but not limited to, the following components:
   1. Cameras
   2. Lenses
   3. Camera Housings and Mounts
   4. Wiring and Cables

F. 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.

G. 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 SSTV 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.

H. 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.

I. 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.

J. 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.

K. 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

L. 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.

3.3 SYSTEM START-UP

A. The Contractor shall not apply power to the SSTV System until the following items have been completed:
1. SSTV System equipment items and have been set up in accordance with manufacturer's instructions.
2. A visual inspection of the SSTV 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.

B. 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.

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 SUPLEMENTAL CONTRACTOR QUIALITY CONTROL

A. The Contractor shall provide the services of technical representatives who are familiar with all components and installation procedures of the installed SSTVSystem; 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 fourhours 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”.

END OF SECTION

SECTION 28 31 00
FIRE DETECTION AND ALARM

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section of the specifications includes the furnishing, installation, and connection of the fire alarm equipment to form a complete coordinated extension to the existing system ready for operation. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, control units, fire safety control devices, annunciators, power supplies, and wiring as shown on the drawings and specified. The fire alarm system shall not be combined with other systems such as building automation, energy management, security, etc.

B. Fire alarm systems shall comply with requirements of the most recent VA FIRE PROTECTION DESIGN MANUAL and NFPA 72 unless variations to NFPA 72 are specifically identified within these contract documents by the following notation: "variation". The design, system layout, document submittal preparation, and supervision of installation and testing shall be provided by a technician that is certified NICET level III or a registered fire protection engineer. The NICET certified technician shall be on site for the supervision and testing of the system. Factory engineers from the equipment manufacturer, thoroughly familiar and knowledgeable with all equipment utilized, shall provide additional technical support at the site as required by the COR or his authorized representative. Installers shall have a minimum of 2 years experience installing fire alarm systems.

1.2 SCOPE

A. An extension to the existing fully addressable fire alarm system shall be designed and installed in accordance with the specifications and drawings. Device location and wiring runs shown on the drawings are for reference only unless specifically dimensioned. Actual locations shall be in accordance with NFPA 72 and this specification.

B. All existing fire alarm equipment, wiring, devices and sub-systems that are not shown to be reused shall be removed. All existing fire alarm conduit not reused shall be removed.

C. Existing fire alarm bells, chimes, door holders, 120VAC duct smoke detectors, valve tamper switches and waterflow/pressure switches may be reused only as specifically indicated on the drawings and provided the equipment:
   1. Meets this specification section
   2. Is UL listed or FM approved
   3. Is compatible with new equipment being installed
   4. Is verified as operable through contractor testing and inspection
   5. Is warranted as new by the contractor.

D. Existing 120 VAC duct smoke detectors, waterflow/pressure switches, and valve tamper switches reused by the Contractor shall be equipped with an addressable interface device compatible with the new equipment being installed.

E. Existing reused equipment shall be covered as new equipment under the Warranty specified herein.

F. Basic Performance:
   1. Alarm and trouble signals from each building fire alarm control panel shall be digitally encoded by UL listed electronic devices onto the existing multiplexed communication system.

1.3 RELATED WORK

A. 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 28 05 00 – COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY. Requirements for general requirements that are common to more than one section in Division 28.

D. Section 28 05 13 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for conductors and cables.

E. Section 28 05 26 - GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY. Requirements for grounding of equipment.

F. Section 28 05 28.33 - CONDUITS AND BACKBOXES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for infrastructure.

G. Section 28 05 13 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for conductors and cables.

H. Section 28 08 00, COMMISIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS. Requirements for commissioning - systems readiness checklists, and training.

I. Section 28 13 00, PHYSICAL ACCESS CONTROL SYSTEMS (PACS). Requirements for integration with physical access control system.

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 Technical 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, the number, size and type of riser raceways and conductors in each riser raceway and number of each type device per floor and zone. Show door holder interface, elevator control interface, HVAC shutdown interface, fire extinguishing system interface, and all other fire safety interfaces. Show wiring Styles on the riser diagram for all circuits. Provide diagrams both on a per building and campus wide basis.
4. Detailed wiring diagrams: Provide for control panels, modules, power supplies, electrical power connections, auxiliary relays and annunciators showing termination identifications, size and type conductors, circuit boards, LED lamps, indicators, adjustable controls, switches, ribbon connectors, wiring harnesses, terminal strips and connectors, spare zones/circuits. Diagrams shall be drawn to a scale sufficient to show spatial relationships between components, enclosures and equipment configuration.
5. Two weeks prior to final inspection, the Contractor shall deliver to the COR 3 sets of as-built drawings and one set of the as-built drawing computer files in AutoCAD 2014 or later. As-built drawings (floor plans) shall show all new and/or existing conduit used for the fire alarm system.

C. Certifications:

1. Together with the shop drawing submittal, submit the technician's NICET level III fire alarm certification as well as certification from the control unit manufacturer that the proposed performer of contract maintenance is an authorized representative of the major equipment manufacturer. Include in the certification the names and addresses of the proposed supervisor of installation and the proposed performer of contract maintenance. Also include the name and title of the manufacturer's representative who makes the certification.
2. Together with the shop drawing submittal, submit a certification from either the control unit manufacturer or the manufacturer of each component (e.g., smoke detector) that the components being furnished are compatible with the control unit.
3. Together with the shop drawing submittal, submit a certification from the major equipment manufacturer that the wiring and connection diagrams meet this specification, UL and NFPA 72 requirements.

1.5 WARRANTY

A. All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of one year from the date of acceptance of the entire installation by the Contracting Officer.

1.6 APPLICABLE PUBLICATIONS

A. The publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. The publications are referenced in text by the basic designation only and the latest editions of these publications shall be applicable.

B. National Fire Protection Association (NFPA):

NFPA 13	Standard for the Installation of Sprinkler Systems, 2010 edition
NFPA 14	Standard for the Installation of Standpipes and Hose Systems, 2010 edition
NFPA 20	Standard for the Installation of Stationary Pumps for Fire Protection, 2010 edition
NFPA 70	National Electrical Code (NEC), 2010 edition
NFPA 72	National Fire Alarm Code, 2010 edition
NFPA 90A	Standard for the Installation of Air Conditioning and Ventilating Systems, 2009 edition
NFPA 101	Life Safety Code, 2009 edition

C. Underwriters Laboratories, Inc. (UL): Fire Protection Equipment Directory

D. Factory Mutual Research Corp (FM): Approval Guide, 2007-2011

E. American National Standards Institute (ANSI):

S3.41	Audible Emergency Evacuation Signal, 1990 edition, reaffirmed 2008

F. International Code Council, International Building Code (IBC), 2009 edition

PART 2 A- PRODUCTS

2.1 EQUIPMENT AND MATERIALS, GENERAL

A. All equipment and components shall be new and the manufacturer's current model, and shall be compatible with the existing fire alarm system. 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.

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 VOICE COMMUNICATION SYSTEM (VCS)

A. General:
   1. An extension to the existing emergency voice communication system shall be installed throughout.

2.4 ALARM NOTIFICATION APPLIANCES

A. Speakers:
   1. Shall operate on either 25 VRMS or 70.7 VRMS with field selectable output taps from 0.5 to 2.0W and originally installed at the 1/2 watt tap. Speakers shall provide a minimum sound output of 80 dBA at 10 feet (3,000 mm) with the 1/2 watt tap.
   2. Frequency response shall be a minimum of 400 HZ to 4,000 HZ.
   3. Four inches (100 mm) or 8 inches (200 mm) cone type speakers ceiling mounted with white colored baffles in areas with suspended ceilings and wall mounted in areas without ceilings.

B. Strobes:
   1. Xenon flash tube type minimum 15 candela in toilet rooms and 75 candela in all other areas with a flash rate of 1 HZ. Strobes shall be synchronized where required by the National Fire Alarm Code (NFPA 72).
   2. Backplate shall be red with 1/2 inch (13 mm) permanent red letters. Lettering to read "Fire", be oriented on the wall or ceiling properly, and be visible from all viewing directions.
   3. Each strobe circuit shall have a minimum of 20 percent spare capacity.
   4. Strobes may be combined with the audible notification appliances specified herein.

2.5 ALARM INITIATING DEVICES

A. Manual Fire Alarm Stations:
   1. Shall be non-breakglass, address reporting type.

2. Station front shall be constructed of a durable material such as cast or extruded metal or high impact plastic. Stations shall be semi-flush type.
3. Stations shall be of single action pull down type with suitable operating instructions provided on front in raised or depressed letters, and clearly labeled "FIRE."
4. Operating handles shall be constructed of a durable material. On operation, the lever shall lock in alarm position and remain so until reset. A key shall be required to gain front access for resetting, or conducting tests and drills.
5. Unless otherwise specified, all exposed parts shall be red in color and have a smooth, hard, durable finish.

B. Smoke Detectors:
1. Smoke detectors shall be photoelectric type and UL listed for use with the fire alarm control unit being furnished.
2. Smoke detectors shall be addressable type complying with applicable UL Standards for system type detectors. Smoke detectors shall be installed in accordance with the manufacturer's recommendations and NFPA 72.
3. Detectors shall have an indication lamp to denote an alarm condition. Provide remote indicator lamps and identification plates where detectors are concealed from view. Locate the remote indicator lamps and identification plates flush mounted on walls so they can be observed from a normal standing position.
4. All spot type and duct type detectors installed shall be of the photoelectric type.
5. Photoelectric detectors shall be factory calibrated and readily field adjustable. The sensitivity of any photoelectric detector shall be factory set at 3.0 plus or minus 0.25 percent obscuration per foot.
6. Detectors shall provide a visual trouble indication if they drift out of sensitivity range or fail internal diagnostics. Detectors shall also provide visual indication of sensitivity level upon testing. Detectors, along with the fire alarm control units shall be UL listed for testing the sensitivity of the detectors.

C. Water Flow and Pressure Switches:
1. Wet pipe water flow switches and dry pipe alarm pressure switches for sprinkler systems shall be connected to the fire alarm system by way of an address reporting interface device.
2. All new water flow switches shall be of a single manufacturer and series and non-accumulative retard type. /See Section 21 13 13, WET-PIPE SPRINKLER SYSTEMS for new switches added. Connect all switches shown on the approved shop drawings.
3. All new switches shall have an alarm transmission delay time that is conveniently adjustable from 0 to 60 seconds. Initial settings shall be 30-45 seconds. Timing shall be recorded and documented during testing.

D. Extinguishing System Connections:
1. Each gaseous suppression system shall be monitored for system alarm and system trouble conditions via addressable interface devices.

2.6 SUPERVISORY DEVICES

A. Duct Smoke Detectors:
1. Duct smoke detectors shall be provided and connected by way of an address reporting interface device. Detectors shall be provided with an approved duct housing mounted exterior to the duct, and shall have perforated sampling tubes extending across the full width of the duct (wall to wall). Detector placement shall be such that there is uniform airflow in the cross section of the duct.
2. Interlocking with fans shall be provided in accordance with NFPA 90A and as specified hereinafter under Part 3.2, "TYPICAL OPERATION".
3. Provide remote indicator lamps, key test stations and identification nameplates (e.g., "DUCT SMOKE DETECTOR AHU-X") for all duct detectors. Locate key test stations in plain view on walls or ceilings so that they can be observed and operated from a normal standing position.

B. Sprinkler and Standpipe System Supervisory Switches:
   1. Each sprinkler system water supply control valve, riser valve or zone control valve, and each standpipe system riser control valve shall be equipped with a supervisory switch. Standpipe hose valves, and test and drain valves shall not be equipped with supervisory switches.
   2. Valve supervisory switches shall be connected to the fire alarm system by way of address reporting interface device. See Section 21 13 13, WET-PIPE SPRINKLER SYSTEMS for new switches to be added. Connect tamper switches for all control valves shown on the approved shop drawings.
   3. The mechanism shall be contained in a weatherproof die-cast aluminum housing that shall provide a 3/4 inch (19 mm) tapped conduit entrance and incorporate the necessary facilities for attachment to the valves.
   4. The entire installed assembly shall be tamper-proof and arranged to cause a switch operation if the housing cover is removed or if the unit is removed from its mounting.

2.7 ADDRESS REPORTING INTERFACE DEVICE

A. Shall have unique addresses that reports directly to the building fire alarm panel.

B. Shall be configurable to monitor normally open or normally closed devices for both alarm and trouble conditions.

C. Shall have terminal designations clearly differentiating between the circuit to which they are reporting from and the device that they are monitoring.

D. Shall be UL listed for fire alarm use and compatibility with the panel to which they are connected.

E. Shall be mounted in weatherproof housings if mounted exterior to a building.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Installation shall be in accordance with NFPA 70, 72, 90A, and 101 as shown on the drawings, and as recommended by the major equipment manufacturer. Fire alarm wiring shall be installed in conduit. All conduit and wire shall be installed in accordance with, Section 28 05 13 CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY, Section 28 05 26 GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY, Section 28 05 28.33 CONDUIT AND BACKBOXES FOR ELECTRONIC SAFETY AND SECURITY, and all penetrations of smoke and fire barriers shall be protected as required by Section 07 84 00, FIRESTOPPING.

B. All conduits, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas.

C. All new and reused exposed conduits shall be painted in accordance with Section 09 91 00, PAINTING to match surrounding finished areas and red in unfinished areas.

D. All existing accessible fire alarm conduit not reused shall be removed.

E. Existing devices that are reused shall be properly mounted and installed. Where devices are installed on existing shallow backboxes, extension rings of the same material, color and texture of the new fire alarm devices shall be used. Mounting surfaces shall be cut and patched in accordance with Section 01 00 00, GENERAL REQUIREMENTS, Restoration, and be re-painted in accordance with Section 09 91 00, PAINTING as necessary to match existing.

F. All fire detection and alarm system devices, control units and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas. Exact locations are to be approved by the COR.

G. Speakers shall be ceiling mounted and fully recessed in areas with suspended ceilings. Speakers shall be wall mounted and recessed in finished areas without suspended ceilings. Speakers may be surface mounted in unfinished areas.

H. Strobes shall be flush wall mounted with the bottom of the unit located 80 inches (2,000 mm) above the floor or 6 inches (150 mm) below ceiling, whichever is lower. Locate and mount to maintain a minimum 36 inches (900 mm) clearance from side obstructions.

I. Manual pull stations shall be installed not less than 42 inches (1,050 mm) or more than 48 inches (1,200 mm) from finished floor to bottom of device and within 60 inches (1,500 mm) of a stairway or an exit door.

J. Where possible, locate water flow and pressure switches a minimum of 12 inches (300 mm) from a fitting that changes the direction of the flow and a minimum of 36 inches (900 mm) from a valve.

K. Mount valve tamper switches so as not to interfere with the normal operation of the valve and adjust to operate within 2 revolutions toward the closed position of the valve control, or when the stem has moved no more than 1/5 of the distance from its normal position.

L. Connect flow and tamper switches installed under Section 21 13 13, WET-PIPE SPRINKLER SYSTEMS.

3.2 TYPICAL OPERATION

A. The existing sequence of operation shall be maintained.

3.3 TESTS

A. Provide the service of a NICET level III, competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment to technically supervise and participate during all of the adjustments and tests for the system. Make all adjustments and tests in the presence of the COR.

B. When the systems have been completed and prior to the scheduling of the final inspection, furnish testing equipment and perform the following tests in the presence of the COR. When any defects are detected, make repairs or install replacement components, and repeat the tests until such time that the complete fire alarm systems meets all contract requirements. After the system has passed the initial test and been approved by the COR, the contractor may request a final inspection.

1. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
2. Test the insulation on all installed cable and wiring by standard methods as recommended by the equipment manufacturer.
3. Run water through all flow switches. Check time delay on water flow switches. Submit a report listing all water flow switch operations and their retard time in seconds.
4. Open each alarm initiating and notification circuit to see if trouble signal actuates.
5. Ground each alarm initiation and notification circuit and verify response of trouble signals.

3.4 FINAL INSPECTION AND ACCEPTANCE

A. Prior to final acceptance a minimum 30 day "burn-in" period shall be provided. The purpose shall be to allow equipment to stabilize and potential installation and software problems and equipment malfunctions to be identified and corrected. During this diagnostic period, all system operations and malfunctions shall be recorded. Final acceptance will be made upon successful completion of the "burn-in" period and where the last 14 days is without a system or equipment malfunction.

B. At the final inspection a factory trained representative of the manufacturer of the major equipment shall repeat the tests in Article 3.3 TESTS and those required by NFPA 72. In addition the representative shall demonstrate that the systems function properly in every respect. The demonstration shall be made in the presence of a VA representative.

END OF SECTION