

ANDERSON

BLACK HILLS NATIONAL CEMETERY RENOVATE AND EXPAND THE ADMINISTRATION AND MAINTENANCE BUILDINGS | BID DOCUMENTS

Black Hill National Cemetery—20901 Pleasant Valley Drive
Sturgis, SD 57785
Project #884CM3015

SPECIFICATION

AE COMM. #16409
October, 29th 2022

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VA



U.S. Department
of Veterans Affairs



**DEPARTMENT OF VETERANS AFFAIRS
 NCA MASTER SPECIFICATIONS**

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Black Hills National Cemetery

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Renovate and Expand Administration and Maintenance Buildings

10/07/22

20901 Pleasant Valley Drive

CD2 Submittal

Sturgis, SD 57785

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**SECTION 01 00 02
GENERAL REQUIREMENTS (MINOR NCA PROJECTS)**

1.1 GENERAL INTENTION

Any mention of Resident Engineer (RE) or Senior Resident Engineer (SRE) in any specification or contract document is equivalent to Project Manager (PM) and/or Contracting Officer Representative (COR).

- A. Contractor shall completely prepare site for building operations, including demolition and removal of portions of existing structures, and furnish labor, materials, equipment and services and perform and complete all work for Renovation and Expansion of Administration Building #1001 and Maintenance Buildings #3001, Lighting and Technology/hardware upgrades to Maintenance Building #3002 and associated work along with providing temporary facilities for the Administration Building and the Maintenance building during construction. Additional miscellaneous exterior work includes service seals at the committal shelter, storm sewer repairs, sidewalk and landscaping. All work as required by drawings and specifications.
- B. One pre-bid on-site walk through will take place. All questions from the walk through will be submitted in a form of an RFI electronically and answered as such.
- C. Offices of Anderson Engineering of MN as Architect-Engineers (A/E), may 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 Project Manger (PM) or his duly authorized representative.
- D. All Testing Laboratory services will be retained and paid for by the Contractor (see Spec Section 01 45 29, Testing Laboratory Services). However, the Department of Veterans Affairs may elect to retain its own Testing Laboratory for any purpose. Before placement and installation of work subject to tests by testing laboratory retained by Department of Veterans Affairs, the Contractor shall notify the PM 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 work-days unless otherwise designated by the PM.

- E. All employees of general contractor and subcontractors shall comply with security requirements as established by the PM, be identified by name and employer. They shall be restricted from unauthorized access.
- F. Prior to commencing work, general contractor shall provide proof that a OSHA certified "competent person" (CP) (29 CFR 1926.20(b)(2)) will maintain a presence at the work site whenever the general or subcontractors are present.
- G. Training:
 - 1. All employees of general contractor or subcontractors shall, at the minimum, have successfully completed the 10-hour OSHA certified Construction Safety course and/or other relevant competency training, as determined by VA CP.
 - 2. Submit OSHA training records of all employees for approval before the start of work.

1.2 STATEMENT OF BID ITEM(S)

- A. ITEM I, GENERAL CONSTRUCTION: Installation of all work shown on the plans and described in the specifications including but not limited to: Renovation and Expansion of Admin Building #1001 and Maintenance Building #3001, repairs and modifications to the Committal Shelter, lighting upgrades to Maintenance Building #3002, security upgrades to the campus, stone masonry work, miscellaneous exterior work, and associated work with providing temporary facilities for the Administration Building #1001 and portion of Maintenance Building #3001 during construction.

1.3 SPECIFICATIONS AND DRAWINGS FOR CONTRACTOR

- A. AFTER AWARD OF CONTRACT, NCA will provide electronic copies of the specification and contract drawings.
- B. Hard copies of the drawings and specifications may be made by the Contractor, at Contractor's expense.

1.4 CONSTRUCTION SECURITY REQUIREMENTS

- A. Security Plan:

1. The security plan defines both physical and administrative security procedures that will remain effective for the entire duration of the project.
2. The General Contractor is responsible for assuring that all sub-contractors working on the project and their employees also comply with these regulations.

B. Security Procedures:

1. General Contractor's employees shall not enter the site without following the procedures approved by the PM. They may also be subject to inspection of their personal effects when entering or leaving the project site.
2. For working outside the "regular hours" as defined in the contract, The General Contractor shall give 3 days' notice to the RE/COTR so that appropriate arrangements can be provided for the Cemetery 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 RE/COTR.
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 PM.

D. Key Control:

1. The General Contractor shall provide duplicate keys and lock combinations to the PM for the purpose of security inspections of every area of project including tool boxes and parked machines, etc., and to take any necessary emergency action.

E. Document Control:

1. Before starting any work, the General Contractor/Sub Contractors shall submit an electronic security memorandum describing the approach to following goals and maintaining confidentiality of "sensitive information".
2. The General Contractor is responsible for safekeeping of all drawings, project manual and other project information. This

information shall be shared only with those with a specific need to accomplish the project.

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 RE/COTR upon request.
4. These security documents shall not be removed or transmitted from the project site without the written approval of PM.
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 PM immediately when there is a loss or compromise of "sensitive information".
7. All electronic information shall be stored in a specified location following VA standards and procedures using an Engineering Document Management Software (EDMS).
 - a. Security, access, and maintenance of all project drawings, both scanned and electronic shall be performed and tracked through the EDMS system.
 - b. "Sensitive information" including drawings and other documents may be attached to e-mail provided all VA encryption procedures are followed.

F. Motor Vehicle Restrictions

1. Vehicle authorization request shall be required for any vehicle entering the site and such request shall be submitted 24 hours before the date and time of access. Access shall be restricted to picking up and dropping off materials and supplies.

1.5 FIRE SAFETY

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

1. American Society for Testing and Materials (ASTM):
 - E84-2009a Surface Burning Characteristics of Building Materials
 2. National Fire Protection Association (NFPA):
 - 10-2010 Standard for Portable Fire Extinguishers
 - 30-2008 Flammable and Combustible Liquids Code
 - 51B-2009 Standard for Fire Prevention During Welding, Cutting and Other Hot Work
 - 70-2008 National Electrical Code
 - 241-2009 Standard for Safeguarding Construction, Alteration, and Demolition Operations
 3. Occupational Safety and Health Administration (OSHA):
 - 29 CFR 1926 Safety and Health Regulations for Construction
- B. Fire Safety Plan: Establish and maintain a fire protection program in accordance with 29 CFR 1926. Prior to start of work, prepare a plan detailing project-specific fire safety measures, including periodic status reports, and submit to PM and Cemetery Director for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES. Prior to any worker for the contractor or subcontractor's beginning work, they shall undergo a safety briefing provided by the General Contractor's competent person per OSHA requirements. This briefing shall include information on the construction limits, safety guidelines, means of egress, break areas, work hours, locations of restrooms, use of NCA equipment, etc. Documentation shall be provided to the PM that individuals have undergone the Contractor's safety briefing.
- C. Site and Building Access: Maintain free and unobstructed access to emergency services and for fire, police, and other emergency response forces in accordance with NFPA 241.
- D. Separate temporary facilities, such as trailers, storage sheds, and dumpsters, from existing buildings and new construction by distances in accordance with NFPA 241. For small facilities with less than 6 m (20 feet) exposing overall length, separate by 3m (10 feet).
- E. Temporary Construction Partitions:

1. Temporary Facilities will be provided for the Black Hills NC administration and maintenance staff, separate from building construction/renovation areas. Temporary construction partitions to provide smoke-tight separations between construction areas and NC staff areas will not be required as they will not be adjoining.
 2. 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; The Admin Building and Maintenance Building will not be occupied by staff during construction.
- H. Egress Routes for Construction Workers: Maintain free and unobstructed egress. Inspect daily. Report findings and corrective actions weekly to PM.
- 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. 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. Request interruptions in accordance with Article, OPERATIONS AND STORAGE AREAS, and coordinate with PM. All existing or temporary fire protection systems (fire alarms) located in construction areas shall be tested as coordinated with the Cemetery. Parameters for the testing and results of any tests performed shall be recorded by the Cemetery and copies provided to the PM.
- L. Smoke Detectors: Prevent accidental operation. Remove temporary covers at end of work operations each day. Coordinate with PM.
- M. Hot Work: Perform and safeguard hot work operations in accordance with NFPA 241 and NFPA 51B. Coordinate with PM.

- N. Fire Hazard Prevention and Safety Inspections: Inspect entire construction areas weekly. Coordinate with, and report findings and corrective actions weekly to PM.
- O. 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.
- P. Dispose of waste and debris in accordance with NFPA 241. Remove from buildings daily and site weekly.
- Q. Perform other construction, alteration, and demolition operations in accordance with 29 CFR 1926.

1.6 OPERATIONS AND STORAGE AREAS

- A. The Contractor shall confine all operations (including storage of materials) on Government premises to areas authorized or approved by the PM. 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 trailers, office trailers) and utilities may be erected by the Contractor only with the approval of the PM 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.
- C. The Contractor shall, under regulations prescribed by the PM, use only established roadways, or use temporary roadways constructed by the Contractor when and as authorized by the PM. When materials are transported in prosecuting the work, vehicles shall not be loaded beyond the loading capacity recommended by the manufacturer of the vehicle or prescribed by any Federal, State, or local law or regulation. When it is necessary to cross curbs or sidewalks, the Contractor shall protect them from damage. The Contractor shall repair or pay for the repair of any damaged curbs, sidewalks, or roads.
- D. Working space and space available for storing materials shall be as shown on the drawings. Contractor parking will be only in areas and on roadways designated and agreed to by the PM in agreement of the Cemetery.

- E. Workmen are subject to rules of the Cemetery applicable to their conduct.
- F. Execute work so as to interfere as little as possible with normal functioning of Cemetery as a whole, including operations of utility services, fire protection systems and any existing equipment, and with work being done by others.
 - 1. Do not store materials and equipment in other than assigned areas.
 - 3. Access by Cemetery personnel to vacated portions of buildings is not required. Storage of Contractor's materials and equipment will be permitted subject to fire and safety requirements.
- G. Phasing: To ensure such executions, the Contractor shall furnish the PM 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, the Contractor shall notify the PM two weeks in advance of the proposed date of starting work in each specific area of site, building or portion thereof. Arrange such phasing dates to ensure accomplishment of this work in successive phases mutually agreeable to the Cemetery Director, PM and Contractor, as follows:

There is no order that construction must be completed. See the items below for work restrictions.

Item I: Complete the drainage work in the maintenance yard prior to installation of temporary trailer for maintenance work.

Item II: Install temporary trailers prior to any building remodel work. Temporary trailers must be fully functional and approved by NCA prior to shifting personnel. Notify cemetery 14 days in advance of move.

Item III: Contractor can choose how they sequence building remodels as necessary. Work can be performed simultaneously or individually.

Item IV: Work on the existing committal shelter seals must take place on the weekend or during hours outside of cemetery operations.

Contractor to get approval on work schedule from NCA/RE prior to starting work in committal shelter.

- H. Building(s) 1001 and 3001 will not be occupied by cemetery personnel during performance of work . Work can be done simultaneously in both buildings or staggered as the contractor sees fit.
- I. Construction Fence: Before construction operations begin, the Contractor shall provide a chain link construction fence, 2.1m (seven feet) minimum height, around the construction area indicated on the drawings. Provide gates as required for access with necessary hardware, including hasps and padlocks. Fasten fence fabric to terminal posts with tension bands and to line posts and top and bottom rails with tie wires spaced at maximum 375mm (15 inches). Bottom of fences shall extend to 25mm (one inch) above grade. The temporary fencing shall encompass the construction work area(s) to serve as a pedestrian barrier to alert cemetery patrons of the construction site. Remove the fence when directed by PM.
- J. When a building is turned over to Contractor, Contractor shall accept entire responsibility, therefore.
1. The Contractor shall maintain a minimum temperature of 4 degrees C (40 degrees F) at all times, except as otherwise specified.
 2. The Contractor shall maintain in operating condition existing fire protection and alarm equipment. In connection with fire alarm equipment, the Contractor shall make arrangements for pre-inspection of the site with Fire Department or Company (Department of Veterans Affairs or municipal) whichever will be required to respond to an alarm from the Contractor's employee.
- K. Utilities Services: Maintain existing utility services for the Cemetery at all times. Provide temporary facilities, labor, materials, equipment, connections, and utilities to assure uninterrupted services. Where necessary to cut existing water, 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 PM. All such actions shall be coordinated with the Utility Company involved.

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 PM. Electrical work shall be accomplished with all affected circuits or equipment de-energized. When an electrical outage cannot be accomplished, work on any energized circuits or equipment shall not commence without the PM, and Cemetery Director's prior knowledge and written approval.
 2. The Contractor shall submit a request to interrupt any such services to both PM and the Cemetery Director in writing, 48 hours in advance of proposed interruption. Request shall state reason, date, exact time of, and approximate duration of such interruption.
 3. The Contractor will be advised (in writing) of approval of request, or of which other date and/or time such interruption will cause least inconvenience to operations of the Cemetery. Interruption time approved by the Cemetery and PM 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 PM.
 5. In case of a contract construction emergency, service will be interrupted on approval of PM. Such approval will be confirmed in writing as soon as practical.
 6. Whenever it is required that a connection fee be paid to a public utility provider for new permanent service to the construction project, for such items as water, sewer, electricity, gas or steam, payment of such fee shall be the responsibility of the Government and not the Contractor.
- L. Abandoned Lines: All service lines such as wires, cables, conduits, ducts, pipes and the like, and their hangers or supports, which are to be abandoned but are not required to be entirely removed, shall be sealed, capped or plugged. The lines shall not be capped in finished areas, but shall be removed and sealed, capped or plugged in ceilings,

within furred spaces, in unfinished areas, or within walls or partitions; so that they are completely behind the finished surfaces.

- M. To minimize interference of construction activities with flow of Cemetery traffic, comply with the following:
 - 1. Keep roads, walks and entrances to grounds, to parking and to occupied areas of buildings clear of construction materials, debris and standing construction equipment and vehicles. Wherever excavation for new utility lines cross existing roads, at least one lane must be open to traffic at all times.
 - 2. Method and scheduling of required cutting, altering and removal of existing roads, walks and entrances must be approved by the PM.
- N. Coordinate the work for this contract with other construction operations as directed by PM. This includes the scheduling of traffic and the use of roadways, as specified in Article, USE OF ROADWAYS.
- O. Coordination of Construction with Cemetery Director: The burial activities at a National Cemetery shall take precedence over construction activities. The Contractor must cooperate and coordinate with the Cemetery Director, through the PM, in arranging construction schedule to cause the least possible interference with Cemetery activities in actual burial areas. Construction noise during the committal services shall not disturb the service. Trucks and workmen shall not pass through the service area during this period.
 - 1. The Contractor is required to discontinue his work sufficiently in advance of Easter Sunday, Mother's Day, Father's Day, Memorial Day, Veteran's Day and/or Federal holidays, to permit him to clean up all areas of operation adjacent to existing burial plots before these dates.
 - 2. Cleaning up shall include the removal of all equipment, tools, materials and debris and leaving the areas in a clean, neat condition.

1.7 ALTERATIONS

- A. Survey: Before any work is started, the Contractor shall make a thorough survey with the PM of buildings, and furnish a signed report, 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.

2. Existence and conditions of items 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 PM.
- 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 PM, to be in such condition that their use is impossible or impractical, shall be furnished and/or replaced by the Contractor with new items in accordance with specifications which will be furnished by the Government. Provided the contract work is changed by reason of this subparagraph B, the contract will be modified accordingly, under provisions of clause entitled "DIFFERING SITE CONDITIONS" (FAR 52.236-2) and "CHANGES" (FAR 52.243-4 and VAAR 852.236-88).
- C. Re-Survey: Thirty days before expected partial or final inspection date, the Contractor and PM 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 the Contractor to such flooring and other surfaces, despite protection measures; and, will form the basis for determining extent of repair work required of the Contractor to restore damage caused by the Contractor's workmen in executing work of this contract.
- D. Protection: Provide the following protective measures:
1. Wherever existing roof surfaces are disturbed they shall be protected against water infiltration. In case of leaks, they shall be repaired immediately upon discovery.
 2. Temporary protection against damage for portions of existing structures and grounds where work is to be done, materials handled and equipment moved and/or relocated.
 3. Protect the interior of existing structures at all times, from damage, dust and weather inclemency. Wherever work is performed, 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 ENVIRONMENTAL CONTROLS

- A. In general, following preventive measures shall be adopted during construction to keep down dust and prevent mold.
 - 1. Dampen debris to keep down dust and provide temporary construction partitions in existing structures where directed by PM. Block off ducts and diffusers to prevent circulation of dust into occupied areas during construction.
- B. Vacuum and wet mop all transition areas from construction to the occupied Cemetery buildings at the end of each workday.
- C. Final Cleanup:
 - 1. Upon completion of the project, or as work progresses, remove all construction debris from above ceiling, vertical shafts and utility chases that have been part of the construction.
 - 2. All air ducts shall be cleaned prior to final inspection.

1.9 DISPOSAL AND RETENTION

- A. Materials and equipment accruing from work removed and from demolition of buildings or structures, or parts thereof, shall be disposed of as follows:
 - 1. Reserved items which are to remain property of the Government are 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 PM.
 - 2. Items not reserved shall become property of the Contractor and be removed by Contractor from the Cemetery.
 - 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: The Contractor shall be responsible for disposal of the Polychlorinated Biphenyl (PCB) transformers. The transformers 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 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 RE/COTR who will annotate the contract file and transmit the Manifest to the Cemetery's Director.

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 CFR 173 | Subpart A General |
| 49 CFR 173 | Subpart B Preparation of Hazardous Material for Transportation |
| 49 CFR 173 | Subpart J Other Regulated Material; Definitions and Preparation |
| TSCA | Compliance Program Policy Nos. 6-PCB-6 and 6-PCB-7 |

1.10 PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES, AND IMPROVEMENTS

A. The Contractor shall preserve and protect all structures, equipment, and vegetation (such as trees, shrubs, and grass) on or adjacent to the

work site, which are not to be removed and which do not unreasonably interfere with the work required under this contract. The Contractor shall only remove trees when specifically authorized to do so, and shall avoid damaging vegetation that will remain in place. If any limbs or branches of trees are broken during contract performance, or by the careless operation of equipment, or by workmen, the Contractor shall trim those limbs or branches with a clean cut and paint the cut with a tree-pruning compound as directed by the PM.

- 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 PM 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 NCA Central/Cemetery) office. The 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; and
5. Providing adequately maintained sanitary facilities.

1.11 RESTORATION

- A. Remove, cut, alter, replace, patch and repair existing work as necessary to install new work. Except as otherwise shown or specified, do not cut, alter or remove any structural work, and do not disturb any ducts, plumbing, steam, gas, water/irrigation or electric work without approval of the PM. Existing work to be altered or extended and that is found to be defective in any way, shall be reported to the PM 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, landscape stone, 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 the Contractor's own expense, the Contractor shall immediately restore to service and repair any damage caused by the Contractor's workmen to existing piping and conduits, wires, cables, etc., of utility services, fire protection systems, communications systems (including telephone), irrigation system control and power, which are indicated on drawings and which are not scheduled for discontinuance or abandonment.
- D. Expense of repairs to such utilities and systems not shown on drawings or locations of which are unknown will be covered by adjustment to contract time and price in accordance with clause entitled "CHANGES"

(FAR 52.243-4 and VAAR 852.236-88) and "DIFFERING SITE CONDITIONS" (FAR 52.236-2).

1.12 PHYSICAL DATA

- A. Data and information furnished or referred to below is for the Contractor's information. The Government shall not be responsible for any interpretation of or conclusion drawn from the data or information by the Contractor.
 - 1. The indications of physical conditions on the drawings and in the specifications are the result of site investigations by the NCA.
- B. Subsurface conditions have been developed by core borings and test pits. Logs of subsurface exploration conducted by American Engineering Testing are found in the geotechnical report.
- C. A copy of the geotechnical investigation report is an Appendix to these specifications and shall be considered part of the contract documents.
- D. The Government does not guarantee that other materials will not be encountered nor that proportions, conditions or character of several materials will not vary from those indicated by explorations. Bidders are expected to examine the site of work and logs of borings and, after investigation, decide for themselves the character of materials and make their bids accordingly. Upon proper application to the Department of Veterans Affairs, including approved scheduling bidders will be permitted to make subsurface explorations of their own at site.

1.13 PROFESSIONAL SURVEYING SERVICES

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

1.14 LAYOUT OF WORK

- A. The Contractor shall 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 the 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 PM. The Contractor shall also be responsible for maintaining and preserving all stakes and other marks established by the PM until authorized to remove them. If such marks are destroyed by the Contractor or through Contractor's negligence before their removal is authorized, the PM may replace them and deduct the expense of the replacement from any amounts due or to become due to the Contractor.

- B. Establish and plainly mark center lines for each building and/or addition to each existing building, lines for each gravesite control monument, and such other lines and grades that are reasonably necessary to properly assure that location, orientation, and elevations established for each such structure and/or addition, roads, parking lots, gravesite control monuments, are in accordance with lines and elevations shown on contract drawings.
- C. Following completion of general mass excavation and before any other permanent work is performed, establish and plainly mark (through use of appropriate batter boards or other means) sufficient additional survey control points or system of points as may be necessary to assure proper alignment, orientation, and grade of all major features of work. The 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 PM before any work (such as footings, floor slabs, columns, walls, utilities and other major controlling features) is placed.
- D. During progress of work, the Contractor shall have lines, grades, locations and plumbness of all major form work checked and certified by a registered land surveyor or registered civil engineer as meeting requirements of contract drawings. Furnish such certification to the PM before any major items of concrete work are placed. In addition, furnish to the PM certificates from a registered land surveyor or registered civil engineer that the following work is complete in every respect as required by contract drawings.

1. Lines of each building and/or addition.
 2. Elevations of bottoms of footings and tops of floors of each building and/or addition.
 3. Lines and elevations of sewers and of all outside distribution systems.
 6. Lines and elevations of roads, streets and parking lots.
 9. Northing/Easting coordinate locations and elevation depth below finished grade of all water, sanitary, storm, gas and irrigation structures, directional fittings, control wire and lines.
- E. Upon completion of the work, the Contractor shall furnish the PM with reproducible drawings, in AutoCAD form, at the scale of the contract drawings, showing the finished grade on the grid developed for constructing the work. These drawings shall bear the seal of the registered land surveyor or registered civil engineer.
- F. The Contractor shall perform the surveying and layout work of this and other articles and specifications in accordance with the provisions of Article "Professional Surveying Services".

1.15 AS-BUILT DRAWINGS

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

1.16 USE OF ROADWAYS

- A. For hauling, use only established public roads and designated permanent roads on Cemetery property. Temporary roads shall be constructed by the Contractor at the Contractor's expense following approved plans that include: construction, operation, maintenance and restoration. When necessary to cross curbing, sidewalks, or similar construction, they must be protected by well-constructed bridges.

1.17 PM'S FIELD OFFICE

- A. There will be no PM field office.

1.18 TEMPORARY USE OF MECHANICAL AND ELECTRICAL EQUIPMENT

- A. Use of new installed mechanical and electrical equipment to provide heat, ventilation, plumbing, light and power will be permitted subject to compliance with the following provisions:
1. Permission to use each unit or system must be given by PM. If the equipment is not installed and maintained in accordance with the following provisions, the PM 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, and their overload elements shall be properly sized, coordinated and adjusted. Voltage supplied to each item of equipment shall be verified to be correct and it shall be determined that motors are not overloaded. The electrical equipment shall be thoroughly cleaned before using it and again immediately before final inspection including vacuum cleaning and wiping clean interior and exterior surfaces.
 3. Units shall be properly lubricated, balanced, and aligned. Vibrations must be eliminated.
 4. Automatic temperature control systems for preheat coils shall function properly and all safety controls shall function to prevent coil freeze-up damage.
 5. The air filtering system utilized shall be that which is designed for the system when complete, and all filter elements shall be replaced at completion of construction and prior to testing and balancing of system.
 6. All components of heat production and distribution system, metering equipment, condensate returns, and other auxiliary facilities used in temporary service shall be cleaned prior to use; maintained to prevent corrosion internally and externally during use; and cleaned, maintained and inspected prior to acceptance by the Government.
- B. Prior to final inspection, the equipment or parts used which show wear and tear beyond normal, shall be replaced with identical replacements, at no additional cost to the Government.
- C. This paragraph shall not reduce the requirements of the mechanical and electrical specifications sections.

1.19 TEMPORARY TOILETS

- A. Provide where directed, (for use of all Contractor's workers) ample temporary sanitary toilet accommodations with suitable sewer and water connections, or when approved by PM provide suitable dry closets where directed. Keep such places clean and free from flies, and all connections and appliances connected therewith are to be removed prior to completion of contract, and premises left perfectly clean.

1.20 AVAILABILITY AND USE OF UTILITY SERVICES

- A. The Government shall make all reasonably required amounts of utilities available to the Contractor from existing outlets and supplies, as specified in the contract. The amount to be paid by the Contractor for chargeable electrical services shall be the prevailing rates charged to the Government. The Contractor shall carefully conserve any utilities furnished without charge.
- B. The Contractor, at Contractor's expense and in a workmanlike manner satisfactory to the PM, shall install and maintain all necessary temporary connections and distribution lines, and all meters required to measure the amount of electricity used for the purpose of determining charges. Before final acceptance of the work by the Government, the Contractor shall remove all the temporary connections, distribution lines, meters, and associated paraphernalia.
- C. The Contractor shall install meters at the Contractor's expense and furnish the Cemetery a monthly record of the Contractor's usage of electricity and other utilities as hereinafter specified. Contractor is responsible for the utility bill generated from their work.
- D. Heat: Furnish temporary heat necessary to prevent injury to work and materials through dampness and cold. Use of open salamanders or any temporary heating devices which may be fire hazards or may smoke and damage finished work, will not be permitted. Maintain minimum temperatures as specified for various materials:
- E. Electricity (for Construction and Testing): Furnish all temporary electric services.
 - 1. Obtain electricity by connecting to the Cemetery electrical distribution system. The Contractor shall meter and pay for electricity required for electric cranes and hoisting devices, electrical welding devices and any electrical heating devices providing temporary heat. Where not available or not convenient to

connect to the Cemetery distribution system, the contractor shall supply power via portable generators at own expense. Generators shall be acoustically screened so as not to disturb committal services and/or visitation to the adjacent columbarium.

- F. Water (for Construction and Testing): Furnish temporary water service.
1. Obtain water by connecting to the Cemetery irrigation distribution system. Backflow preventer may not be required at connections to the irrigation system. Water is available at no cost to the Contractor.
 2. If potable water is required and convenient connection is available the contractor may connect to the Cemetery potable water distribution system. The contractor shall install reduced pressure backflow preventer at each connection at own expense.
 3. Maintain connections, pipe, fittings and fixtures and conserve water-use so none is wasted. Failure to stop leakage or other wastes will be cause for revocation (at PM's discretion) of use of water from the Cemetery's system.
 4. Where not available or not convenient to connect to the Cemetery distribution system, the Contractor shall supply water via portable/temporary means at his own expense.
- G. Fuel: Natural and LP gas required for burner cleaning, normal initial burner-burner setup and adjusting, and for performing the specified burner tests will be furnished by the Government. Fuel required for prolonged burner setup, adjustments, or modifications due to improper design or operation of burner, or control devices shall be furnished by the Contractor at Contractor's expense.

1.21 NEW TELEPHONE EQUIPMENT

- A. The contractor shall coordinate with the work of installation of telephone equipment by others (the NCA IT team). This work shall be completed before the building is turned over to the Cemetery for use.

1.22 TESTS

- A. Pre-test mechanical and electrical equipment and systems and make corrections required for proper operation of such systems before requesting final tests. Final test will not be conducted unless pre-tested.
- B. Conduct final tests required in various sections of specifications in presence of an authorized representative of the RE/COTR. Contractor

shall furnish all labor, materials, equipment, instruments, and forms, to conduct and record such tests.

- C. Mechanical and electrical systems shall be balanced, controlled and coordinated. A system is defined as the entire complex which must be coordinated to work together during normal operation to produce results for which the system is designed. For example, air conditioning supply; air is only one part of entire system which provides comfort conditions for a building. Other related components are return air, exhaust air, hot water, controls and electricity, etc. Another example of a complex which involves several components of different disciplines is a burner installation. Efficient and acceptable burner operation depends upon the coordination and proper operation of fuel, combustion air, controls, and other related components.
- D. All related components as defined above shall be functioning when any system component is tested. Tests shall be completed within a reasonably short period of time during which operating and environmental conditions remain reasonably constant.
- E. Individual test result of any component, where required, will only be accepted when submitted with the test results of related components and of the entire system.

1.23 INSTRUCTIONS

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

1.24 GOVERNMENT-FURNISHED PROPERTY

- A. The Government shall deliver to the Contractor, the Government-furnished property shown on drawings. For this project that is the gravesite locator to be installed in the administration building.
- B. Materials furnished by the Government to be installed by the Contractor will be furnished to the Contractor at the Cemetery.
- C. Storage space for materials will be provided by the Contractor and the Contractor shall be prepared to unload and store such equipment therein upon its receipt at the Cemetery.
- D. Notify PM in writing, 60 days in advance, of date on which Contractor will be prepared to receive materials furnished by Government.

Arrangements will then be made by the Government for delivery of materials.

1. Immediately upon delivery of materials, the Contractor shall arrange for a joint inspection thereof with a representative of the Government. At such time the Contractor shall acknowledge receipt of materials described, make notations, and immediately furnish the Government representative with a written statement as to its condition or shortages.
 2. The Contractor thereafter is responsible for such material until such time as acceptance of contract work is made by the Government.
- E. Equipment furnished by the Government will be delivered in a partially assembled (knock down) condition in accordance with existing standard commercial practices, complete with all fittings, fastenings, and appliances necessary for connections to respective services installed under contract. All fittings and appliances (i.e., couplings, ells, tees, nipples, piping, conduits, cables, and the like) necessary to make the connection between the Government furnished equipment item and the utility stub-up shall be furnished and installed by the contractor at no additional cost to the Government.
- F. Completely assemble and install the Government furnished equipment in place ready for proper operation in accordance with specifications and drawings.
- G. Furnish supervision of installation of equipment at construction site by qualified factory trained technicians regularly employed by the equipment manufacturer.

1.25 RELOCATED EQUIPMENT ITEMS

- A. Contractor shall disconnect, dismantle as necessary, remove and reinstall in new location, all existing equipment and items indicated by symbol "R" or otherwise shown to be relocated by the Contractor.
- B. Perform relocation of such equipment or items at such times and in such a manner as directed by the PM.
- C. Suitably cap existing service lines, such as water, drain, gas, air, and/or electrical, whenever such lines are disconnected from equipment to be relocated. Remove abandoned lines in finished areas and cap as specified herein before under paragraph "Abandoned Lines".

- D. Provide all mechanical and electrical service connections, fittings, fastenings and any other materials necessary for assembly and installation of relocated equipment; and leave such equipment in proper operating condition.
- E. All service lines such as noted above for relocated equipment shall be in place at point of relocation ready for use before any existing equipment is disconnected. Make relocated existing equipment ready for operation or use immediately after reinstallation.

1.26 CONSTRUCTION SIGN

- A. Provide a Construction Sign where directed by the PM. All wood members shall be of framing lumber. Cover sign frame with 0.7 mm (24 gage) galvanized sheet steel nailed securely around edges and on all bearings. Sign face shall be 4 feet x 5 feet and 6 inches. Provide two 100 by 100 mm (4 inch by 4 inch) posts (or equivalent round posts) set 900 mm (three feet) into ground. Set bottom of sign level at 900 mm (three feet) above ground and secure to posts with through bolts. Make posts full height of sign. Brace posts with 50mm x 100 mm (two by four inch) material as directed.
- B. Paint all surfaces of sign and posts two coats of white semi-gloss paint. Border and letters shall be of black gloss paint, except project title which shall be blue gloss paint.
- C. Maintain sign and remove it when directed by the PM.
- D. Detail Drawing of construction sign showing required legend and other characteristics of sign is a part of this specification.

1.27 SAFETY SIGN

- A. Provide a Safety Sign where directed by PM. Signboard shall be shall be three feet x four feet, 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 PM.

- D. Detail Drawing of safety sign showing required legend and other characteristics of sign is included in this specification.
- E. Post the number of accident free days on a daily basis.

1.28 CONSTRUCTION DIGITAL IMAGES

- A. During construction period through completion, furnish Department of Veterans Affairs weekly color digital photographs of construction progress (8 to 10 images per week.) Photographs of the reinforcing steel shall be taken after all reinforcing steel, sleeves, inserts, etc. are in place but prior to setting of runways. Photographs must show distinctly, at as large a scale as possible, all parts of work embraced in picture.
- B. Photographs are to be taken with a high-resolution digital camera, minimum 6 megapixels, with good wide-angle capability. The images shall be recorded in JPEG format with a minimum of 24-bit color and no reduction in actual picture size.
 - 1. Compressed size of the file shall be no less than 80% or the original with no loss of information.
 - 2. File names shall contain the Project number, the date the image was taken, and a unique sequential identifier, for example:
101CM3202_10-01-2013_0001. Use underscore, not spaces in digital file names.
- C. The digital photo files shall become property of Government and will be both e-mailed and submitted on CD-ROM.
 - 1. The images shall be forwarded electronically to the PM/Project Manager via email to NAME@va.gov within 2 days of when the photo was taken. Identify the content of each picture by a caption incorporated in the photo.
 - 2. The digital photo files shall also be submitted on CD-ROM to the PM/Project Manager at the conclusion of the project. The CD-ROM shall also contain an index of all the images contained therein in either a TXT or Microsoft Word format.

1.29 FINAL ELEVATION PHOTOGRAPHS

- A. Final photographs shall be taken by a commercial/professional photographer. They shall be taken upon completion, including landscaping. They shall be taken on a clear sunny day at as large a

scale as possible to obtain sufficient detail to show depth and to provide clear, sharp pictures. All images shall become property of the Government.

- B. Photographs shall be artistically composed showing full front elevations of new columbarium court(s), memorial wall, ossuary, bridge, site features and surrounding landscapes. A minimum of thirty six (36) images shall be taken as per these specifications.
- C. Minimum digital photo file size for final photos is 20 mb un-interpolated, preferably 52 mb. Submit proofs, via e-mail or web photo gallery, from which the PM/Project Manager will select the final images for printing.
- D. Pictures selected by the PM/Project Manager for printing shall be printed on regular weight paper, matte finish archival grade photographic paper and produced by a RA4 process from the digital image with a minimum 300 PPI. Photographs shall have full picture print with no margin.
- E. Submit two (2) 400 mm x 500 mm (16 x 20) framed prints and three (3) 8 x 10 prints of the final selected photos. Deliver to the PM/Project Manager, in boxes suitable for shipping,
- F. Submit a CD-ROM to the PM/Project Manager containing all (minimum 36) final digital photo files.
 - 1. Images on CD-ROM shall be recorded in JPEG format with a minimum of 24 bit color and no reduction in actual picture size. Compressed size of the file shall be no less than 80% of the original with no loss of information.
 - 2. File names shall contain the date the image was taken, the Project number and a unique sequential identifier.
 - 3. The CD-ROM shall also contain an index of all the images contained therein in either a TXT or Microsoft Word format.
- G. Each of the selected 16 x 20 prints shall be placed in a frame with a minimum 2 inches, maximum 3 inches, of appropriate matting as a border. Provide a selection of 3 different mats and 3 different frames from which the PM will select one mat and one frame style to frame both prints. Preferred frame style is wood molding, matte black finish, box frame, 1-1/8" wide x 7/8-inch deep.
- H. Place a typewritten self-adhesive identity label on the back of each final print without damage to photograph. PHOTO NUMBER shall be

included in both the digital file name on the CD and on the photo print label.

I. The following information shall be on the identity-label for photographs:

1. PHOTO NUMBER;
2. CEMETERY NAME
3. LOCATION;
4. PROJECT TITLE;
5. PROJECT NUMBER;
6. DATE TAKEN;
7. CONSTRUCTION COMPANY;
8. CONTRACT NUMBER.

1.30 HISTORIC PRESERVATION

A. Where the Contractor or any of the Contractor's employees, prior to, or during the construction work, are advised of or discover any possible archeological, historical and/or cultural resources, the Contractor shall immediately notify the PM verbally, and then with a written follow up.

1.31 PROJECT HEALTH AND SAFETY PLAN

A. Prior to commencing any construction, the Contractor shall submit a site specific Project Health and Safety Plan (PHSP). At a minimum, the PHSP shall cover the following topics:

1. Organizational structure (including Responsible Persons)
2. Site Characterization and Job Hazard Identification
3. Site Control and Security
4. Training
5. PPE
6. Heat Stress
7. Spill Containment
8. Decontamination
9. Emergency Response
10. Trench Safety

- - - E N D - - -

SECTION 01 00 10
TEMPORARY FACILITIES

1.1 TEMPORARY FACILITIES FOR PUBLIC AND EMPLOYEES

- A. Within thirty days after receipt of "Notice to Proceed", provide shop drawing submittal for a temporary Admin facility , for administrative personnel and public reception as indicated on the Construction Documents. Work should include ramp and stair access as shown located on a minimum two-inch deep gravel surfaced area properly drained. Ramp and stair access should extend to the existing concrete sidewalk and provide accessibility for the public.
- B. Within thirty days of receipt of "Notice to Proceed", provide shop drawing submittal for a temporary Maintenance facility for displaced Maintenance personnel as indicated on the Construction Documents. The furniture shall be new.
- C. Each temporary facility shall consist of two- 12' X 56' trailer units and provide not less than 1540 gross square feet of floor area. Installation of the temporary facilities shall meet all local codes.
- D. Provide each temporary facility with two, three-foot wide exterior doors, including hardware and OSHA approved platform and stairs leading to grade. Temporary facility for the public shall include an accessible ramp with handrails meeting ABAA requirements.
- D. Enclose the entire perimeter of both temporary facilities from the floor to the ground and finish to match exterior. Provide R19 insulation and seal tight to the ground with a painted 3/4" exterior grade plywood skirt.
- E. Exterior finishes shall be manufacturer's standards.
- F. Provide floor and wall with not less than R19 insulation. Roof shall have R=25 insulation value.
- G. Interior finishes shall consist of resilient flooring, painted wallboard on walls, and acoustical tile ceilings. Interior wood doors may be either painted or stained.
- H. Provide two 12' X 56' trailers linked together to act as temporary facilities for employees and the public during the building addition and remodeling of the Administration building. Facility shall provide for two employee offices and 3 workstations, public reception lobby,

one employee toilets, one file room, and one breakroom/meeting room. Interior shall be subdivided with full height partitions. Provide each space with 3' wide door with master keyed locks. Section off an area with a low furniture system panel and accessible counter for the Administration Reception desk.

- I. Provide two 12' X 56' trailers linked together to act as temporary facilities for employees during the remodeling/addition of the Maintenance Building. Facility shall serve as employee toilets and locker rooms. The interior shall be subdivided with full height partitions to provide two separate toilets, two locker rooms, employee breakroom, housekeeping room, Foreman's office, and circulation spaces. Provide women's locker room with bench and three lockers. Provide men's locker room with bench and eighteen lockers. In the employee break room, provide a lengths of 16' long countertop with under counter cabinets and sink. Provide 5 tables and 20 chairs, a full size refrigerators, and two microwaves. Provide each space with a three-foot wide wood door and appropriate hardware. Provide privacy levers with locks on each toilet room.
- J. In the temporary maintenance facility, Provide six (6) 2-1/2' wide by 3' high operable windows in the break room and one in the Foreman's office. Provide one (1) 2' high window in toilet room(s) and none in locker rooms. Window openings shall be fitted with security bars to prevent any forced entry. The doors of field office shall have deadbolts keyed from both sides. In the temporary administration facility provide three (3) 2-1/2' x 3' high operable windows in the breakroom and two (2) in each office. Provide two (2) windows in the open office area.
- K. Provide sufficient LED lighting in each room to deliver 70'candles of light at desk top height without the aid of daylight. Provide one light switch in each room.
- L. Provide one (1) duplex receptacle in each wall of each room. If a wall is 10' long or more, provide two (2) receptacles for each 10 feet, or portion thereof, of wall. Provide two (2) duplex receptacles in low partition at Admin. Assistant's desk.
- M. The Contractor shall provide the following:
 1. Electricity, hot and cold water, and necessary utility services.

2. All necessary piping, power circuits, network cabling, patch panels, equipment racks, cat. 5e or better cabling for phones and computers, electrical fixtures, lighting, and other items necessary to provide a habitable structure for the purpose intended. Provide minimum of one(1) network receptacles and two (2) electrical receptacles per workstation to be located as approved by PM upon review of the Contractor's submitted plan.
 3. Thermostatically controlled, centralized heating and air conditioning system designed to maintain the temperature between 70 and 80 degrees Fahrenheit with 50 percent relative humidity maintained during the air conditioning season. Thermostats shall be energy saving programmable type with a minimum of three temperature settings for each day of the week.
 4. One water closet, lavatory, mirror, toilet paper dispenser, paper towel dispenser, soap dispenser, towel bar, and two-prong coat hooks for each toilet room. Provide holding tank for sanitary sewer, including periodic pumping as required, or any other features needed to make the facility fully operational at the location, including provisions to keep from freezing.
 5. One wall mounted first aid kit that meets or exceeds current OSHA and AMSI Z.803-1 requirements.
 6. One wall mounted key safe with push-button combination lock sized for 48 keys.
 7. Two wall mounted 10 pound Tri-Class (ABC) dry chemical fire extinguishers.
 8. The Contractor shall professionally install a suitable security system for the field office and provide alarm monitoring services for the duration of the PM occupancy.
- N. For the duration of the temporary occupancy, provide the following:
1. Satisfactory conditions in and around the temporary facilities and parking area.
 2. Maintenance of gravel surfaced area, including the area for parking, in an acceptable condition for vehicle and foot traffic at all times.
 3. Maintenance of utility services.
 4. Twice weekly janitorial services and supplies (toilet paper, soap, paper towels, water, etc.).

5. Potable water, fuel and electric power for normal office uses, including lights, heating, and air conditioning.
6. Photocopier/Printer/Scanner (complete with installation, service, maintenance, supplies, and payment of all monthly usage charges):
 - a. Minimum Photocopier/Printer requirements:
 - 1) Collating/sorting/stapling.
 - 2) Enlarging/reducing
 - 3) Multi-size sheet feeder.
 - 4) Four paper tray sizes and bypass tray.
 - 5) Two-sided and single-sided copying.
 - 6) Network capability/connectivity
 - b. Minimum Scanner requirements:
 - 1) Scan to email and scan to folder capability.
 - 2) PDF, TIFF, JPEG output format capability
 - 3) Network capability/connectivity.
 - c. All services, maintenance and supplies shall be same day service.
8. Internet, Data and Voice Equipment/Connection and Communications (complete installation, maintenance and payment of all monthly usage charges).
 - a. 2 Voice lines (one dedicated phone line for FAX machine and one dedicated phone line for communications)
 - b. Voice line numbers must have local area code.
 - c. Cellular telephones for each employee.
 - d. One conference room telephone set with conference speaker(s), and extra-long telephone cord
 - e. Indoor equipment: Must provide separate RJ45 connections for data communications (CAT5 cabling) and RJ11 connections for analog voice communications in quantities specified in General Requirements paragraph 1.17.L.2 above. Provide central location for termination of the CAT5 cabling.
 - f. Data Connection: Provide connection lines; methods and material shall be per ANSI/EIA/TIA-568-1991 Standard. Install two (2) four pair Category 5e/6 cable unshielded twisted pair (total of 8 conductors) (UTP) Category 5e/6 IEEE 802.3 100BaseT UTP Level 5e/6, 24 AWG cables. Contractor shall supply 100BaseT, Category 5e or Category 6 certified rack-mounted modular RJ45 punch down b

lock/panel as required (24/48 ports) for jacks meeting the ANSI/EIA/TIA-568-A-5 category 5e/6 standards.

- g. 24/7 live phone-base technical support.
- h. Next business day on-site support, maintenance, and service.
- O. The Contractor shall provide the following new items:
 - 1.(1) Electric water cooler for temporary maintenance facility and provide a contract for water for the duration of the project.
- P. At the completion of all work, including the punch list, the PM's field office and facilities shall become the property of the Contractor. The Contractor shall remove the office and facilities, including the utility connections, from the Cemetery. The site shall be restored to original condition and finished in accordance with contract requirements and be left intact, including utility connections, for future use by Department of Veterans Affairs.
- Q. Contractor to provide floor plans for approval by the PM prior to furnishing the four temporary facilities.

**SECTION 01 32 16.13
PROJECT SCHEDULE**

PART 1- GENERAL:

1.1 DESCRIPTION:

- A. The schedule is a tool used to successfully manage the project. It will be used to plan the work, report progress, evaluate time extension requests, and is the basis for payment.
- B. The Contractor shall develop a fully resource loaded (cost and manpower) computer generated schedule demonstrating fulfillment of the entirety of the contract requirements, shall keep the computer generated schedule up-to-date in accordance with the requirements of this section and shall utilize the plan for scheduling the work, coordinating, mitigating delays, and monitoring work under this contract (including all activities of subcontractors, equipment vendors and suppliers). After review and approval by VA, this schedule will be designated as the approved Baseline Schedule.
- C. Conventional Critical Path Method (CPM) Precedence Diagramming Method (PDM) technique shall be utilized to satisfy both time and cost applications. All schedule data and reports required under this specification section shall be based upon total float, not relative or free float schedules. The approved baseline schedule becomes the official project schedule of record governing schedule management, oversight and actions on the corresponding contract.

1.2 CONTRACTOR'S REPRESENTATIVE:

- A. The Contractor shall designate a representative on the site who will be responsible for the preparation, timeliness, quality and the accuracy of the network diagram, review and report progress of the project with and to the Contracting Officer's representative.
- B. The Contractor's representative shall have direct project control and complete authority to act on behalf of the Contractor in fulfilling the requirements of this specification section and such authority shall not be interrupted throughout the duration of the project.

1.3 CONTRACTOR'S CONSULTANT:

- A. To fulfill all of the requirements of this specification section, the Contractor shall engage an independent CPM consultant who is skilled in the time and cost application of scheduling using (PDM) network

techniques for similar sized construction projects, the cost of which shall be included in the Contractor's bid proposal price. The consultant must have prepared and maintained at least 3 previous schedules of similar size and complexity to this contract using Primavera P6. At the Contracting Officer's request the scheduler shall be present in-person at monthly schedule review meetings. Any travel costs incurred shall be at no additional cost to the Government. This consultant shall not have any financial ties, business ties, affiliation with, or be a subsidiary company to, the Contractor. The consultant is expected to provide unbiased professional services to the contractor and to VA's representatives in developing and maintaining the project schedule.

- B. Prior to engaging a consultant, and within 10 calendar days after award of the contract, the Contractor shall submit to the Contracting Officer:
1. The name and address of the proposed consultant and Company.
 2. Sufficient information to show that the proposed consultant has the qualifications to meet the requirements specified in this specification section.
 3. A list of prior construction projects, along with selected CPM samples on current projects which the proposed consultant has performed complete project scheduling services. These network diagram samples must show complete project planning for a project of similar size and scope as covered under this contract.
- C. The Contracting Officer has the right to approve or disapprove employment of the proposed consultant, and will notify the Contractor of the VA decision within seven calendar days from receipt of information. In case of disapproval, the Contractor shall resubmit another consultant within 10 calendar days for renewed consideration. The contractor must have their CPM Consultant approved prior to i) submitting the baseline schedule, ii) Notice to Proceed, iii) Pre-construction Conference.

1.4 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 shall arrange a separate meeting with the

Contracting Officer and/or his representative to discuss the requirements 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 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 shall not relieve the contractor from compliance with requirements of this specification section and the remaining contract documents.

PART 2 - SCHEDULE CRITERIA / DATA REQUIREMENTS:

2.1 COMPUTER PRODUCED SCHEDULE DEVELOPMENT CRITERIA

- A. The computer produced schedule shall be prepared and maintained using Primavera P6 software.
- B. Work Breakdown Structure (WBS) - Group all activities and milestones within appropriate WBS categories including, at a minimum, the following:
 - a. Project Milestones:
 - (1) Management Milestones
 - (2) Project Administrative Meetings
 - b. Pre-Construction Phase:
 - (1) Submittals and Reviews
 - (2) Procurement
 - c. Construction Phase; Create multiple sub-sections in accordance with project specific categories of work including in WBS descending order as follows:
 - (1) General Area
 - (a) Type of Work Item
 - 1. Location
 - d. Commissioning & Testing:
 - (1) Specific area/locations of commissioning
 - (2) Final Testing
 - (3) Training

- e. Project Closeout: Include activity items such as QC inspection, working off punch list items, VA final inspection, Demobilization, O&M draft and final submittals, as-built drawings, training, etc.
 - f. Modifications: Create multiple sub-sections as the project progresses identified by modification number and title upon issuance of the SF30.
- C. Work activity/event relationships shall be restricted to Finish-to-Start (FS) and Start-to-Start (SS) only without lead or lag constraints. Note: Some exception may be allowed for lag in SS relationship, but must be approved by the VA's Contracting Officer on case by case basis prior to inclusion in the schedule.
- D. Activity/event constraints not required by the contract will not be accepted unless submitted to and approved by the Contracting Officer. The contractor shall make a separate written detailed request to the Contracting Officer identifying these date constraints and why they are logically necessary to secure the Contracting Officer's written approval before incorporating them into the network diagram. The Contracting Officer's separate approval of the schedule shall not excuse the contractor of this requirement.
- E. Logic events (non-work milestones) will be permitted where necessary to reflect proper logic among work events, but must have zero duration. The complete computer schedule shall reflect the Contractor's approach to pursuing the entire project.
- F. Intermediate Phasing milestones contained in the contract documents shall be clearly shown in the schedule.
- G. The Contractor's initial baseline submission, prior to VA review and approval, in its original form shall reflect the original contract scope of work.
- H. Early Project Completion or "Short Schedule" - VA will not approve any baseline schedule which shows completion date prior to the contract completion date. Also, there should not be any "filler or "contingency" type of activities to fill the entire contract duration. VA has no obligation to accelerate activities to support a proposed early contract completion. However, if the subsequent updates show that early handover is feasible due to "ahead of schedule" situation, VA may accept the work earlier at no additional cost to the Government.

I. The Critical Path shall be limited to:

1. No more than 20% of the activities shall be on the critical and near-critical path(s). On the baseline schedule the 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.
2. Multiple Critical paths will not be allowed.

J. The Contractor shall show activities/events for:

1. Contractor's time required for the preparation of submittals required by the specification, of shop drawings, templates, fabrication, delivery and similar pre-construction work.
2. Contracting Officer's and Architect-Engineer's review and approval of material submittals, shop drawings, equipment schedules samples, template, or similar items with time duration of **no less than 20 workdays**.
3. Fabrication and delivery of materials that are not locally available immediately upon approval of the submittal data. These activities shall be tied to the related construction activity/activities.
4. Shutdowns or Interruption of VA utilities, delivery of Government furnished equipment (GFE), and rough-in drawings, project phasing and any other specification requirements.
5. VC/VV Equipment - All significant VC (VA furnished and Contractor installed) and VV (VA furnished and VA installed) equipment shall be clearly shown in the schedule. Any smaller VC and VV Equipment shall also be logically grouped together and shown in the schedule.
6. Test, balance and adjust various systems and pieces of equipment, maintenance and operation manuals, instructions and preventive maintenance tasks.
7. **Commissioning (Cx)Activities** - Based upon the project specific Commissioning plan and project specification section 01 91 00, the contractor shall include in the **baseline schedule all the systems commissioning activities (see systems covered in Division 7, 8, 21, 22, 23, 26, 28, 31 and others as specified)** including start up, Pre-functional check list, Pre-test, individual component and system level Functional test, Operator's training, O.& M. Manuals etc.(including any deficiency correction and re-testing). **The majority of commissioning activities should be completed as part of**

- the normal construction schedule and finalized prior to the construction contract completion date.** To this end, the Commissioning Agent and the Contractor shall collaborate to integrate commissioning activities into the Contractor's overall construction schedule. All commissioning activities shall be cost loaded. The Commissioning Plan will identify critical commissioning activities and associated construction/start up tasks that must precede these activities to allow for successful execution of the commissioning activities. In order to coordinate these activities with the construction schedule, a **Commissioning Duration Schedule** shall be provided by the Commissioning Agent to the VA SRE and the Contractor to provide a rational basis for integration of commissioning into the construction schedule. The Commissioning Duration Schedule should include the following information:
- I. Description of Commissioning Activity
 - II. Prerequisite Construction Tasks Required to Execute the Cx Activity
 - III. Duration of Each Activity
 - IV. Documentation Associated with Each Task/Document Responsibility
8. Once the duration schedule is delivered to the Contractor, the Contractor will collaborate with the Commissioning Agent to integrate all commissioning activities into the fixed duration construction schedule in accordance with requirements for scheduling the project. The Baseline Schedule, as approved by the VA at the beginning, may not have all necessary Cx details, but the contractor is required to subsequently update the commissioning activities as the more detailed **Commissioning Duration Schedule** is being developed.
- K. 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. Schedule these activities/events so that only one phase is scheduled for completion within the same 30 consecutive calendar day period (except for those phases immediately preceding the final acceptance). Maintain this scheduling condition throughout the length of the contract unless waived by the Contracting Officer's representative in writing.

- M. Bid items other than the Base Bid (ITEM 1) shall have trade codes corresponding to the appropriate bid item number (e.g., ITM 3, ITM 4 and other items).
1. 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.
 2. Break up the work such that activities/events shall have:
 - a. Duration no longer than **20 work days** each, 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 Contracting Officer may approve the showing of a longer duration.
 - b. The duration for VA approval of any required submittal, shop drawing, or other submittals shall not be **less than 20 work days**. Refer to drawing CPM-1 for VA approval activities/events which will require minimum duration longer than 20 workdays. The construction time as determined by the CPM schedule from early start to late finish for any sub-phase, phase or the entire project shall not exceed the contract time(s) specified or shown.
 - c. An activity/event shall only reflect the work of one entity (subcontract or craft).
 - d. The activity/event once began can continue unimpeded until the activity/event is complete.
 3. Describe work activities/events clearly, so the work is readily identifiable with clear scope 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 (Refer to item 2.1 B above for some exceptions).
 4. Uniquely number each activity/event ID with ALPHA-NUMERIC value in ascending order. Activities should be generally numbered in such a way to reflect trade discipline, phase or location of the work.
- N. Show Government and other agency activities that could impact progress. These activities include, but are not limited to: approvals, acceptance, design reviews, environmental permit approvals by State and

- local regulators, inspections, utility tie-in, Government Furnished Equipment (GFE) and Notice to Proceed (NTP) for phasing requirements.
- O. The first activity in the project schedule must be a start milestone titled "NTP Acknowledged," which must have a "Start On" constraint date equal to the date that the NTP is acknowledged.
 - P. The last activity in the schedule must be a finish milestone titled "End Project" which must have a "Finish On or Before" constraint date equal to the current Contract Completion Date as stated in the NTP letter or the most current signed contract modification.
 - Q. Constrain the project schedule to the Contract Completion Date in such a way that if the schedule calculates an early finish, then the float calculation for "End Project" milestone reflects positive float on the longest path. If the project schedule calculates a late finish, then the "End Project" milestone float calculation reflects negative float on the longest path. The Government is under no obligation to accelerate Government activities to support a Contractor's early completion.
 - R. Schedule activities on a Calendar to which the activity logically belongs. Develop calendars to accommodate any contract defined work period such as a 7-day calendar for fab/deliver activities, concrete cure times, etc. Develop the default Calendar to match the physical work plan with non-work periods identified including weekends and holidays. Develop Seasonal Calendar(s) and assign to seasonally affected activities as applicable.
 - S. Only two open ended activities are allowed: the first activity "NTP Acknowledged" may have no predecessor logic, and the last activity - "End Project" may have no successor logic. Predecessor open ended logic may be allowed in a time impact analyses upon the Contracting Officer's approval.
 - T. Actual Start and Finish dates must not automatically update with default mechanisms included in the scheduling software. Updating of the percent complete and the remaining duration of any activity must be independent functions. Disable program features that calculate one of these parameters from the other. Activity Actual Start (AS) and Actual Finish (AF) dates assigned during the updating process must match those dates provided in the Contractor Quality Control Reports. Failure to

document the AS and AF dates in the Daily Quality Control report will result in disapproval of the Contractor's schedule.

- U. If there is no separate contract line item (CLIN) for as-built drawings, cost load the "Submission and approval of as-built drawings" activity not less than \$35,000 or 1 percent of the present contract value, whichever is greater, up to \$200,000. Activity will be declared 100 percent complete upon the Government's approval.
- V. Cost load the "Submission and approval of O & M manuals" activity not less than \$20,000. Activity will be declared 100 percent complete upon the Government's approval of all O & M manuals.

2.2 WORK ACTIVITY/EVENT COST DATA

- A. Cost Loading - The Contractor shall cost load all work activities/events except procurement activities. The cost loading shall reflect the appropriate level of effort of the work activities/events. The cumulative amount of all cost loaded work activities/events (including alternates) shall equal the total contract price. Prorate overhead, profit and general conditions on all work activities/events for the entire project length. The contractor shall generate from this information cash flow curves indicating graphically the total percentage of work activity/event dollar value scheduled to be in place on early finish, late finish. These cash flow curves will be used by the Contracting Officer to assist him in determining approval or disapproval of the cost loading. In the event of disapproval, the Contractor shall revise and resubmit in accordance with Article, THE INITIAL BASELINE SCHEDULE SUBMITTAL (Item 3.1B below). 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 the FAR 52.232 - 5 (PAYMENTS UNDER FIXED-PRICE CONSTRUCTION), Article, and VAAR 852.236 - 83 (PAYMENTS UNDER FIXED-PRICE CONSTRUCTION).
- C. The Contractor shall cost load work activities/events for ASBESTOS ABATEMENT. The sum of asbestos abatement work activity/event costs shall equal the value of the asbestos bid item in the Contractors' bid.

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

PART 3 - SUBMITTALS, DELIVERABLES, AND UPDATE PROCESS:

3.1 SUBMITTALS:

- A. The Independent CPM Consultant Submittal: Within 10 calendar days after NTP, the Contractor shall submit to the Contracting Officer for review and approval the qualifications of their proposed independent CPM consultant. The submittal information shall be in accordance with PART 1 GENERAL, ARTICLE 1.3 CONTRACTOR'S CONSULTANT of this Specification.
- B. THE INITIAL BASELINE SCHEDULE SUBMITTAL: Within 30 calendar days (45 calendar days on projects over \$50,000,000) after Contracting Officer approval of the Independent CPM Consultant, the Contractor shall submit the initial baseline schedule submittal package for the Contracting Officer's review and approval. This submittal shall comply with all requirements of this specification section and shall consist of:
2. Computerized Schedule
 - a. An electronic file in a compressed Primavera (P6) computerized schedule (.xer file).
 - b. Five hard copy and electronic reports to be identified by the Contracting Officer.
 3. Supporting Data
 - a. The proposed number of working days per week.
 - b. The holidays to be observed during the life of the contract (by day, month, and year).
 - c. The planned number of shifts per day.
 - d. The number of hours per shift.
 - e. List the major construction equipment to be used on the site, describing how each piece relates to and will be used in support of the submitted network diagram work activities/events.
 - f. Provide a typed, doubled spaced description, at least one page in length, of the sequencing plan and contractor's approach to constructing the project.

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

C. VA RESPONSE TO INITIAL BASELINE SCHEDULE SUBMITTAL

Within 30 calendar days after submittal of the initial baseline schedule, the Contracting Officer or his representative will do one or both of the following:

1. Notify the Contractor concerning his actions, opinions, and objections.
2. Hold a joint review meeting with the Contractor at or near the job site for joint review, correction, or adjustment of the submitted baseline schedule. Within 14 calendar days after the joint review, the Contractor shall revise and resubmit the baseline schedule along with all reports and information required by paragraph 3.1.B of this specification. The revised submission will be reviewed by the Contracting Officer and, if found to be as previously agreed upon, will be approved.
3. The corresponding computer-produced schedule and the submitted supporting data, when approved, shall constitute the official **Baseline Schedule** until subsequently revised in accordance with the requirements of this section.

D. COMPUTER PRODUCED SCHEDULES SUBMITTALS:

1. The contractor shall submit to the VA Senior Resident Engineer (SRE) and CPM Schedule Analyst (simultaneously), computer-produced time/cost schedules and reports generated from monthly project updates. This monthly computer service will include: electronic file copies of up to **five different reports** (inclusive of all pages), available within the user defined reports of Primavera (P6) to the Contracting Officer's representatives; a hard copy listing of all project schedule changes, and associated data, made at the update; an electronic file of this data in Primavera (P6) format; and the resulting monthly updated schedule reports in a compressed electronic file in Primavera (P6). These schedule reports must be submitted **within 7 calendar days of the monthly update meeting**, along with the signed (by the contractor and VA) Look ahead report (with % complete progress) made at the previous update meeting; and substantively support the contractor's monthly payment

request. The SRE shall identify the five different report formats that the contractor shall provide based upon the monthly schedule updates.

2. The contractor is responsible for the correctness and timeliness of the computer-produced reports. The Contractor is also responsible for the accurate and timely submittal (within 7 calendar days as noted above) of the updated project schedule and all CPM data necessary to produce the computer reports and payment request that is specified.

E. VA RESPONSES TO COMPUTER PRODUCED SCHEDULE submittals

The VA may report errors in computer-produced reports to the Contractor's representative within ten calendar days from receipt of reports, indicating approval or disapproval. In case of disapproval, the Contractor will reprocess the computer-produced reports when requested by the Contracting Officer's representative, to correct errors which affect the payment and schedule for the project. In certain large and complex project, as determined by the Contracting Officer, this monthly reporting shall be formal submittal and approval process; meaning that the next month's update shall not proceed without timely submittal and approval.

F. FIRST UPDATE SCHEDULE SUBMITTAL:

Within 30 calendar days of VA acceptance of the project baseline schedule, the Contractor shall submit the first update of the schedule. This update shall contain any progress of the work the contractor wishes to receive payment for from contract notice to proceed. Any changes/delays shall be entered at the first update after the baseline schedule has been approved. The Contractor should provide their requests for time and supporting time extension analysis for contract time as a result of contract changes/delays, after this update, and in accordance with Article, ADJUSTMENT OF CONTRACT COMPLETION. These changes/delays shall be entered at the first update after the final network diagram has been approved. The Contractor should provide their requests for time and supporting time extension analysis for contract time as a result of contract changes/delays, after this update, and in accordance with Article, ADJUSTMENT OF CONTRACT COMPLETION.

G. PERIODIC PROGRESS AND PAYMENT SUBMITTALS:

The Contractor is entitled to a periodic (not less than monthly) progress payment upon approval of the resource loaded project schedule.

1. The contractor shall submit 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 3.2, PAYMENT AND PROGRESS REPORTING, as the basis upon which progress payments will be made pursuant to Article FAR 52.232 - 5 (PAYMENTS UNDER FIXED-PRICE CONSTRUCTION), and VAAR 852.236 - 83 (PAYMENTS UNDER FIXED-PRICE CONSTRUCTION).
2. Failure to meet the requirements of this specification may result in the disapproval of the preliminary, initial or periodic schedule updates and subsequent rejection of payment requests until compliance is met. In the event that the Contracting Officer directs schedule revisions and those revisions have not been included in subsequent Project Schedule revisions or updates, the Contracting Officer may withhold 10 percent of pay request amount from each payment period until such revisions to the project schedule have been made.

3.2 PAYMENT AND PROGRESS REPORTING - SCHEDULE UPDATES

- A. Schedule Update Meeting - Monthly job site schedule update meetings shall be held on dates mutually agreed to by the Contracting Officer (or Contracting Officer's representative) and the Contractor. The contractor and his CPM consultant will be required to attend all monthly update meetings. Presence of Subcontractors during update meeting is optional unless required by the Contracting Officer (or Contracting Officer's representative). The Contractor shall update the project schedule and all other data required by this section shall be accurately filled in and completed draft "pencil copy" prior to the monthly update meeting. The Contractor shall provide this information to the Contracting Officer or the VA representative in completed form three work days in advance of the update meeting. The contractor shall use only approved previous month's schedule to report progress (% complete) in "pencil copy" and shall not change this in any shape or form. Logic or duration changes for future incomplete activities should be entered later as agreed upon in the meeting and shown in the resulting reports. Job progress will be reviewed to verify:

1. Actual start and/or finish dates for updated/completed activities/events.
 2. Remaining duration, required to complete each activity/event started, or scheduled to start, but not completed.
 3. Percentage for completed and partially completed activities/events.
 4. Logic and duration revisions required by this section of the specifications, particularly if the baseline logic / sequence have changed significantly, which could potentially alter or impact the critical path of the schedule. Highlight and request VA approval prior to making any logic, durations, manpower and cost loading changes.
 5. Activity/event duration and percent complete shall be updated independently, meaning that the Remaining Durations (RD) shall be reviewed for all "in-progress" activities and entered manually based on realistic remaining work content, and shall not be left to "auto-calculate" by the software.
 6. Out of sequence progress - Activities that have progressed before all preceding logic has been satisfied (Out-of-Sequence progress) are not allowed except on a rare case by case basis, subject to approval by the Contracting Officer. Propose logic corrections to eliminate out of sequence progress or justify not changing the sequencing for approval prior to submitting updated monthly schedule. Correct out of sequence progress that continues for more than two update cycles by logic revision, as approved by the Contracting Officer. Also, submit complete revised schedule when more than 5% of the remaining activities are out of sequence. Calculate multiple float paths option is not allowed.
 7. Logic changes - Specifically identify and discuss all logic changes pertaining to change orders (see section item 3.2.E below), contractor proposed changes in work plan or sequence, correction to schedule logic for out-of-sequence progress etc. that have been made pursuant to contract provisions. VA will only approve logic revisions in order to keep the schedule valid in terms of its usefulness in calculating a realistic completion date, correcting erroneous logic ties, and accurately sequencing the work.
- B. Schedule Narrative - The Contractor, in addition to the 5 schedule reports noted earlier, shall submit a narrative report as a part of his

monthly update reporting prepared after the update meeting, in a form agreed upon by the Contractor and the Contracting Officer. The narrative report shall be prepared by the contractor's authorized representatives (Project manager, Superintendent or other responsible official) and not by the CPM consultant. The narrative report shall include, at a minimum, a description of major construction problem areas; current and anticipated delaying factors and their estimated impact on performance of other activities/events and completion dates; and an explanation of corrective action being taken or proposed. This narrative shall also include 1) any forward Logic Revisions; 2) any added or deleted activities; 3) any cost loading or budget changes; 4) any missed major milestones. This monthly schedule narrative should also briefly discuss the potential schedule risks / mitigation efforts, as required by the item 3.1.G above. This report is in addition to the daily reports pursuant to the provisions of Article, DAILY REPORT OF WORKERS AND MATERIALS in the GENERAL CONDITIONS.

- C. Cash Flow S-curve or Schedule Variance Control (SVC) Diagram - With each schedule submission, provide a SVC diagram showing Scheduled and Actual (earned value) Project cost curve (both incremental and cumulative) based on both projected early and late activity finish dates. Also, revise the Cash Flow S-curve when the contract is modified, or as directed by the Contracting Officer.
- D. After completion of the joint review and the Contracting Officer's approval of all entries, the contractor will generate an updated computer-produced calendar-dated schedule and submit to the Contracting Officer's representative with reports in accordance with the Article, COMPUTER PRODUCED SCHEDULES, specified. These reports shall be submitted within 7 calendar days after the monthly update meeting to the SRE and the VA CPM Schedule analyst simultaneously via electronic media, as noted earlier.
- E. Parallel Runs / Time Extension Analysis - The Contractor shall provide a proposed frag net as part of every change order/supplemental agreement proposal. The frag net proposal shall consist of a list of proposed activities encompassing the scope of the changed work, proposed duration for each activity, and proposed predecessor/successor for the frag net. Upon approval of the CO, the contractor's CPM consultant shall produce a parallel run incorporating all current

period contract change(s) as a batch against the **previous month's** approved monthly project schedule with no other changes made. Insertion of any CO or SA activities into the CPM database with faulty logic ties like NTP (predecessor) and Project complete (successor) and zero (0) duration will not be accepted. The resulting electronic project schedule data file shall be appropriately identified as a parallel run and submitted to the VA SRE and the CPM Analyst in accordance with the requirements listed in articles 3.2.D. This electronic submission is separate from the regular monthly project schedule reports requirements and shall be submitted to the SRE within fourteen (14) calendar days of completing the regular schedule update meeting. The VA will perform a Time Impact Analysis (TIA) of all parallel run submissions. If the TIA concludes that the parallel run results in a delay to the critical path (longest path) a time extension will be included as part of a Supplemental Agreement.

- F. Schedule Coordination/ Progress review meeting - Following approval of the CPM schedule updates, the VA, the General Contractor, its approved CPM Consultant, RE office representatives, and all subcontractors needed, as determined by the SRE, shall meet to discuss the monthly updated schedule. This schedule coordination meeting shall be chaired by the VA SRE and will occur after each monthly project schedule update meeting utilizing the resulting schedule reports from the previous schedule update. The main emphasis shall be to address work activities to avoid slippages of project schedule and to identify any necessary corrective actions required to maintain project schedule during the reporting period. VA 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. If the project is behind schedule, discussions should concentrate on ways to prevent further slippage as well as ways to improve the project schedule status, as appropriate.
- G. Ownership of Project Float - Project float is the length of time between the contractor's predicted completion milestone and the contract completion date milestone. Project Float available in the schedule, at any time, shall not be considered for the exclusive use of either the VA or the Contractor.

- H. Out-of-Sequence Progress - Activities that have progressed before all preceding logic has been satisfied (Out-of-Sequence Progress) will be allowed only on a case-by-case basis subject to approval by the Contracting Officer. Propose logic corrections to eliminate out of sequence progress or justify not changing the sequencing for approval prior to submitting an updated project schedule. Address out of sequence progress or logic changes in the Narrative Report and in the periodic schedule update meetings.
- I. Added and Deleted Activities - Do not delete activities from the project schedule or add new activities to the schedule without approval from the Contracting Officer. Activity ID and description changes are considered new activities and cannot be changed without Contracting Officer approval.
- J. Original Durations - Activity Original Durations (OD) must be reasonable to perform the work item. OD changes are prohibited unless justification is provided and approved by the Contracting Officer.
- K. Retained Logic - Schedule calculations must retain the logic between predecessors and successors ("retained logic" mode) even when the successor activity(s) starts and the predecessor activity(s) has not finished (out-of-sequence progress). Software features that in effect sever the tie between predecessor and successor activities when the successor has started and the predecessor logic is not satisfied ("progress override") are not be allowed.

3.3 RESPONSIBILITY FOR COMPLETION / PROJECT DELAY

- A. Whenever it becomes apparent from the current monthly progress review meeting or the monthly schedule update that phasing or contract completion dates will not be met, the Contractor shall provide a Recovery Plan to the Contracting Officer outlining the remedial action they will take to recover from the delay. Remedial actions can consist of some of all of the following measures with a focus on critical path activities:
 - 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 to recover all of the delay for which the contractor is responsible.

B. Prior to proceeding with any of the above actions, the Contractor shall obtain approval from the Contracting Officer for the proposed Recovery Plan. If such actions are approved, the contractor shall incorporate any required changes to the schedule into the next update, at no additional cost to the Government.

3.4 CHANGES TO NETWORK DIAGRAM AND REVISED SCHEDULE:

A. Within 30 calendar days after VA acceptance and approval of any updated computer-produced schedule, the Contractor shall submit a revised schedule file, the associated requested reports, and a list of any activity/event changes including predecessors and successors for any of the following reasons:

1. Delay in completion of any activity/event or group of activities/events; that indicate an extension of the project completion by 20 working days or 10 percent of the remaining project duration, whichever is less.
2. Delays in submittals, deliveries, or work stoppage are encountered which make rescheduling of the work necessary.
3. The schedule does not represent the actual prosecution and realistic progress of the project, or when more than 5% of the remaining activities are "out of sequence" as noted earlier (Ref.3.2.A.7).
4. When there is, or has been, a substantial revision to the activity/event costs of the network diagram regardless of the cause for these revisions.

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

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

- D. The cost of revisions to the network diagram resulting from contract changes will be included in the proposal for changes in work as specified in Article, FAR 52.243 -4 (CHANGES), VAAR 852.236 - 88 (CHANGES - SUPPLEMENTS), and will be based on the complexity of the revision or contract change, man hours expended in analyzing the change, and the total cost of the change.
- E. The cost of revisions to the network diagram not resulting from contract changes is the responsibility of the Contractor.

3.5 ADJUSTMENT OF CONTRACT COMPLETION DATE / TIME EXTENSION DUE TO CHANGES TO THE CONTRACT

- A. Contract Time Extension due to Changes to Contract - The contract completion date will be adjusted only for causes specified in this contract. The contractor shall submit requests for a time extension to the Contracting Officer within reasonable time frame (within 1 month of the issuance of the Change order or before signing of the bilateral Supplemental Agreement) and must provide a justification, CPM data and additional supporting evidence as the Contracting Officer may deem necessary for determination as to whether or not the Contractor is entitled to a time extension under the provisions of the contract. Fragnets must be inserted into the most recent schedule update and must have logical predecessors and successors. 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 original or extended 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. The burden of proof to request the time extension is the sole responsibility of the contractor, and the contractor is required to

revise the analysis or provide further documentation when requested by the Contracting Officer.

- 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 Article, FAR 52.243 -4 (CHANGES), VAAR 852.236 - 88 (CHANGES - SUPPLEMENTS). The Contractor shall include, as a part of each change order proposal, a sequence of activities showing all CPM logic revisions (Fragnets), duration (in work days) changes, and cost changes, manpower loading for work in question and its relationship to other activities on the approved network diagram (as specified above in item 3.2.E - Parallel Run /Time Impact Analysis).

3.6 ADJUSTMENT OF CONTRACT COMPLETION DATE / TIME EXTENSION DUE TO WEATHER:

All delays due to weather impacts shall be analyzed on a month by month basis. Use the following table of monthly anticipated adverse weather delays as the basis for establishing a Weather Calendar, indicating the adverse weather delay days as non-work days in addition to weekends and Federal Holidays. The table uses the National Oceanic and Atmospheric Administration's (NOAA) historical monthly averages for days with precipitation, using a nominal 10-year, greater than 2.5mm (0.10 inch) amount parameter, as indicated on the Station Report for the NOAA location closest to the project site and adjusted from Calendar Days to Work Days. Assign the Weather Calendar to any activity that could be impacted by adverse weather. The Contracting Officer will issue a modification in accordance with the contract clauses, giving the Contractor a time extension for the difference between the number of days indicated on the table and the number of days of adverse weather that actually occurred. A lost work day due to weather conditions is defined as a day in which the Contractor cannot work at least 50 percent of the day on the current critical path activity. Following is a schedule of anticipated monthly non-work days due to adverse weather to be used as the basis for building the Weather Calendar.

MONTHLY ANTICIPATED ADVERSE WEATHER DELAYS

| JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 5 | 5 | 6 | 7 | 6 | 6 | 6 | 4 | 5 | 6 | 5 | 5 |

Black Hills National Cemetery

NCA Project #884CM3015

Renovate and Expand Administration and Maintenance Buildings

10/31/22

20901 Pleasant Valley Drive

Bid Documents

Sturgis, SD 57785

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SECTION 01 33 23
SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

1.1 SUMMARY

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. 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. 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

The submittal register will list items of equipment and materials for which submittals are required by the specifications. Contractor shall supply the NCA PM a submittal register. The Contractor is not relieved from supplying

submittals required by the contract documents, but which have been omitted from the submittal register. The submittal register will serve as a scheduling document for submittals and will be used to control submittal actions throughout the contract period. 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 NCA/VA. 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. The Contractor shall meet monthly with the designated REO team member to review and get approval of the updated submittal register. 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

Submittals are to be scheduled, submitted, reviewed, and approved prior to the acquisition of the material or equipment. Coordinate scheduling, sequencing, preparing, and processing of submittals with performance of work so that work will not be delayed by submittal processing. Scheduled submittals will be included and shown in the overall project schedule. Allow time for potential resubmittal. No delay costs or time extensions will be allowed for time lost in late submittals or resubmittals.

1.5 SUBMITTAL PREPARATION

Each submittal is to be complete and in sufficient detail to allow ready determination of compliance with contract requirements. 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. If available product data is incomplete, provide Contractor-prepared documentation to supplement product data and satisfy submittal requirements. Provide a transmittal form for each submittal with the following information:

- Project title and location.
- Construction contract number.
- Date of the drawings and revisions.
- Name, address, and telephone number of subcontractors, supplier,

manufacturer, and any other subcontractor associated with the submittal.

- List paragraph number of the specification section and sheet number of the contract drawings by which the submittal is required.
- When a resubmission, add alphabetic suffix on submittal description. For example, submittal 18 would become 18A, to indicate resubmission.
- Product identification and location in project.

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. Failure to point out deviations will result in the VA requiring removal and replacement of such work at the Contractor's expense. Stamp, sign, and date each submittal transmittal form indicating action taken. 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

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

1.7 SAMPLES

Submit two sets of physical samples showing range of variation, for each required item. 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. When color, texture, or pattern is specified by naming a particular manufacturer and style, include one sample of that manufacturer and style, for comparison. 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. The VA reserves the right to disapprove any material or equipment which previously has proven unsatisfactory in service.

1.8 OPERATION AND MAINTENANCE DATA

Submit data specified for a given item within 30 calendar days after the item is delivered to the contract site. 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 VA REVIEW OF SUBMITTALS AND RFIs

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. Period of review for submittals begins when the VA PM receives submittal from the Contractor. Period of review for each resubmittal is the same as for initial submittal. VA review period is 15 working days for submittals. VA review period is 10 working days for RFIs. The VA will return submittals to the Contractor with the following notations:

- "Approved": authorizes the Contractor to proceed with the work covered.
- "Approved as noted": authorizes the Contractor to proceed with the work covered provided the Contractor incorporates the noted comments and makes the noted corrections.
- "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.
- "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.

1.10 APPROVED SUBMITTALS

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

1.11 WITHHOLDING OF PAYMENT

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

1.12 SUBMITTAL REGISTER:

Additional submittals may be required per RE and/or Engineer.

- - - E N D - - -

**SECTION 01 35 26
SAFETY REQUIREMENTS**

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Black Hills National Cemetery
Renovate and Expand Administration and Maintenance Buildings
20901 Pleasant Valley Drive
Sturgis, SD 57785

NCA Project #884CM3015

10/31/22

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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-2010Guidelines for Design and Construction of
Healthcare Facilities

E. National Fire Protection Association (NFPA):

10-2013.....Standard for Portable Fire Extinguishers

30-2012.....Flammable and Combustible Liquids Code

51B-2014.....Standard for Fire Prevention During Welding,
Cutting and Other Hot Work

70-2014.....National Electrical Code

70B-2013.....Recommended Practice for Electrical Equipment
Maintenance

70E-2015Standard for Electrical Safety in the Workplace

99-2012.....Health Care Facilities Code

241-2013.....Standard for Safeguarding Construction,
Alteration, and Demolition Operations

F. The Joint Commission (TJC)

TJC ManualComprehensive Accreditation and Certification
Manual

G. U.S. Nuclear Regulatory Commission

10 CFR 20Standards for Protection Against Radiation

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

29 CFR 1904Reporting and Recording Injuries & Illnesses

29 CFR 1910Safety and Health Regulations for General
Industry

29 CFR 1926Safety and Health Regulations for Construction
Industry

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

I. VHA Directive 2005-007

J. 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

All mishaps that occur incidentally to an activity, project, or facility for which this specification is applicable shall be reported immediately and investigated accordingly, with a formal report delivered to VA CFM within 24 hours of the reported mishap.

- P. No impact - near miss incidents that should be reported and investigated;
- Q. Minor incident/impact - incidents that require first aid or result in minor equipment damage (less than \$5000). These incidents must be reported and investigated.
- R. 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;

- S. 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.
- T. 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).

U. 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:

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

A. Preconstruction Submittals

Accident Prevention Plan (APP); G

B. Reports

- a. Monthly Contractor Health Safety and Environmental (HS&E) Performance Report
- b. Notifications and Reports
- c. Mishap Reports; G
- d. LHE Inspection Reports

C. Work Plans

- a. Standard Lift Plan; G
- b. Critical Lift Plan; G
- c. Activity Hazard Analysis (AHA)
- d. Confined Space Entry Permit
- e. Hot Work Permit
- f. Radiography Operation Planning Work Sheet; G
- g. Portable Gauge Operations Planning Worksheet; G

D. Certificates

- a. Contractor Safety Self-Evaluation Checklist

- b. Crane Operators/Riggers Certifications G
- c. Certificate of Compliance
- d. Mobile Cranes Inspection Certificate
- e. License Certificates
- f. 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 Resident Engineer or Contracting Officer Representative or Government Designated Authority.

1.5 ACCIDENT PREVENTION PLAN (APP):

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

1. Written in English by a qualified person who is employed by the Prime Contractor articulating the specific work and hazards pertaining to the contract (model language can be found in ASSP A10.33). Specifically articulating the safety requirements found within these VA contract safety specifications and the United States Army Corps of Engineers - Safety and Health Requirements Manual - EM 385-1-1-2014.
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 training is required for all workers on site and the OSHA 30-hour or EM 385-1-1 training is required for Trade Competent Persons (CPs)

g. SAFETY AND HEALTH INSPECTIONS.

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

h. MISHAP INVESTIGATION & REPORTING. The Contractor shall conduct mishap investigations of all mishaps that occur onsite. The APP shall include mishap investigation procedure and identify person(s) responsible to provide the following to the Resident Engineer, Contracting Officer Representative or Government Designated Authority:

- 1) Monthly HS&E Performance Report;
- 2) Mishap investigation reports;

3) Project site injury and illness logs.

All mishaps that occur incidentally to an activity, project, or facility for which this specification is applicable shall be reported immediately and investigated accordingly, with a formal report delivered to VA CFM within 24 hours of the reported mishap.

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 be limited to procedures for addressing the risks associates with the following:

- 1) Emergency response;
- 2) Contingency for severe weather;
- 3) Fire Prevention;
- 4) Medical Support;
- 5) Posting of emergency telephone numbers;
- 6) Prevention of alcohol and drug abuse;
- 7) Site sanitation (housekeeping, drinking water, toilets);
- 8) Night operations and lighting;
- 9) Hazard communication program;
- 10) Welding/Cutting "Hot" work;
- 11) Electrical Safe Work Practices (Electrical LOTO/NFPA 70E);
- 12) General Electrical Safety;
- 13) Hazardous energy control (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).

- C. Submit the APP to the Resident Engineer or Contracting Officer Representative or Government Designated Authority for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES 15 calendar days prior to the date of the preconstruction conference for acceptance. Work cannot proceed without an accepted APP.
- D. Once accepted by the Resident Engineer or Contracting Officer Representative, the APP and attachments will be enforced as part of the contract. Disregarding the provisions of this contract or the accepted APP will be cause for stopping of work, at the discretion of the Contracting Officer in accordance with FAR Clause 52.236-13, *Accident Prevention*, until the matter has been rectified.
- E. Once work begins, changes to the accepted APP shall be made with the knowledge and concurrence of the Resident Engineer, Contracting Officer Representative or Government Designated Authority. Should any severe hazard exposure, i.e. imminent danger, become evident, stop work in the area, secure the area, and develop a plan to remove the exposure and

control the hazard. Notify the Resident Engineering Office 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 Resident Engineer, Contracting Officer Representative or Government Designated Authority and discussed with all engaged in the activity, including the Contractor, subcontractor(s), and Government on-site representatives at preparatory and initial control phase meetings.
 1. The names of the Competent/Qualified Person(s) required for a particular activity (for example, excavations, scaffolding, fall protection, other activities as specified by OSHA, EM 385-1-1, or other State and Local agencies) shall be identified and included in the AHA. Certification of their competency/qualification shall be submitted to the Government Designated Authority (GDA) for acceptance prior to the start of that work activity.
 2. The AHA shall be reviewed and modified as necessary to address changing site conditions, operations, or change of competent/qualified person(s).

- a. If more than one Competent/Qualified Person is used on the AHA activity, a list of names shall be submitted as an attachment to the AHA. Those listed must be Competent/Qualified for the type of work involved in the AHA and familiar with current site safety issues.
 - b. If a new Competent/Qualified Person (not on the original list) is added, the list shall be updated (an administrative action not requiring an updated AHA). The new person shall acknowledge in writing that he or she has reviewed the AHA and is familiar with current site safety issues.
3. Submit AHAs to the Resident Engineer, Contracting Officer Representative or Government Designated Authority for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES for review at least 15 calendar days prior to the start of each phase. Subsequent AHAs as shall be formatted as amendments to the APP. The analysis should be used during daily inspections to ensure the implementation and effectiveness of the activity's safety and health controls.
 4. The AHA list will be reviewed periodically (at least monthly) at the Contractor supervisory safety meeting and updated as necessary when procedures, scheduling, or hazards change.
 5. Develop the activity hazard analyses using the project schedule as the basis for the activities performed. All activities listed on the project schedule will require an AHA. The AHAs will be developed by the contractor, supplier, or subcontractor and provided to the prime contractor for review and approval and then submitted to the, Contracting Officer Representative or Government Designated Authority for review for compliance.

1.7 PRECONSTRUCTION CONFERENCE:

- A. Contractor representatives who have a responsibility or significant role in implementation of the accident prevention program, as required by 29 CFR 1926.20(b)(1), on the project shall attend the 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 24 hours, 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 (up to 24 hours) off-site, a Designated Representative (DR), 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:

- B. A. The designated Prime Contractor SSHO must meet the requirements of all applicable OSHA standards and be capable (through training, experience, and qualifications) of ensuring that the requirements of 29 CFR 1926.16 and other appropriate Federal, State and local requirements are met for the project. As a minimum the SSHO shall hold as current, a Certified Safety Professional (CSP) or a Construction Health and Safety Technician (CHST) certification or has a safety and health degree from an accredited university or college and have 3 years of construction industry safety experience. 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.
- C. All designated CPs shall have completed the OSHA 30-hour Construction Safety course and/or EM 385-1-1 training within the past 5 years.
- D. In addition to the OSHA 30 Hour Construction Safety Course and/or EM 385-1-1 training, all CPs with high hazard work operations such as operations involving asbestos, electrical, cranes, demolition, work at heights/fall protection, fire safety/life safety, ladder, rigging, scaffolds, and trenches/excavations shall have a specialized formal course in the hazard recognition & control associated with those high hazard work operations. Documented "repeat" deficiencies in the execution of safety requirements will require retaking the requisite formal course.
- E. All other construction workers shall have the OSHA 10-hour Construction Safety Outreach course and any necessary safety training to be able to identify hazards within their work environment.

- F. Submit training records associated with the above training requirements to the Contracting Officer Representative or Government Designated Authority for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES 15 calendar days prior to the date of the preconstruction conference for acceptance.
- G. Prior to any worker for the contractor or subcontractors beginning work, they shall undergo a safety briefing provided by the SSHO or his/her designated representative. As a minimum, this briefing shall include information on the site-specific hazards, construction limits, VAMC safety guidelines, means of egress, break areas, work hours, locations of restrooms, use of VAMC equipment, emergency procedures, accident reporting etc... Documentation shall be provided to the COR that individuals have undergone contractor's safety briefing.
- H. Ongoing safety training will be accomplished in the form of weekly documented safety meeting.

1.11 INSPECTIONS:

- A. The SSHO shall conduct frequent and regular safety inspections (daily) of the site and each of the subcontractors CPs shall conduct frequent and regular safety inspections (daily) of their work operations as required by 29 CFR 1926.20(b)(2). Each week, the SSHO shall conduct a formal documented inspection with a written report of the entire construction areas with the subcontractors' "Trade Safety and Health CPs" present in their work areas. Coordinate with, and report findings and corrective actions weekly to Contracting Officer Representative or Government Designated Authority.
- B. A Certified Safety Professional (CSP) with specialized knowledge in construction safety or a certified Construction Safety and Health Technician (CSHT) shall randomly conduct a monthly site safety inspection. The CSP or CSHT can be a corporate safety professional or independently contracted. The CSP or CSHT will provide their certificate number on the required report for verification as necessary.

1. Results of the inspection will be documented with tracking of the identified hazards to abatement.
2. The Contracting Officer Representative or Government Designated Authority will be notified immediately prior to start of the inspection and invited to accompany the inspection.
3. Identified hazard and controls will be discussed to come to a mutual understanding to ensure abatement and prevent future reoccurrence.
4. A report of the inspection findings with status of abatement will be provided to the Contracting Officer Representative or Government Designated Authority within one week of the onsite inspection.

1.12 MISHAPS, OSHA 300 LOGS, AND MAN-HOURS:

- A. The prime contractor shall establish and maintain a mishap reporting, recordkeeping, and analysis system to track and analyze all injuries and illnesses, high visibility incidents, and accidental property damage (both government and contractor) that occur on site. Notify the Contracting Officer Representative or Government Designated Authority as soon as practical, but no more than four hours after any mishap meeting the definition of a Moderate or Major incident, High Visibility Incidents, or any weight handling and hoisting equipment mishap. Within notification 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 accident site until the Contracting Officer Representative or Government Designated Authority determine whether a government investigation will be conducted.
- B. Conduct a mishap investigation for all Minor, Moderate and Major incidents as defined in paragraph DEFINITIONS, and property damage mishaps resulting in at least \$20,000 in damages, to establish the root cause(s) of the mishap. Complete the VA Form 2162 (or equivalent), and provide the report to the Contracting Officer Representative or Government Designated Authority within 5 calendar days of the accident.

The Contracting Officer Representative or Government Designated Authority will provide copies of any required or special forms.

- C. A summation of all man-hours worked by the contractor and associated sub-contractors for each month will be reported to Contracting Officer Representative.
- D. A summation of all Minor, Moderate, and Major incidents experienced on site by the contractor and associated sub-contractors for each month will be provided to the Contracting Officer Representative or Government Designated Authority monthly. The contractor and associated sub-contractors' OSHA 300 logs will be made available to the Contracting Officer Representative or Government Designated Authority 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. Mandatory PPE includes:
 - 1. Hard Hats - unless written authorization is given by the Contracting Officer Representative or Government Designated Authority in circumstances of work operations that have limited potential for falling object hazards such as during finishing work or minor remodeling. With authorization to relax the requirement of hard hats, if a worker becomes exposed to an overhead falling object hazard, then hard hats would be required in accordance with the OSHA and/or EM 385-1-1 regulations.
 - 2. Safety glasses - unless written authorization is given by the Contracting Officer Representative or Government Designated Authority in circumstances of no eye hazards, appropriate safety glasses meeting the ANSI Z.87.1 standard must be worn by each person on site.
 - 3. Appropriate Safety Shoes - based on the hazards present, safety shoes meeting the requirements of ASTM F2413-11 shall be worn by

each person on site unless written authorization is given by Contracting Officer Representative or Government Designated Authority in circumstances of no foot hazards.

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

1.14 INFECTION CONTROL

- A. Infection Control is critical in all medical center facilities. Interior construction activities causing disturbance of existing dust, or creating new dust, must be conducted within ventilation-controlled areas that minimize the flow of airborne particles into patient areas. Exterior construction activities causing disturbance of soil or creates dust in some other manner must be controlled.
- B. An AHA associated with infection control will be performed by VA personnel in accordance with FGI Guidelines (i.e. Infection Control Risk Assessment (ICRA)). The ICRA procedure found on the American Society for Healthcare Engineering (ASHE) website will be utilized. Risk classifications of Class II or lower will require approval by the Contracting Officer Representative or Government Designated Authority before beginning any construction work. Risk classifications of Class III or higher will require a permit before beginning any construction work. Infection Control permits will be issued by the COR. The Infection Control Permits will be posted outside the appropriate construction area. More than one permit may be issued for a construction project if the work is located in separate areas requiring separate classes.
 1. Class I requirements:
 - a. During Construction Work:
 - 1) Notify the Contracting Officer Representative or Government Designated Authority
 - 2) Execute work by methods to minimize raising dust from construction operations.

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

b. Upon Completion:

- 1) Clean work area upon completion of task
- 2) Notify the Contracting Officer Representative or Government Designated Authority

2. Class II requirements:

a. During Construction Work:

- 1) Notify the Contracting Officer Representative or Government Designated Authority
- 2) Provide active means to prevent airborne dust from dispersing into atmosphere such as wet methods or tool mounted dust collectors where possible.
- 3) Water mist work surfaces to control dust while cutting.
- 4) Seal unused doors with duct tape.
- 5) Block off and seal air vents.
- 6) Remove or isolate HVAC system in areas where work is being performed.

b. Upon Completion:

- 1) Wipe work surfaces with cleaner/disinfectant.
- 2) Contain construction waste before transport in tightly covered containers.
- 3) Wet mop and/or vacuum with HEPA filtered vacuum before leaving work area.
- 4) Upon completion, restore HVAC system where work was performed
- 5) Notify the Contracting Officer Representative or Government Designated Authority

3. Class III requirements:

a. During Construction Work:

- 1) Obtain permit from the Contracting Officer Representative or Government Designated Authority
- 2) Remove or Isolate HVAC system in area where work is being done to prevent contamination of duct system.
- 3) Complete all critical barriers i.e. sheetrock, plywood, plastic, to seal area from non-work area or implement control cube method (cart with plastic covering and sealed connection to work site with HEPA vacuum for vacuuming prior to exit) before construction begins. Install construction barriers and ceiling protection carefully, outside of normal work hours.
- 4) Maintain negative air pressure, 0.01 inches of water gauge, within work site utilizing HEPA equipped air filtration units and continuously monitored with a digital display, recording and alarm instrument, which must be calibrated on installation, maintained with periodic calibration and monitored by the contractor.
- 5) Contain construction waste before transport in tightly covered containers.
- 6) Cover transport receptacles or carts. Tape covering unless solid lid.

b. Upon Completion:

- 1) Do not remove barriers from work area until completed project is inspected by the Contracting Officer Representative or Government Designated Authority and thoroughly cleaned by the VA Environmental Services Department.
- 2) Remove construction barriers and ceiling protection carefully to minimize spreading of dirt and debris associated with construction, outside of normal work hours.
- 3) Vacuum work area with HEPA filtered vacuums.
- 4) Wet mop area with cleaner/disinfectant.

- 5) Upon completion, restore HVAC system where work was performed.
- 6) Return permit to the Contracting Officer Representative or Government Designated Authority

4. Class IV requirements:

a. During Construction Work:

- 1) Obtain permit from the Contracting Officer Representative or Government Designated Authority
- 2) Isolate HVAC system in area where work is being done to prevent contamination of duct system.
- 3) Complete all critical barriers i.e. sheetrock, plywood, plastic, to seal area from non-work area or implement control cube method (cart with plastic covering and sealed connection to work site with HEPA vacuum for vacuuming prior to exit) before construction begins. Install construction barriers and ceiling protection carefully, outside of normal work hours.
- 4) Maintain negative air pressure, 0.01 inches of water gauge, within work site utilizing HEPA equipped air filtration units and continuously monitored with a digital display, recording and alarm instrument, which must be calibrated on installation, maintained with periodic calibration and monitored by the contractor.
- 5) Seal holes, pipes, conduits, and punctures.
- 6) Construct anteroom and require all personnel to pass through this room so they can be vacuumed using a HEPA vacuum cleaner before leaving work site or they can wear cloth or paper coveralls that are removed each time they leave work site.
- 7) All personnel entering work site are required to wear shoe covers. Shoe covers must be changed each time the worker exits the work area.

b. Upon Completion:

- 1) Do not remove barriers from work area until completed project is inspected by the Contracting Officer Representative

Government Designated Authority with thorough cleaning by the VA Environmental Services Dept.

- 2) Remove construction barriers and ceiling protection carefully to minimize spreading of dirt and debris associated with construction, outside of normal work hours.
- 3) Contain construction waste before transport in tightly covered containers.
- 4) Cover transport receptacles or carts. Tape covering unless solid lid.
- 5) Vacuum work area with HEPA filtered vacuums.
- 6) Wet mop area with cleaner/disinfectant.
- 7) Upon completion, restore HVAC system where work was performed.
- 8) Return permit to the Contracting Officer Representative or Government Designated Authority

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

1. Class III and IV - closed door with masking tape applied over the frame and door is acceptable for projects that can be contained in a single room.
2. Construction, demolition or reconstruction not capable of containment within a single room must have the following barriers erected and made presentable on hospital occupied side:
 - a. Class III & IV (where dust control is the only hazard, and an agreement is reached with the COR and Medical Center) - Airtight plastic barrier that extends from the floor to ceiling. Seams must be sealed with duct tape to prevent dust and debris from escaping
 - b. Class III & IV - Drywall barrier erected with joints covered or sealed to prevent dust and debris from escaping.
 - c. Class III & IV - Seal all penetrations in existing barrier airtight

- d. Class III & IV - Barriers at penetration of ceiling envelopes, chases and ceiling spaces to stop movement air and debris
- e. Class IV only - Anteroom or double entrance openings that allow workers to remove protective clothing or vacuum off existing clothing
- f. Class III & IV - At elevators shafts or stairways within the field of construction, overlapping flap minimum of two feet wide of polyethylene enclosures for personnel access.

D. Products and Materials:

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

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

- F. A dust control program will be established and maintained as part of the contractor's infection preventive measures in accordance with the FGI Guidelines for Design and Construction of Healthcare Facilities. Prior to start of work, prepare a plan detailing project-specific dust protection measures with associated product data, including periodic status reports, and submit to COR and Facility CSC for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- G. Medical center Infection Control personnel will monitor for airborne disease (e.g. aspergillosis) during construction. A baseline of conditions will be established by the medical center prior to the start of work and periodically during the construction stage to determine impact of construction activities on indoor air quality with safe thresholds established.
- H. In general, the following preventive measures shall be adopted during construction to keep down dust and prevent mold.
1. Contractor shall verify that construction exhaust to exterior is not reintroduced to the medical center through intake vents or building openings. HEPA filtration is required where the exhaust dust may reenter the medical center.
 2. Exhaust hoses shall be exhausted so that dust is not reintroduced to the medical center.
 3. Adhesive Walk-off/Carpet Walk-off Mats shall be used at all interior transitions from the construction area to any occupied medical center area. These mats shall be changed as often as required to maintain clean work areas directly outside construction area at all times.
 4. Vacuum and wet mop all transition areas from construction to the occupied medical center at the end of each workday. Vacuum shall utilize HEPA filtration. Maintain surrounding area frequently. Remove debris as it is created. Transport these outside the construction area in containers with tightly fitting lids.

5. The contractor shall not haul debris through patient-care areas without prior approval of the COR and the Medical Center. When, approved, debris shall be hauled in enclosed dust proof containers or wrapped in plastic and sealed with duct tape. No sharp objects should be allowed to cut through the plastic. Wipe down the exterior of the containers with a damp rag to remove dust. All equipment, tools, material, etc. transported through occupied areas shall be made free from dust and moisture by vacuuming and wipe down.
6. There shall be no standing water during construction. This includes water in equipment drip pans and open containers within the construction areas. All accidental spills must be cleaned up and dried within 12 hours. Remove and dispose of porous materials that remain damp for more than 72 hours.
7. At completion, remove construction barriers and ceiling protection carefully, outside of normal work hours. Vacuum and clean all surfaces free of dust after the removal.

I. Final Cleanup:

1. Upon completion of project, or as work progresses, remove all construction debris from above ceiling, vertical shafts and utility chases that have been part of the construction.
2. Perform HEPA vacuum cleaning of all surfaces in the construction area. This includes walls, ceilings, cabinets, furniture (built-in or free standing), partitions, flooring, etc.
3. All new air ducts shall be cleaned prior to final inspection.

J. Exterior Construction

1. Contractor shall verify that dust will not be introduced into the medical center through intake vents or building openings. HEPA filtration on intake vents is required where dust may be introduced.
2. Dust created from disturbance of soil such as from vehicle movement will be wetted with use of a water truck as necessary

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

1.15 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.

1.16 FIRE SAFETY

- A. Fire Safety Plan: Establish and maintain a site-specific fire protection program in accordance with 29 CFR 1926. Prior to start of work, prepare a plan detailing project-specific fire safety measures, including periodic status reports, and submit to Contracting Officer Representative or Government Designated Authority for review for compliance with contract requirements in accordance with Section 01 33

23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES. This plan may be an element of the Accident Prevention Plan.

- B. Site and Building Access: Maintain free and unobstructed access to facility emergency services and for fire, police and other emergency response forces in accordance with NFPA 241.
- C. Separate temporary facilities, such as trailers, storage sheds, and dumpsters, from existing buildings and new construction by distances in accordance with NFPA 241. For small facilities with less than 6 m (20 feet) exposing overall length, separate by 3m (10 feet).
- D. Temporary Construction Partitions:
- E. Temporary Heating and Electrical: Install, use and maintain installations in accordance with 29 CFR 1926, NFPA 241 and NFPA 70.
- F. Means of Egress: Do not block exiting for occupied buildings, including paths from exits to roads. Minimize disruptions and coordinate with Resident Engineer or Contracting Officer Representative or Government Designated Authority.
- G. Egress Routes for Construction Workers: Maintain free and unobstructed egress. Inspect daily. Report findings and corrective actions weekly to Resident Engineer or Contracting Officer Representative or Government Designated Authority.
- H. Fire Extinguishers: Provide and maintain extinguishers in construction areas and temporary storage areas in accordance with 29 CFR 1926, NFPA 241 and NFPA 10.
- I. Flammable and Combustible Liquids: Store, dispense and use liquids in accordance with 29 CFR 1926, NFPA 241 and NFPA 30.
- J. Hot Work: Perform and safeguard hot work operations in accordance with NFPA 241 and NFPA 51B. Coordinate with Resident Engineer. Obtain permits at least 48 hours in advance. Designate contractor's responsible project-site fire prevention program manager to permit hot work.
- K. Fire Hazard Prevention and Safety Inspections: Inspect entire construction areas weekly. Coordinate with, and report findings and

corrective actions weekly to Resident Engineer or Contracting Officer Representative or Government Designated Authority.

- L. 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.
- M. Dispose of waste and debris in accordance with NFPA 241. Remove from buildings daily.
- N. If required, submit documentation to the Resident Engineer, COR or other Government Designated Authority that personnel have been trained in the fire safety aspects of working in areas with impaired structural or compartmentalization features.

1.17 ELECTRICAL

- A. All electrical work shall comply with NFPA 70 (NEC), NFPA 70B, NFPA 70E, 29 CFR Part 1910 Subpart J - General Environmental Controls, 29 CFR Part 1910 Subpart S - Electrical, and 29 CFR 1926 Subpart K in addition to other references required by contract.
- B. All qualified persons performing electrical work under this contract shall be licensed journeyman or master electricians. All apprentice electricians performing under this contract shall be deemed unqualified persons unless they are working under the immediate supervision of a licensed electrician or master electrician.
- C. All electrical work will be accomplished de-energized and in the Electrically Safe Work Condition (refer to NFPA 70E for Work Involving Electrical Hazards, including Exemptions to Work Permit). Any Contractor, subcontractor or temporary worker who fails to fully comply with this requirement is subject to immediate termination in accordance with FAR clause 52.236-5(c). Only in rare circumstance where achieving an electrically safe work condition prior to beginning work would increase or cause additional hazards or is infeasible due to equipment design or operational limitations is energized work permitted. The Contracting Officer Representative or Government Designated Authority with approval of the Medical Center Director will make the determination if the circumstances would meet the exception outlined

above. An AHA and permit specific to energized work activities will be developed, reviewed, and accepted by the VA prior to the start of that activity.

1. Development of a Hazardous Electrical Energy Control Procedure is required prior to de-energization. A single Simple Lockout/Tagout Procedure for multiple work operations can only be used for work involving qualified person(s) de-energizing one set of conductors or circuit part source. Task specific Complex Lockout/Tagout Procedures are required at all other times.
 2. Verification of the absence of voltage after de-energization and lockout/tagout is considered "energized electrical work" (live work) under NFPA 70E, and shall only be performed by qualified persons wearing appropriate shock protective (voltage rated) gloves and arc rate personal protective clothing and equipment, using Underwriters Laboratories (UL) tested and appropriately rated contact electrical testing instruments or equipment appropriate for the environment in which they will be used.
 3. Personal Protective Equipment (PPE) and electrical testing instruments will be readily available for inspection by the Resident Engineer, Contracting Officer Representative or Government Designated Authority.
- D. Before beginning any electrical work, an Activity Hazard Analysis (AHA) will be conducted to include Shock Hazard and Arc Flash Hazard analyses (NFPA Tables can be used only as a last alternative and it is strongly suggested a full Arc Flash Hazard Analyses be conducted). Work shall not begin until the AHA for the work activity and permit for energized work has been reviewed and accepted by the Resident Engineer, Contracting Officer Representative or Government Designated Authority and discussed with all engaged in the activity, including the Contractor, subcontractor(s), and Government on-site representatives at preparatory and initial control phase meetings.
- E. Ground-fault circuit interrupters. GFCI protection shall be provided where an employee is operating or using cord- and plug-connected tools related to construction activity supplied by 125-volt, 15-, 20-, or 30-

ampere circuits. Where employees operate or use equipment supplied by greater than 125-volt, 15-, 20-, or 30- ampere circuits, GFCI protection or an assured equipment grounding conductor program shall be implemented in accordance with NFPA 70E - 2015, Chapter 1, Article 110.4(C) (2).

1.18 FALL PROTECTION

- A. The fall protection (FP) threshold height requirement is 4ft for ALL WORK, unless specified differently or 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.
 - 1. The use of a Safety Monitoring System (SMS) as a fall protection method is prohibited.
 - 2. The use of Controlled Access Zone (CAZ) as a fall protection method is prohibited.
 - 3. A Warning Line System (WLS) may ONLY be used on floors or flat or low-sloped roofs (between 0 - 18.4 degrees or 4:12 slope) and shall be erected around all sides of the work area (See 29 CFR 1926.502(f) for construction of WLS requirements). Working within the WLS does not require FP. No worker shall be allowed in the area between the roof or floor edge and the WLS without FP. FP is required when working outside the WLS.
 - 4. Fall protection while using a ladder will be governed by the more stringent of OSHA and EM 385-1-1 requirements.

1.19 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.

1.20 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 kneeling, laying in, or stooping within the excavation is required.
- B. All excavations and trenches 24 inches in depth or greater shall require a written trenching and excavation permit (NOTE - some States and other local jurisdictions require separate state/jurisdiction-issued excavation permits). The permit shall have two sections, one section will be completed prior to digging or drilling and the other will be completed prior to personnel entering the excavations greater than 5 feet in depth. Each section of the permit shall be provided to the Resident Engineer, COR and/or Facility Safety Officer and/or other

Government Designated Authority prior to proceeding with digging or drilling and prior to proceeding with entering the excavation. After completion of the work and prior to opening a new section of an excavation, the permit shall be closed out and provided to the Resident Engineer, COR and/or Facility Safety Officer and/or other Government Designated Authority. The permit shall be maintained onsite and the first section of the permit shall include the following:

1. Estimated start time & stop 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.

1.21 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 Resident Engineer, COR and/or other Government Designated Authority 14 days prior to the scheduled lift complete with route for truck carrying load, crane load analysis, siting of crane and path of swing and all other elements of a critical lift plan where the lift meets the definition of a critical lift. Critical lifts require a more comprehensive lift plan to minimize the potential of crane failure and/or catastrophic loss. The plan must be reviewed and accepted by the General Contractor before being submitted to the VA for review. The lift will not be allowed to proceed without prior acceptance of this document.
- D. Crane operators shall not carry loads
 - 1. over the general public or VAMC personnel
 - 2. over any occupied building unless
 - a. the top two floors are vacated
 - b. or overhead protection with a design live load of 300 psf is provided

1.22 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.

1.23 CONFINED SPACE ENTRY

- A. All confined space entry shall comply with 29 CFR 1926, Subpart AA except for specifically referenced operations in 29 CFR 1926 such as excavations/trenches [1926.651(g)].
- B. A site-specific Confined Space Entry Plan (including permitting process) shall be developed and submitted to the Resident Engineer, COR and/or other Government Designated Authority.

1.24 WELDING AND CUTTING

As specified in section 1.14, Hot Work: Perform and safeguard hot work operations in accordance with NFPA 241 and NFPA 51B. Coordinate with Resident Engineer, COR and/or other Government Designated Authority. Obtain permits from Resident Engineer, COR and/or other Government Designated Authority at least 48 hours in advance. Designate contractor's responsible project-site fire prevention program manager to permit hot work.

1.25 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
- D. 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.
- F. 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.

1.26 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 toeboards 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.

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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.

- - - E N D - - -

SECTION 01 42 19
REFERENCE STANDARDS

PART 1 - GENERAL

1.1 DESCRIPTION

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

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

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

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

- A. The specifications and standards cited in this solicitation can be examined at the following location:
United States Department of Veteran Affairs
Technical Information Library
<http://www.cfm.va.gov/til/>

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)

- A. The specifications cited in this solicitation may be obtained from the associations or organizations listed below.
- AA Aluminum Association, Inc.
<http://www.aluminum.org>

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

AADM American Association of Automatic Door Manufacturers
<http://www.aaadm.com>

AATC American Association of Textile Chemists and Colorist
<http://www.aatcc.org>

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

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

AASHTO American Association of State Highway and Transportation
Officials
<http://www.transportation.org/Pages/default.aspx>

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>

ADA American with Disabilities Act
<http://www.access-board.gov/guidelines-and-standards/buildings-and-sites/about-the-ada-standards/background/adaag>

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>

AHA American Hardboard Association
<http://www.domensino.com/AHA/>

AIHA American National Standards Institute/American Industrial Hygiene
Association
<http://www.aiha.org/Pages/default.aspx>

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

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

AITC American Institute of Timber Construction
<http://www.aitc-glulam.org>

ALI Automotive Lift Institute
<http://www.autolift.org/>

AMCA Air Movement and Control Association
<http://www.amca.org/>

ANLA American Nursery & Landscape Association
<http://www.anla.org>

ANSI American National Standards Institute, Inc.
<http://www.ansi.org>

APA Architectural Precast Association
<http://www.archprecast.org/>

APA The Engineered Wood Association
<http://www.apawood.org>

ARI Air-Conditioning and Refrigeration Institute
<http://www.lightindustries.com/ARI/>

ARMA Asphalt Roofing Manufacturers Association
<http://www.asphaltroofing.org/>

ASAE American Society of Agricultural Engineers
<http://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
<http://www.asse-plumbing.org>

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

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

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

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AWPA American Wood Protection Association
<http://www.awpa.com>

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

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

BIA The Brick Industry Association
<http://www.bia.org>

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

CARB California Environmental Protection Agency Air Resources Board
<http://arb.ca.gov/hompage.html/>

CFR Code of Federal Regulations
<http://www.gpo.gov/fdsys/browse/collectionCfr.action?collectionCode=CFR>

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

CID Commercial Item Description
<http://www.gsa.gov/portal/content/100847>

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

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

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

CPA Composite Panel Association
<http://www.compositepanel.org/>

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

CRI Carpet and Rug Institute
<http://www.carpet-rug.com>

CRRC Cool Roof Rating System
<http://coolroofs.org/>

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

CSI Cast Stone Institute
<http://www.caststone.org>

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DASMA Door and Access Systems Manufacturers Association

<http://www.dasma.com/>

DHI Door and Hardware Institute

<http://www.dhi.org>

DOE U.S. Department of Energy

<http://www.energy.gov/>

EEI Edison Electric Institute

<http://www.eei.org>

EGSA Electrical Generating Systems Association

<http://www.egsa.org>

EIMA Exterior Insulation Manufacturers Association

<http://www.eima.com/>

EPA Environmental Protection Agency

<http://www.epa.gov>

ETL ETL Testing Laboratories, Inc.

<http://www.envirotestinglabs.com/>

FCC Federal Communications Commission

<http://www.fcc.gov>

FHA Federal Highway Administration

<http://www.fhwa.dot.gov/>

FM FM Global

<http://www.fmglobal.com>

FPS The Forest Products Society

<http://www.forestprod.org>

FSC Forest Stewardship Council

<http://www.fscus.org>

GA Gypsum Association

<http://www.gypsum.org>

GANNA Glass Association of North America

<http://www.glasswebsite.com>

GBI Green Building Initiative

<http://www.thegbi.org/>

GS Green Seal

<http://www.greenseal.org>

GSA General Services Administration

<http://www.gsa.gov>

- HI Hydraulic Institute
<http://www.pumps.org>
- HPVA Hardwood Plywood & Veneer Association
<http://www.hpva.org>
- ICC The International Code Council
<http://www.iccsafe.org/Pages/default.aspx>
- ICEA Insulated Cable Engineers Association Inc.
<http://www.icea.net>
- IEEE Institute of Electrical and Electronics Engineers
<http://www.ieee.org/>
- IGMA Insulating Glass Manufacturers Alliance
<http://www.igmaonline.org>
- ITS Intertek Training Services
<http://www.intertek.com/>
- MBMA Metal Buildings Manufacturers Association
<http://www.mbma.com>
- MHI Material Handling Industry of America
<http://www.mhi.org/>
- MIA Marble Institute of America
<http://www.marble-institute.com/>
- MIC Masonry Industry Council
- MPI Master Painters Institute
<http://www.mpi.net/>
- MSJC Masonry Standards Joint Committee
<http://www.masonrysociety.org/msjc/>
- NAAMM National Association of Architectural Metal Manufacturers
<http://www.naamm.org>
- NAPHCC Plumbing-Heating-Cooling Contractors Association
<http://www.phccweb.org/>
- NBS National Bureau of Standards
See - NIST
- NEC National Electric Code
See - NFPA National Fire Protection Association
- NEMA National Electrical Manufacturers Association
<http://www.nema.org>
- NFPA National Fire Protection Association
<http://www.nfpa.org>

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NFRC National Fenestration Rating Council
<http://www.nfrc.org/>

NHLA National Hardwood Lumber Association
<http://www.natlhardwood.org>

NIH National Institute of Health
<http://www.nih.gov>

NIOSH The National Institute for Occupational Safety and Health
<http://www.cdc.gov/niosh/>

NIST National Institute of Standards and Technology
<http://www.nist.gov>

NLMA Northeastern Lumber Manufacturers Association, Inc.
<http://www.nelma.org>

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

NPCA National Precast Concrete Association
<http://www.precast.org>

NRCA National Roofing Contractors Association
<http://www.nrca.net>

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

NSF NSF International
<http://www.nsf.org/>

NTMA National Terrazzo and Mosaic Association
<http://ntma.com/>

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

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

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

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

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

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

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

RCSC Research Council of Structural Connections
<http://www.boltcouncil.org/>

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

RIS Redwood Inspection Service
See - CRA

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

SCAQMD South Coast Air Quality Management District
<http://www.aqmd.gov>

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

SDI Steel Deck Institute
<http://www.sdi.org>

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

SEI Structural Engineering Institute
<http://www.asce.org/SEI/>

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

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

SPRI Single Ply Roofing Industry
<http://www.spri.org>

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

STI Steel Tank Institute
<http://www.steeltank.com>

SWI Steel Window Institute
<http://www.steelwindows.com>

SWRI Sealant Waterproofing and Restoration Institute
<http://www.swrionline.org/>

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TCNA Tile Council of North America, Inc.
<http://www.tileusa.com>

TPI Truss Plate Institute, Inc.
<http://www.tpinst.org/>

UL Underwriters' Laboratories Incorporated
<http://www.ul.com>

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

USDA U.S. Department of Agriculture
<http://www.usda.gov>

USGBC U.S. Green Building Council
<http://www.usgbc.org>

WCLIB West Coast Lumber Inspection Bureau
<http://www.wclib.org/>

WDMA Window and Door Manufacturers Association
<https://www.wdma.com/>

WH Warnock Hersey
<http://www.intertek.com/marks/wh/>

WRCLA Western Red Cedar Lumber Association
<http://www.wrcla.org/>

WWPA Western Wood Products Association
<http://www2.wwpa.org/>

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Construction Quality Control (QC) Plan; G

Submit a Construction QC Plan prior to start of construction.

Indoor Air Quality (IAQ) Management Plan; G, L
Basis of Design and Design Intent

**1.3 INFORMATION FOR THE SENIOR RESIDENT ENGINEER/CONTRACTING
OFFICER/PROJECT MANAGER (SRE/CO/PM)**

Prior to commencing work on construction, the Contractor can obtain a single copy set of the current report forms from the SRE/CO/PM. The report forms will consist of the Contractor Production Report, Contractor Production Report (Continuation Sheet), Contractor Quality Control (CQC) Report, (CQC) Report (Continuation Sheet), Preparatory Phase Checklist, Initial Phase Checklist, Rework Items List, and Testing Plan and Log.

Deliver the following to the (SRE/CO/PM) during Construction:

- a. CQC Report: Mail or hand-carry the original (wet signatures) and one copy by 10:00 AM the next working day after each day that work is performed and for every 7 consecutive calendar days of no-work.
- b. Contractor Production Report: Submit the report electronically by 10:00 AM the next working day after each day that work is performed and for every 7 consecutive calendar days of no-work. Mail or hand-carry the original (wet signatures) and one copy by 10:00 AM the next working day after each day that work is performed and for every 7 consecutive calendar days of no-work, attached to the CQC Report.
- c. Preparatory Phase Checklist: Submit the report electronically in the same manner as the CQC Report for each Preparatory Phase held.
- d. Initial Phase Checklist: Submit the report electronically in the same manner as the CQC Report for each Initial Phase held.
- f. Field Test Reports: Within two working days after the test is performed, submit the report as an electronic attachment to the CQC Report.
- g. Monthly Summary Report of Tests: Submit the report as an electronic attachment to the CQC Report at the end of each month.
- h. Testing Plan and Log: Submit the report as an electronic attachment to the CQC Report, at the end of each month.
- i. Rework Items List: Submit lists containing new entries daily, in the same manner as the CQC Report.
- j. CQC Meeting Minutes: Within two working days after the meeting is held, submit the report as an electronic attachment to the CQC Report.
- k. QC Certifications: As required by the paragraph entitled "QC Certifications".

1.4 QC PROGRAM REQUIREMENTS

Establish and maintain a QC program as described in this section. **This QC program is a key element in meeting the objectives of VA's Commissioning requirements, compliance with contract documents, and applicable codes and regulations.** The QC program consists of a QC Organization, QC Plan, QC Plan Meeting(s), a Coordination and Mutual Understanding Meeting, QC meetings, three phases of control, submittal review and approval, testing, completion inspections, and QC certifications and documentation necessary to provide materials, equipment, workmanship, fabrication, construction and operations which comply with the requirements of this Contract. The QC program must cover on-site and off-site work and be coordinated with the work sequence. No construction work or testing may be performed unless the QC Manager is on the work site. The QC Manager must report to an officer of the firm and not be subordinate to the Project Superintendent or the Project Manager. The QC Manager, Project Superintendent and Project Manager must work together effectively. Although the QC Manager is the primary individual responsible for quality control, all individuals will be held responsible for the quality of work on the job.

1.4.1 Commissioning

Commissioning (Cx) is a systematic process of ensuring that all building systems meet the requirements and perform interactively according to the Contract. The QC Program is a key to this process by coordinating, verifying and documenting measures to achieve the following objectives:

- a. Verify and document that the applicable equipment and systems are installed in accordance with the design intent as expressed through the Contract and according to the manufacturer's recommendations and industry accepted minimum standards.
- b. Verify and document that equipment and systems receive complete operational checkout by the installing Contractors.
- c. Verify and document proper performance of equipment and systems.
- d. Verify that Operation and Maintenance (O&M) documentation is complete.
- e. Verify the Training Plan and training materials are accurate and provide correct instruction and documentation on the critical elements of the products, materials, and systems in the constructed facility. Verify that all identified Government operating personnel are trained.

1.4.2 Acceptance of the Construction Quality Control (QC) Plan

Acceptance of the QC Plan is required prior to the start of construction. The (SRE/CO/PM) reserves the right to require changes in the QC Plan and operations as necessary, including removal of personnel, to ensure the specified quality of work. The (SRE/CO/PM) reserves the right to interview any member of the QC organization at any time in order to verify the submitted qualifications. All QC organization personnel are subject to acceptance by the (SRE/CO/PM). The (SRE/CO/PM) may require the removal of any individual for non-compliance with quality requirements specified in the Contract.

1.4.3 Preliminary Construction Work Authorized Prior to Acceptance

The only construction work that is authorized to proceed prior to the acceptance of the QC Plan is mobilization of storage and office trailers, temporary utilities, and surveying.

1.4.4 Notification of Changes

Notify the (SRE/CO/PM), in writing, of any proposed changes in the QC Plan or changes to the QC organization personnel, a minimum of 10 work days prior to a proposed change. Proposed changes are subject to acceptance by the (SRE/CO/PM).

1.4.5 Compliance with Architectural Barriers Act Accessibility Standards

The Architectural Barriers Act (ABA) requires all construction, renovation, or leasing with federal funds to meet the Architectural Barriers Act Accessibility Standard (ABAAS). The Contractor is required to know and apply these Standards, 36 CFR 1191, and program requirements. The Contractor shall engage an individual(s) qualified in the application of ABA standards to oversee, test, and document the Contractor's compliance with these regulations and the contract documents. The individual(s) shall have field experience applying objective design, research, industry conventions and standards. The individual(s) may also serve as one of the other QC Managers. (Amendment 2)

1.5 QC ORGANIZATION

1.5.1 QC Manager

1.5.1.1 Duties

Provide a QC Manager at the work site to implement and manage the QC program. The only duties and responsibilities of the QC Manager are to manage and implement the QC program on this Contract. The QC Manager shall report directly to the Project Manager and Company President. The QC Manager shall be on-site when work is being performed by the prime and/or sub-contractors. The QC Manager shall document all non-conforming conditions, items and/or workmanship.

The QC Manager is required to attend the partnering meetings, QC Plan Meetings, Coordination and Mutual Understanding Meeting, conduct the QC meetings, perform the three phases of control, perform submittal review and approval, ensure testing is performed and provide QC certifications and documentation required in this Contract. The QC Manager is responsible for managing and coordinating the three phases of control and documentation performed by testing laboratory personnel and any other inspection and testing personnel required by this Contract. The QC Manager is the manager of all QC activities including all Subcontractors.

1.5.1.2 Qualifications

An individual with a minimum of 5 years combined experience in the following positions: Project Superintendent, QC Manager, Project Manager, Project Engineer or Construction Manager on similar size and type construction contracts which included the major trades that are part of this Contract.

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The individual must have at least two years experience as a QC Manager. The individual must have experience in the areas of hazard identification, safety compliance, and sustainability.

1.5.2 Contractor's Commissioning Coordinator (CCC)

Provide an individual on the Contractor's staff who is regularly and frequently on site and shall be responsible for managing the Contractors in their day-to-day performance of the specified commissioning work. Required qualifications for the CCC include relevant process management experience and ability to schedule, coordinate and manage mechanical and electrical subcontractors. The CCC's responsibilities are further defined in Section 01 91 13 GENERAL COMMISSIONING REQUIREMENTS.

1.5.3 Contractor's LEED Coordinator (CLC)

The individual on the Contractor's staff responsible for ensuring construction-related LEED credits and prerequisites are properly documented. This individual shall be a LEED Accredited Professional (LEED AP) and shall be identified in the LEED Implementation Plan. This individual will coordinate with the LEED Consultant to ensure complete documentation for submission to Green Building Certification Institute (GBCI) for validation of credits and project certification. The CLC's responsibilities are further defined in Section 01 33 29 LEED(TM) DOCUMENTATION.

1.5.4 LEED Administrator

Individual hired by the Government to administer documentation for submission to the GBCI to achieve the project accreditation goal. The LEED Administrator will review the LEED submittals as listed under Section 01 33 00.00 20 SUBMITTAL PROCEDURES and as described under Section 01 33 29 LEED(TM) DOCUMENTATION. This individual will be responsible for the final submission to the GBCI once all credits have been fully documented and administers the project team members registered under the LEED online project. This individual will coordinate with the Contractor's LEED Coordinator to compile project documentation.

1.5.5 Commissioning Authority

Individual hired as a third party directly by the Government who coordinates, plans, and schedules with the Contractor's Commissioning Coordinator (CCC) to implement the Commissioning Plan.

1.5.6 LEED Commissioning Authority

1.5.6.1 Duties

Provide an independent, third party Commissioning Authority (CA) as key person for the Cx and documentation thereof, who is subordinate to the QC Manager. The CA directs and coordinates Cx activities and submits Cx reports to the (SRE/CO/PM) to meet the submittal and reporting requirements of the LEED EA Prerequisite Requirement for Fundamental Commissioning. The CA coordinates the actions of the Testing Laboratory personnel and other inspection and testing personnel required by this Contract for building Cx.

1.5.6.2 Qualifications

The CA must be certified as a commissioning professional by the AABC Commissioning Group (AGC), Association of Energy Engineers (AEE), the Building Commissioning Association (BCA), the National Environmental Balancing Bureau (NEBB), or the University of Wisconsin - Madison (UWM). CA resume is required, providing education, experience and management capabilities on at least two similar size and type contracts. The CA may not have been involved with the project design, construction management, or supervision and must be with a third-party firm that is not on the design team.

1.5.7 Construction Quality Management Training

In addition to the above experience and education requirements, the QC Manager must have completed the course entitled "Construction Quality Management (CQM) for Contractors". If the QC Manager does not have a current certification, they must obtain the CQM for Contractors course certification within 90 days of award. This course is periodically offered by the Naval Facilities Engineering Command and the Army Corps of Engineers. Contact the agencies for information on the next scheduled class.

1.5.8 Alternate QC Manager Duties and Qualifications

Designate an alternate for the QC Manager at the work site to serve in the event of the designated QC Manager's absence. The period of absence may not exceed two weeks at one time, and not more than 30 workdays during a calendar year. The qualification requirements for the Alternate QC Manager must be the same as for the QC Manager.

1.6 QUALITY CONTROL (QC) PLAN

1.6.1 Construction Quality Control (QC) Plan

1.6.1.1 Requirements

Provide, for acceptance by the (SRE/CO/PM), a Construction QC Plan submitted in a three-ring binder that includes a table of contents, with major sections identified with tabs, with pages numbered sequentially, and that documents the proposed methods and responsibilities for accomplishing commissioning activities during the construction of the project:

- a. QC ORGANIZATION: A chart showing the QC organizational structure.
- b. NAMES AND QUALIFICATIONS: Names and qualifications, in resume format, for each person in the QC organization. Include the CQM for Contractors course certifications for the QC Manager and Alternate QC Manager as required by the paragraphs entitled "Construction Quality Management Training" and "Alternate QC Manager Duties and Qualifications".
- c. DUTIES, RESPONSIBILITY AND AUTHORITY OF QC PERSONNEL: Duties, responsibilities, and authorities of each person in the QC organization.
- d. OUTSIDE ORGANIZATIONS: A listing of outside organizations, such as architectural and consulting engineering firms, that will be employed by the Contractor and a description of the services these firms will provide.

- e. APPOINTMENT LETTERS: Letters signed by an officer of the firm appointing the QC Manager and Alternate QC Manager and stating that they are responsible for implementing and managing the QC program as described in this Contract. Include in this letter the responsibility of the QC Manager and Alternate QC Manager to implement and manage the three phases of control, and their authority to stop work which is not in compliance with the Contract. Letters of direction are to be issued by the QC Manager to all other QC Specialists outlining their duties, authorities, and responsibilities. Include copies of the letters in the QC Plan.
- f. SUBMITTAL PROCEDURES AND INITIAL SUBMITTAL REGISTER: Procedures for reviewing, approving, and managing submittals. Provide the name(s) of the person(s) in the QC organization authorized to review and certify for completeness submittals prior to approval. Provide the initial submittal of the Submittal Register as specified in Section 01 33 00 SUBMITTAL PROCEDURES.
- g. TESTING LABORATORY INFORMATION: Testing laboratory information required by the paragraphs entitled "Accreditation Requirements", as applicable.
- h. TESTING PLAN AND LOG: A Testing Plan and Log that includes the tests required, referenced by the specification paragraph number requiring the test, the frequency, and the person responsible for each test. Use Government forms to log and track tests.
- i. PROCEDURES TO COMPLETE REWORK ITEMS: Procedures to identify, record, track, and complete rework items. Provide a sample rework item list including fields for the date the item was identified, description of the item, referenced requirement (specification, code, standard, etc.), action proposed or taken by Contractor, and date completed. Procedures to identify, record, track, and complete rework items. Use Government forms to record and track rework items.
- j. DOCUMENTATION PROCEDURES: Use Government form.
- k. LIST OF DEFINABLE FEATURES: A Definable Feature of Work (DFOW) is a task that is separate and distinct from other tasks and has control requirements and work crews unique to that task. A DFOW is identified by different trades or disciplines and is an item or activity on the construction schedule. Include all activities for which this specification requires QC Specialists or specialty inspection personnel. Provide separate DFOWs in the Network Analysis Schedule for each design development stage and submittal package.
- l. PROCEDURES FOR PERFORMING THE THREE PHASES OF CONTROL: Identify procedures used to ensure the three phases of control to manage the quality on this project. For each DFOW, a Preparatory and Initial phase checklist will be filled out during the Preparatory and Initial phase meetings. Conduct the Preparatory and Initial Phases and meetings with a view towards obtaining quality construction by planning ahead and identifying potential problems for each DFOW.

- m. PERSONNEL MATRIX: Not Applicable.
- n. PROCEDURES FOR COMPLETION INSPECTION: Procedures for identifying and documenting the completion inspection process. Include in these procedures the responsible party for punch out inspection, pre-final inspection, and final acceptance inspection.
- o. TRAINING PROCEDURES AND TRAINING LOG: Not Applicable.
- p. ORGANIZATION AND PERSONNEL CERTIFICATIONS LOG: Procedures for coordinating, tracking and documenting all certifications on Subcontractors, testing laboratories, suppliers, personnel, etc. QC Manager will ensure that certifications are current, appropriate for the work being performed, and will not lapse during any period of the contract that the work is being performed.

1.7 QC PLAN MEETINGS

Prior to submission of the QC Plan, the QC Manager will meet with the (SRE/CO/PM) to discuss the QC Plan requirements of this Contract. The purpose of this meeting is to develop a mutual understanding of the QC Plan requirements prior to plan development and submission and to agree on the Contractor's list of DFOWs.

1.8 COORDINATION AND MUTUAL UNDERSTANDING MEETING

After submission of the QC Plan, and prior to the start of construction, the QC Manager will meet with the (SRE/CO/PM) to present the QC program required by this Contract. When a new QC Manager is appointed, the coordination and mutual understanding meeting shall be repeated.

1.8.1 Purpose

The purpose of this meeting is to develop a mutual understanding of the QC details, including documentation, administration for on-site and off-site work, design intent, Cx, environmental requirements and procedures, coordination of activities to be performed, and the coordination of the Contractor's management, production, and QC personnel. At the meeting, the Contractor will be required to explain in detail how three phases of control will be implemented for each DFOW, as well as how each DFOW will be affected by each management plan or requirement as listed below:

- a. Waste Management Plan.
- b. IAQ Management Plan.
- c. Procedures for noise and acoustics management.
- d. Environmental Protection Plan.
- e. Environmental regulatory requirements.
- f. Cx Plan.
- g. **Architectural Barriers Act Accessibility Standard. (Amendment 2)**

1.8.2 Coordination of Activities

Coordinate activities included in various sections to assure efficient and orderly installation of each component. Coordinate operations included under different sections that are dependent on each other for proper installation and operation. Schedule construction operations with consideration for indoor air quality as specified in the IAQ Management Plan. Coordinate prefunctional tests and startup testing with Cx.

1.8.3 Attendees

As a minimum, the Contractor's personnel required to attend include an officer of the firm, the Project Manager, Project Superintendent, QC Manager, Alternate QC Manager, A/E, CA, Environmental Manager, and Subcontractor representatives. Each Subcontractor who will be assigned QC responsibilities shall have a principal of the firm at the meeting. Minutes of the meeting will be prepared by the QC Manager and signed by the Contractor and the (SRE/CO/PM). Provide a copy of the signed minutes to all attendees and shall be included in the QC Plan.

1.9 QC MEETINGS

After the start of construction, conduct QC meetings once every two weeks by the QC Manager at the work site with the Project Superintendent, the CA, and the foremen who are performing the work of the DFOWs. The QC Manager is to prepare the minutes of the meeting and provide a copy to the (SRE/CO/PM) within two working days after the meeting. The (SRE/CO/PM) may attend these meetings. As a minimum, accomplish the following at each meeting:

- a. Review the minutes of the previous meeting.
- b. Review the schedule and the status of work and rework.
- c. Review the status of submittals.
- d. Review the work to be accomplished in the next two weeks and documentation required.
- e. Resolve QC and production problems (RFI, etc.).
- f. Address items that may require revising the QC Plan.
- g. Review Accident Prevention Plan (APP).
- h. Review environmental requirements and procedures.
- i. Review Waste Management Plan.
- j. Review IAQ Management Plan.
- k. Review Environmental Management Plan.
- l. Review the status of training completion.
- m. Review Cx Plan and progress.

1.10 DESIGN REVIEW AND DOCUMENTATION

1.10.1 Basis of Design and Design Intent

Review the basis of design received from the (SRE/CO/PM).

1.10.2 Design Review

Review design documents to verify that each commissioned system meets the design intent relative to functionality, energy performance, water performance, maintainability, sustainability, system cost, indoor environmental quality, and local environmental impacts. Fully document review in written report.

1.10.3 Contract Document Review

Review the Contract documents to verify that Cx is adequately specified, and that each commissioned system is likely to meet the design intent relative to functionality, energy performance, water performance, maintainability, sustainability, system cost, indoor environmental quality, and local environmental impacts.

1.11 THREE PHASES OF CONTROL

Adequately cover both on-site and off-site work with the Three Phases of Control and include the following for each DFOW.

1.11.1 Preparatory Phase

Notify the (SRE/CO/PM) at least two work days in advance of each preparatory phase meeting. The meeting will be conducted by the QC Manager and attended by the Project Superintendent, Safety Manager, the CA, and the foreman responsible for the DFOW. When the DFOW will be accomplished by a Subcontractor, that Subcontractor's foreman (the leader of the work crew accomplishing the DFOW and who shall be present on site for the duration of the work) shall attend the preparatory phase meeting. Document the results of the preparatory phase actions in the daily Contractor Quality Control Report and in the Preparatory Phase Checklist. Perform the following prior to beginning work on each DFOW:

- a. Review each paragraph of the applicable specification sections.
- b. Review the Contract drawings.
- c. Verify that field measurements are as indicated on construction and/or shop drawings before confirming product orders, in order to minimize waste due to excessive materials.
- d. Verify that appropriate shop drawings and submittals for materials and equipment have been submitted and approved. Verify receipt of approved factory test results, when required.
- e. Review the testing plan and ensure that provisions have been made to provide the required QC testing.
- f. Examine the work area to ensure that the required preliminary work has been completed.

- g. Coordinate the schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.
- h. Arrange for the return of shipping/packaging materials, such as wood pallets, where economically feasible.
- i. Examine the required materials, equipment and sample work to ensure that they are on hand and conform to the approved shop drawings and submitted data.
- j. Discuss specific controls used and construction methods, construction tolerances, workmanship standards, and the approach that will be used to provide quality construction by planning ahead and identifying potential problems for each DFOW.
- k. Review the APP and appropriate Activity Hazard Analysis (AHA) to ensure that applicable safety requirements are met, and that required Material Safety Data Sheets (MSDS) are submitted.
- l. Review the Cx Plan and ensure all preliminary work items have been completed and documented.
- m. Schedule the date/time for the initial inspection.

1.11.2 Initial Phase

The Initial Phase inspection shall be conducted as soon as a representative portion of the work is completed. Notify the (SRE/CO/PM) at least two work days in advance of each initial phase. When construction crews are ready to start work on a DFOW, conduct the initial phase with the Project Superintendent, and the foreman responsible for that DFOW. Observe the initial segment of the DFOW to ensure that the work complies with Contract requirements. Document the results of the initial phase in the daily CQC Report and in the Initial Phase Checklist. Repeat the initial phase for each new crew to work on-site, or when acceptable levels of specified quality are not being met. Perform the following for each DFOW:

- a. Establish the quality of workmanship required.
- b. Resolve conflicts.
- c. Ensure that testing is performed by the approved laboratory.
- d. Check work procedures for compliance with the APP and the appropriate AHA to ensure that applicable safety requirements are met.
- e. Review the Cx Plan and ensure all preparatory work items have been completed and documented.

1.11.3 Follow-Up Phase

Perform the following for on-going work daily, or more frequently as necessary, until the completion of each DFOW and document in the daily CQC Report:

- a. Ensure the work is in compliance with Contract requirements.
- b. Maintain the quality of workmanship required.
- c. Ensure that testing is performed by the approved laboratory.
- d. Ensure that rework items are being corrected.
- e. Assure manufacturers representatives have performed necessary inspections if required and perform safety inspections.
- f. Review the Cx Plan and ensure all work items, testing, and documentation has been completed.

1.11.4 Additional Preparatory and Initial Phases

Conduct additional preparatory and initial phases on the same DFOW if the quality of on-going work is unacceptable, if there are changes in the applicable QC organization, if there are changes in the on-site production supervision or work crew, if work on a DFOW is resumed after substantial period of inactivity, or if other problems develop.

1.11.5 Notification of Three Phases of Control for Off-Site Work

Notify the (SRE/CO/PM) at least two weeks prior to the start of the preparatory and initial phases.

1.12 SUBMITTAL REVIEW AND APPROVAL

Procedures for submission, review and approval of submittals are described in Section 01 33 00 SUBMITTAL PROCEDURES.

1.13 TESTING

Except as stated otherwise in the specification sections, perform sampling and testing required under this Contract.

1.13.1 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 (E 329, C 1077, D 3666, D 3740, A 880, E 543) listed in the technical sections of the specifications. Laboratories engaged in Hazardous Materials Testing shall meet the requirements of OSHA and EPA. The policy applies to the specific laboratory performing the actual testing, not just the Corporate Office.

1.13.2 Laboratory Accreditation Authorities

Laboratory Accreditation Authorities include the National Voluntary Laboratory Accreditation Program (NVLAP) administered by the National

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Institute of Standards and Technology at <http://ts.nist.gov/ts/htdocs/210/214/214.htm> , the American Association of State Highway and Transportation Officials (AASHTO) program at <http://www.transportation.org/aashto/home.nsf/frontpage> , International Accreditation Services, Inc. (IAS) at <http://www.iasonline.org>, U. S. Army Corps of Engineers Materials Testing Center (MTC) at <http://www.wes.army.mil/SL/MTC/>, the American Association for Laboratory Accreditation (A2LA) program at <http://www.a2la.org/>, the Washington Association of Building Officials (WABO) at <http://www.wabo.org/> (Approval authority for WABO is limited to projects within Washington State), and the Washington Area Council of Engineering Laboratories (WACEL) at <http://www.wacel.org/labaccred.html> (Approval authority by WACEL is limited to projects within Facilities Engineering Command (FEC) Washington geographical area).

1.13.3 Capability Check

The (SRE/CO/PM) retains the right to check laboratory equipment in the proposed laboratory and the laboratory technician's testing procedures, techniques, and other items pertinent to testing, for compliance with the standards set forth in this Contract.

1.13.4 Test Results

Cite applicable Contract requirements, tests or analytical procedures used. Provide actual results and include a statement that the item tested or analyzed conforms or fails to conform to specified requirements. If the item fails to conform, notify the (SRE/CO/PM) immediately. Conspicuously stamp the cover sheet for each report in large red letters "CONFORMS" or "DOES NOT CONFORM" to the specification requirements, whichever is applicable. Test results must be signed by a testing laboratory representative authorized to sign certified test reports. Furnish the signed reports, certifications, and other documentation to the (SRE/CO/PM) via the QC Manager. Furnish a summary report of field tests at the end of each month, per the paragraph entitled "INFORMATION FOR THE CONTRACTING OFFICER".

1.13.5 Test Reports and Monthly Summary Report of Tests

Furnish the signed reports, certifications, and a summary report of field tests at the end of each month to the (SRE/CO/PM). Attach a copy of the summary report to the last daily Contractor Quality Control Report of each month. Provide a copy of the signed test reports and certifications to the OMSI preparer for inclusion into the OMSI documentation.

1.14 QC CERTIFICATIONS

1.14.1 CQC Report Certification

Contain the following statement within the CQC Report: "On behalf of the Contractor, I certify that this report is complete and correct and equipment and material used and work performed during this reporting period is in compliance with the contract drawings and specifications to the best of my knowledge, except as noted in this report".

1.14.2 Invoice Certification

Furnish a certificate to the (SRE/CO/PM) with each payment request, signed by the QC Manager, attesting that as-built drawings are current, coordinated and attesting that the work for which payment is requested, including stored material, is in compliance with Contract requirements.

1.14.3 Completion Certification

Upon completion of work under this Contract, the QC Manager shall furnish a certificate to the (SRE/CO/PM) attesting that "the work has been completed, inspected, tested and is in compliance with the Contract". Provide a copy of this final QC Certification for completion to the OMSI preparer for inclusion into the OMSI documentation.

1.15 COMPLETION INSPECTIONS

1.15.1 Punch-Out Inspection

Near the completion of all work or any increment thereof, established by a completion time stated in the Contract Clause entitled "Commencement, Prosecution, and Completion of Work", or stated elsewhere in the specifications, the QC Manager and the CA must conduct an inspection of the work and develop a "punch list" of items which do not conform to the approved drawings, specifications and Contract. Include in the punch list any remaining items on the "Rework Items List", which were not corrected prior to the Punch-Out Inspection. Include within the punch list the estimated date by which the deficiencies will be corrected. Provide a copy of the punch list to the (SRE/CO/PM). The QC Manager, or staff, must make follow-on inspections 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".

1.15.2 Pre-Final Inspection

The Government and QCM will perform this inspection to verify that the facility is complete and ready to be occupied. A Government "Pre-Final Punch List" will be documented by the CQM as a result of this inspection. The QC Manager will ensure that all items on this list are corrected prior to notifying the Government that a "Final" inspection with the Client can be scheduled. Any items noted on the "Pre-Final" inspection must be corrected in a timely manner and be accomplished before the contract completion date for the work, or any particular increment thereof, if the project is divided into increments by separate completion dates.

1.15.3 Final Acceptance Inspection

Notify the (SRE/CO/PM) at least 14 calendar days prior to the date a final acceptance inspection can be held. State within the notice that all items previously identified on the pre-final punch list will be corrected and acceptable, along with any other unfinished Contract work, by the date of the final acceptance inspection. The Contractor must be represented by the QC Manager, the Project Superintendent, the CA, and others deemed necessary. Attendees for the Government will include the (SRE/CO/PM), other VA/NCA personnel, and personnel representing the Client. Failure of the Contractor to have all contract work acceptably complete for this inspection will be cause for the (SRE/CO/PM) to bill the Contractor for the Government's additional inspection cost in accordance with the Contract Clause entitled "Inspection of Construction".

1.16 DOCUMENTATION

Maintain current and complete records of on-site and off-site QC program operations and activities.

1.16.1 Construction Documentation

Reports are required for each day that work is performed and must be attached to the Contractor Quality Control Report prepared for the same day. Maintain current and complete records of on-site and off-site QC program operations and activities. The forms identified under the paragraph "INFORMATION FOR THE CONTRACTING OFFICER" will be used. Reports are required for each day work is performed. Account for each calendar day throughout the life of the Contract. Every space on the forms must be filled in. Use N/A if nothing can be reported in one of the spaces. The Project Superintendent and the QC Manager must prepare and sign the Contractor Production and CQC Reports, respectively. The reporting of work must be identified by terminology consistent with the construction schedule. In the "remarks" sections of the reports, enter pertinent information including directions received, problems encountered during construction, work progress and delays, conflicts or errors in the drawings or specifications, field changes, safety hazards encountered, instructions given and corrective actions taken, delays encountered and a record of visitors to the work site, quality control problem areas, deviations from the QC Plan, construction deficiencies encountered, meetings held. For each entry in the report(s), identify the Schedule Activity No. that is associated with the entered remark.

1.16.2 Quality Control Validation

Establish and maintain the following in a series of three ring binders. Binders shall be divided and tabbed as shown below. These binders must be readily available to the (SRE/CO/PM) during all business hours.

- a. All completed Preparatory and Initial Phase Checklists, arranged by specification section.
- b. All milestone inspections, arranged by Activity Number.
- c. An up-to-date copy of the Testing Plan and Log with supporting field test reports, arranged by specification section.
- d. Copies of all contract modifications, arranged in numerical order. Also include documentation that modified work was accomplished.
- e. An up-to-date copy of the Rework Items List.
- f. Maintain up-to-date copies of all punch lists issued by the QC staff to the Contractor and Sub-Contractors and all punch lists issued by the Government.
- g. Commissioning documentation including Cx checklists, schedules, tests, and reports.

1.16.3 Testing Plan and Log

As tests are performed, the CA and the QC Manager will record on the "Testing Plan and Log" the date the test was performed and the date the test results were forwarded to the (SRE/CO/PM). Attach a copy of the updated "Testing Plan and Log" to the last daily CQC Report of each month, per the paragraph "INFORMATION FOR THE CONTRACTING OFFICER". Provide a copy of the final "Testing Plan and Log" to the OMSI preparer for inclusion into the OMSI documentation.

1.16.4 Rework Items List

The QC Manager must maintain a list of work that does not comply with the Contract, identifying what items need to be reworked, the date the item was originally discovered, the date the item will be corrected by, and the date the item was corrected. There is no requirement to report a rework item that is corrected the same day it is discovered, however, such reporting is an indication that the QC program is working. Attach a copy of the "Rework Items List" to the last daily CQC Report of each month. The Contractor is responsible for including those items identified by the (SRE/CO/PM).

1.16.5 As-Built Drawings

The QC Manager is required to ensure the as-built drawings are kept current on a daily basis and marked to show deviations which have been made from the Contract drawings. Ensure each deviation has been identified with the appropriate modifying documentation (e.g. PC No., Modification No., Request for Information No., etc.). The QC Manager must initial each revision. Upon completion of work, the QC Manager will furnish a certificate attesting to the accuracy of the as-built drawings prior to submission to the (SRE/CO/PM).

1.17 NOTIFICATION ON NON-COMPLIANCE

The (SRE/CO/PM) will notify the Contractor of any detected non-compliance with the Contract. Take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site, shall be deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the (SRE/CO/PM) may 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 for excess costs or damages by the Contractor.

1.18 CONSTRUCTION INDOOR AIR QUALITY (IAQ) MANAGEMENT PLAN

Submit an IAQ Management Plan within 15 days after Contract award and not less than 10 days before the preconstruction meeting. Revise and resubmit Plan as required by the (SRE/CO/PM). Make copies of the final plan available to all workers on site. Include provisions in the Plan to meet the requirements specified below and to ensure safe, healthy air for construction workers and building occupants.

1.18.1 Requirements During Construction

Provide for evaluation of indoor Carbon Dioxide concentrations in accordance with ASTM D6245. Provide for evaluation of volatile organic compounds (VOCs) in indoor air in accordance with ASTM D6345. Use filters with a

Minimum Efficiency Reporting Value (MERV) of 8 in permanently installed air handlers during construction.

1.18.1.1 Control Measures

Meet or exceed the requirements of ANSI/SMACNA 008, Chapter 3, to help minimize contamination of the building from construction activities. The 5 requirements of this manual which must be adhered to are described below:

- a. HVAC protection: Isolate return side of HVAC system from surrounding environment to prevent construction dust and debris from entering the duct work and spaces.
- b. Source control: Use low emitting paints and other finishes, sealants, adhesives, and other materials as specified. When available, cleaning products shall have a low VOC content and be non-toxic to minimize building contamination. Utilize cleaning techniques that minimize dust generation. Cycle equipment off when not needed. Prohibit idling motor vehicles where emissions could be drawn into building. Designate receiving/storage areas for incoming material that minimize IAQ impacts.
- c. Pathway interruption: When pollutants are generated use strategies such as 100 percent outside air ventilation or erection of physical barriers between work and non-work areas to prevent contamination.
- d. Housekeeping: Clean frequently to remove construction dust and debris. Promptly clean up spills. Remove accumulated water and keep work areas dry to discourage the growth of mold and bacteria. Take extra measures when hazardous materials are involved.
- e. Scheduling: Control the sequence of construction to minimize the absorption of VOCs by other building materials.

1.18.1.2 Moisture Contamination

- a. Remove accumulated water and keep work dry.
- b. Use dehumidification to remove moist, humid air from a work area.
- c. Do not use combustion heaters or generators inside the building.
- d. Protect porous materials from exposure to moisture.
- e. Remove and replace items which remain damp for more than a few hours.

1.18.2 Requirements after Construction

After construction ends and prior to occupancy, conduct a building flush-out or test the indoor air contaminant levels. Flush-out must be a minimum two-weeks with MERV-13 filtration media as determined by ASHRAE 52.2 at 100 percent outside air, or in accordance with LEED GBDC. Air contamination testing must be consistent with EPA's current Compendium of Methods for the Determination of Air Pollutants in Indoor Air, and with the LEED GBDC. After building flush-out or testing and prior to occupancy, replace

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filtration media. Filtration media must have a MERV of 13 as determined by ASHRAE 52.2.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 PREPARATION

Designate receiving/storage areas for incoming material to be delivered according to installation schedule and to be placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication. Store and handle materials in a manner as to prevent loss from weather and other damage. Keep materials, products, and accessories covered and off the ground, and store in a dry, secure area. Prevent contact with material that may cause corrosion, discoloration, or staining. Protect all materials and installations from damage by the activities of other trades.

-- End of Section --

SECTION 01 45 29
TESTING LABORATORY SERVICES

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies materials testing activities and inspection services required during project construction to be provided by a third party Testing Laboratory retained and paid for by Contractor. Refer to Section 01 00 01, GENERAL REQUIREMENTS, for additional information.

1.2 RELATED DOCUMENTS

A. Section 01 00 01, GENERAL REQUIREMENTS.

1.3 APPLICABLE PUBLICATIONS

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

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

| | |
|-----------------|--|
| T27-11 | Sieve Analysis of Fine and Coarse Aggregates |
| T96-02 (R2006) | Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine |
| T99-10 | The Moisture-Density Relations of Soils Using a 2.5 Kg (5.5 lb.) Rammer and a 305 mm (12 in.) Drop |
| T104-99 (R2007) | Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate |
| T180-10 | Moisture-Density Relations of Soils using a 4.54 kg (10 lb.) Rammer and a 457 mm (18 in.) Drop |
| T191-02 (R2006) | Density of Soil In-Place by the Sand-Cone Method |

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

| | |
|----------|---|
| A325-10 | Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength |
| A370-12a | Definitions for Mechanical Testing of Steel Products |

| | |
|-----------------|--|
| A490-12 | Heat Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength |
| C31/C31M-12 | Making and Curing Concrete Test Specimens in the Field |
| C33/C33M-13 | Concrete Aggregates |
| C39/C39M-12 | Compressive Strength of Cylindrical Concrete Specimens |
| C109/C109M-12 | Compressive Strength of Hydraulic Cement Mortars |
| C138/C138M-12a | Unit Weight, Yield, and Air Content (Gravimetric) of Concrete |
| C140-13 | Sampling and Testing Concrete Masonry Units and Related Units |
| C143/C143M-12 | Slump of Hydraulic Cement Concrete |
| C172/C172M-10 | Sampling Freshly Mixed Concrete |
| C173/C173M-12 | Air Content of freshly Mixed Concrete by the Volumetric Method |
| C330/C330M-09 | Lightweight Aggregates for Structural Concrete |
| C567/C567M-11 | Density Structural Lightweight Concrete |
| C780-12a | Pre-construction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry |
| C1019-11 | Sampling and Testing Grout |
| C1064/C1064M-12 | Freshly Mixed Hydraulic Cement Concrete |
| C1077-13 | Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation |
| C1314-12 | Compressive Strength of Masonry Prisms |
| C1364-10b | Architectural Cast Stone |
| D698-12 | Laboratory Compaction Characteristics of Soil Using Standard Effort |
| D1143/D1143M-07 | Deep Foundations Under Static Axial Compressive Load |
| D1188-07 | Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens |

| | |
|-----------------|---|
| D1556-07 | Density and Unit Weight of Soil in Place by the Sand-Cone Method |
| D1557-12 | Laboratory Compaction Characteristics of Soil Using Modified Effort |
| D2166-06 | Unconfined Compressive Strength of Cohesive Soil |
| D2167-08 | Density and Unit Weight of Soil in Place by the Rubber Balloon Method |
| D2216-10 | Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass |
| D2974-07 | Moisture, Ash, and Organic Matter of Peat and Other Organic Soils |
| D3666-11 | Minimum Requirements for Agencies Testing and Inspection Bituminous Paving Materials |
| D3740-12a | Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock |
| E94-04 (2010) | Radiographic Examination |
| E164-08 | Contact Ultrasonic Testing of Weldments |
| E329-11c | Agencies Engaged in Construction Inspection, Testing, or Special Inspection |
| E543-13 | Agencies Performing Nondestructive Testing |
| E709-08 | Guide for Magnetic Particle Testing |
| E1155-96 (2008) | Determining FF Floor Flatness and FL Floor Levelness Numbers |

D. American Welding Society (AWS):

D1.1-07 Structural Welding Code-Steel

1.4 REQUIREMENTS

A. Accreditation Requirements: Third party Testing Laboratory retained and paid for by Contractor must be accredited by one or more of the National Voluntary Laboratory Accreditation Program (NVLAP) programs acceptable in the geographic region for the project. Furnish to the Project Manager (PM) a copy of the Certificate of Accreditation and Scope of Accreditation. For testing laboratories that have not yet obtained accreditation by a NVLAP program, submit an acknowledgement letter from one of the laboratory accreditation authorities indicating that the application for accreditation has been received and the

accreditation process has started, and submit to the PM for approval, certified statements, signed by an official of the testing laboratory attesting that the proposed laboratory, meets or conforms to the ASTM standards listed below as appropriate to the testing field.

1. Laboratories engaged in testing of construction materials must meet the requirements of ASTM E329.
 2. Laboratories engaged in testing of concrete and concrete aggregates must meet the requirements of ASTM C1077.
 3. Laboratories engaged in testing of bituminous paving materials must meet the requirements of ASTM D3666.
 4. Laboratories engaged in testing of soil and rock, as used in engineering design and construction, must meet the requirements of ASTM D3740.
 5. Laboratories engaged in inspection and testing of steel, stainless steel, and related alloys will be evaluated according to ASTM A880.
 6. Laboratories engaged in non-destructive testing (NDT) must meet the requirements of ASTM E543.
 7. Laboratories engaged in Hazardous Materials Testing must meet the requirements of OSHA and EPA.
- B. Inspection and Testing: Testing laboratory to inspect materials and workmanship and perform tests described herein and additional tests requested by PM. When it appears, materials furnished, or work performed by Contractor fail to meet construction contract requirements, Testing Laboratory must direct attention of PM to such failure.
- C. Written Reports: Testing laboratory to submit test reports to PM and Contractor within 24 hours after each test is completed unless other arrangements are agreed to in writing by the PM. Submit reports of tests that fail to meet construction contract requirements on colored paper.
- D. Verbal Reports: Give verbal notification to PM immediately of any irregularity.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EARTHWORK

- A. General: The Testing Laboratory is to 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 is as identified herein including, 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 PM regarding suitability or unsuitability of areas where proof-rolling was observed. Where unsuitable results are observed, witness excavation of unsuitable material and recommend to PM 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 ASTM D698.
 2. Make field density tests in accordance with the primary testing method following ASTM D2922 wherever possible. Field density tests utilizing ASTM D1556 or ASTM D2167 to 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 must provide satisfactory explanation to the PM before the tests are conducted.
 - a. Building Slab Subgrade: At least one test of subgrade for every 2000 square feet of building slab, but in no case fewer than

three tests. In each compacted fill layer, perform one test for every 2000 square feet of overlaying building slab, but in no case fewer than three tests.

- b. Foundation Wall Backfill: One test per 100 feet of each layer of compacted fill but in no case fewer than two tests.
 - c. Pavement Subgrade: One test for each 400 square yards, but in no case fewer than two tests.
 - d. Curb, Gutter, and Sidewalk: One test for each 300 feet, but in no case fewer than two tests.
 - e. Trenches: One test at maximum 100-foot intervals per 4 foot of vertical lift and at changes in required density, but in no case fewer than two tests.
 - f. Footing Subgrade: At least one test for each layer of soil on which footings will be placed. Subsequent verification and approval of each footing subgrade may be based on a visual comparison of each subgrade with related tested subgrade when acceptable to PM. In each compacted fill layer below wall footings, perform one field density test for every 100 feet of wall. Verify subgrade is level, all loose or disturbed soils have been removed, and correlate actual soil conditions observed with those indicated by test borings.
- C. Testing for Footing Bearing Capacity: Evaluate if suitable bearing capacity material is encountered in footing subgrade.
- D. Testing Materials: Test suitability of on-site and off-site borrow as directed by PM.

3.2 LANDSCAPING

- A. Test topsoil for organic materials, pH, phosphate, potash content, and gradation of particles.
 - 1. Test for organic material by using ASTM D2974.
 - 2. Determine percent of silt, sand, clay, and foreign materials such as rock, roots, and vegetation.
 - 3. Test for moisture absorption capacity.
- B. Submit laboratory test report of topsoil to PM.
- C. Submit recommendations for soil amendments, from a regional soil conservation service or cooperative extension, to bring soil into compliance with minimum parameters in these specifications.

3.3 ASPHALT CONCRETE PAVING

A. Aggregate Base Course:

1. Determine maximum density and optimum moisture content for aggregate base material in accordance with local DOT.
2. Make a minimum of three field density tests on each day's final compaction on each aggregate course.
3. Sample and test aggregate as necessary to insure compliance with specification requirements for gradation, wear, and soundness as specified in the applicable state highway standards and specifications.

B. Asphalt Concrete:

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

3.4 SITE WORK CONCRETE

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

3.5 CONCRETE

A. Batch Plant Inspection and Materials Testing:

1. Perform continuous batch plant inspection until concrete quality is established to satisfaction of PM and perform periodic inspections thereafter as determined by PM.
2. Periodically inspect and test batch proportioning equipment for accuracy and report deficiencies to PM.
3. Sample and test mix ingredients as necessary to insure compliance with specifications.
4. Sample and test aggregates daily and as necessary for moisture content. Test the dry rodded weight of the coarse aggregate whenever a sieve analysis is made, and when it appears there has been a change in the aggregate.

5. Certify, in duplicate, ingredients and proportions and amounts of ingredients in concrete conform to approved trial mixes. When concrete is batched or mixed off immediate building site, certify (by signing, initialing or stamping thereon) on delivery slips (duplicate) that ingredients in truck-load mixes conform to proportions of aggregate weight, cement factor, and water-cement ratio of approved trial mixes.

B. Field Inspection and Materials Testing:

1. Provide an ACI Certified Field Technician, Grade 1, technician for the entire placement at all times to perform concrete sampling and testing.
2. Review the delivery and batch tickets of the ready-mix concrete trucks arriving on-site. Notify the Contractor if the concrete cannot be placed within the specified time limits or if the type of concrete delivered is incorrect. Reject any loads that do not comply with the Specification requirements. Rejected loads are to be removed from the site at the Contractor's expense. Any rejected concrete that is placed will be subject to removal.
3. Take concrete samples at point of placement in accordance with ASTM C172. Mold and cure compression test cylinders in accordance with ASTM C31. Make at least three cylinders for each 50 cubic yards or less of each concrete type, and at least three cylinders for any one day's pour for each concrete type. After good concrete quality control has been established and maintained as determined by PM make three cylinders for each 100 cubic yards or less of each concrete type, and at least three cylinders from any one day's pour for each concrete type. Label each cylinder with an identification number. PM 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 25

- cubic yards thereafter each day. For concrete not required to be air-entrained, test every 100 cubic yards at random. For pumped concrete, initially test concrete at both the hopper and the discharge end of the hose to determine change in air content.
6. If slump or air content fall outside specified limits, make another test immediately from another portion of same batch.
 7. Perform unit weight tests in compliance with ASTM C138 for normal weight concrete and ASTM C567 for lightweight concrete. Test the first truck and each time cylinders are made.
 8. Notify laboratory technician at batch plant of mix irregularities and request materials and proportioning check.
 9. Verify that specified mixing has been accomplished.
 10. Environmental Conditions: Determine the temperature per ASTM C1064 for each truckload of concrete during hot weather and cold weather concreting operations:
 - a. When ambient air temperature falls below 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 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 for surface defects.
 14. Observe curing procedures for conformance with specifications, record dates of concrete placement, start of preliminary curing, start of final curing, end of curing period.
 15. Observe preparations for placement of concrete:

- a. Inspect handling, conveying, and placing equipment, inspect vibrating and compaction equipment.
 - b. Inspect preparation of construction, expansion, and isolation joints.
 16. Observe preparations for protection from hot weather, cold weather, sun, and rain, and preparations for curing.
 17. Observe concrete mixing:
 - a. Monitor and record amount of water added at project site.
 - b. Observe minimum and maximum mixing times.
 18. Measure concrete flatwork for levelness and flatness as follows:
 - a. Perform Floor Tolerance Measurements F_F and F_L in accordance with ASTM E1155. Calculate the actual overall F- numbers using the inferior/superior area method.
 - b. Perform all floor tolerance measurements within 48 hours after slab installation and prior to removal of shoring and formwork.
 - c. Provide the Contractor and the PM with the results of all profile tests, including a running tabulation of the overall F_F and F_L values for all slabs installed to date, within 72 hours after each slab installation.
 19. Other inspections:
 - a. Grouting under base plates.
 - b. Grouting anchor bolts and reinforcing steel in hardened concrete.
- C. Laboratory Tests of Field Samples:
1. Test compression test cylinders for strength in accordance with ASTM C39. For each test series, test one cylinder at 7 days and one cylinder at 28 days. Use remaining cylinder as a spare tested as directed by PM. Compile laboratory test reports as follows:
Compressive strength test to be the result of one cylinder, except when one cylinder shows evidence of improper sampling, molding or testing, in which case it must be discarded and strength of spare cylinder to be used.
 2. Make weight tests of hardened lightweight structural concrete in accordance with ASTM C567.
 3. Furnish certified compression test reports (duplicate) to PM. 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 psi.
- e. Weight of lightweight structural concrete in pounds per cubic feet.
- f. Weather conditions during placing.
- g. Temperature of concrete in each test cylinder when test cylinder was molded.
- h. Maximum and minimum ambient temperature during placing.
- i. Ambient temperature when concrete sample in test cylinder was taken.
- j. Date delivered to laboratory and date tested.

3.6 REINFORCEMENT

- A. Review mill test reports furnished by Contractor.
- B. Make one tensile and one bend test in accordance with ASTM A370 from each pair of samples obtained.
- C. Written report must 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.

3.7 PRESTRESSED CONCRETE

- A. Inspection at Plant: Forms, placement and concrete cover of reinforcing steel and tendons, placement and finishing of concrete, and tensioning of tendons.
- B. Concrete Testing: Test concrete including materials for concrete required in Article, CONCRETE of this section, except make two test cylinders for each day's production of each strength of concrete produced.
- C. Test tendons for conformance with ASTM A416 and furnish report to PM.
- D. Inspect members to ensure that specification requirements for curing and finishes have been met.

3.8 ARCHITECTURAL CAST STONE

- A. Perform testing according to ASTM C1364 or verify compliance by reviewing previous test results of same product.
- B. Inspect the plant to verify that specification requirements for curing and finishes have been met.

3.9 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 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 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 5000 square feet of wall area.

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

E. Field Inspection and Materials Testing:

1. Verify the following prior to grouting:
 - a. Grout space is clean.
 - b. Type, spacing, and placement of reinforcement, connectors, and anchors comply with the contract requirements.

3.10 STRUCTURAL STEEL

- A. See Structural Drawings for Structural Steel testing and inspection table.
- B. Submit inspection reports, record of welders and their certification, and identification, and instances of noncompliance to PM.

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3.11 STEEL DECKING (NOT USED)

3.12 SHEAR CONNECTOR STUDS (NOT USED)

3.13 TYPE OF TEST

A. Landscaping: Topsoil Test as specified in Section 32 90 00 PLANTING.

3.14 ADDITIONAL TESTING

A. PM may request additional testing at any time at no additional cost to the Government.

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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, and solid waste, as well as other pollutants and resources encountered or generated by the Contractor. The Contractor is obligated to consider specified control measures with the costs included within the various contract items of work.
- B. Environmental pollution and damage is defined as the presence of chemical, physical, or biological elements or agents which:
 - 1. Adversely effect human health or welfare.
 - 2. Unfavorably alter ecological balances of importance to human life.
 - 3. Affect other species of importance to humankind.
 - 4. Degrade the utility of the environment for aesthetic, cultural, and historical purposes.

1.2 DEFINITIONS OF POLLUTANTS

- A. Chemical Waste: Petroleum products, bituminous materials, salts, acids, alkalis, herbicides, pesticides, organic chemicals, and inorganic wastes.
- B. Debris: Combustible and noncombustible wastes, such as leaves, tree trimmings, ashes, and waste materials resulting from construction or maintenance and repair work.
- C. Sediment: Soil and other debris that has been eroded and transported by runoff water.
- D. Solid Waste: Rubbish, debris, garbage, and other discarded solid materials resulting from project construction activities.
- E. 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 "waters of the United States" and require a permit to discharge water from the governing agency.
- F. Rubbish: Combustible and noncombustible wastes such as, but not limited to, paper, plastic, metal and plastic containers and cans, boxes, metal and lumber scrap.

G. Sanitary Wastes: Domestic Sanitary Sewage.

1.3 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, ordinances and note any corrective action taken.

1.4 REFERENCES

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by the basic designation only. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
- B. U.S. National Archives and Records Administration (NARA):
33 CFR 328 Definitions, Waters of the United States.
- C. Federal Environmental Regulatory Requirements: Comply with applicable regulations. The following is for Contractor's information only:
 - 1. Storm water permits; refer to The Office of Wastewater Management, NPDES Storm Water Program: <http://www.epa.gov/npdes/stormwater>
 - 2. Dredge and fill (Section 404) permits; refer to U.S. EPA Office of Wetlands, Oceans, and Watersheds (OWOW): <http://www.epa.gov/owow/>
 - 3. RCRA hazardous and non-hazardous solid waste requirements; refer to EPA's Office of Solid Waste and Emergency Response:
<http://www.epa.gov/epaoswer/osw/laws-reg.htm>
 - 4. Oil spill requirements for construction activities; refer to EPA Oil Program web site: <http://www.epa.gov/oilspill/>
 - 5. Hazardous substances (Superfund Liability) requirements for construction activities; refer to EPA's Superfund website:
<http://www.epa.gov/superfund/index.htm>
 - 6. Polychlorinated Biphenyl (PCB) waste requirements; refer to EPA's Polychlorinated Biphenyl (PCB) Homepage: <http://www.epa.gov/pcb/>
 - 7. Air quality requirements for construction activities; refer to EPA'S Air Program Mobile Sources Page:
<http://www.epa.gov/ebtpages/airmobilesources.html>
 - 8. Asbestos requirements for construction activities; refer to EPA's Asbestos Management and Regulatory Requirements Website:
<http://www.epa.gov/fedsite/cd/asbestos.html>
 - 9. National Environmental Policy Act (NEPA) requirements for construction activities

10. Endangered Species Act; refer to The US Fish and Wildlife Service
Endangered Species Program: <http://endangered.fws.gov/>

11. National Historic Preservation Act

C. State and Local Environmental Regulatory Requirements: Comply with applicable regulations. The following is for Contractor's information only:

1. State Office/Department of Environmental Quality.
2. Local Office/Department of Environmental Quality.
3. The Construction Industry Compliance Assistance Center:
<http://www.cicacenter.org/index.cfm>
4. The National Environmental Compliance Assistance Clearinghouse:
<http://cfpub.epa.gov/clearinghouse/>

1.5 SUSTAINABILITY REQUIREMENTS (NOT USED)

1.6 SUBMITTALS

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

1. Environmental Protection Plan: After the contract is awarded and prior to the commencement of the work, meet with the Project Manager (PM) 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, prepare and submit to the PM for approval, a written and/or graphic Environmental Protection Plan including, but not limited to, the following:
 - a. Name(s) and qualifications of person(s) within the Contractor's organization who is (are) responsible for:
 - 1) Ensuring adherence to the Environmental Protection Plan.
 - 2) Manifesting hazardous waste to be removed from the site.
 - 3) Training the Contractor's environmental protection personnel.
 - b. Description of the Contractor's environmental protection personnel training program.
 - c. 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.

- d. 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.
 - e. Procedures to provide environmental protection that complies 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.
 - f. Permits, licenses, and the location of the solid waste disposal area.
 - g. Drawings showing locations of any proposed temporary excavations or embankments for haul roads, stream crossings, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials. Include as part of an Erosion Control Plan approved and/or mandated state agency, and the Department of Veterans Affairs.
 - h. Environmental Monitoring Plans for the job site including land, water, air, and noise.
 - i. Work Area Plan showing the proposed activity in each portion of the area and identifying the areas of construction limits or protected areas. Plan should include measures for marking the limits of use areas. This plan may be incorporated within the Erosion Control Plan.
- B. Within 20 days after the date of its submittal, the PM shall approve the Contractor's Comprehensive Environmental Protection Plan, or respond with an explanation for its rejection and resubmittal.
- C. 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.

1.7 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 and after the project is complete, based upon leaving the site that has yet to mature of hydroseeding. Confine construction

activities to areas defined by construction limits, the specifications and drawings.

- B. Protection of Land Resources: Prior to construction, identify all land resources to be preserved within the work area. Do not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, top soil, land forms, wetlands or wetland buffers without prior approval from the PM. Do not fasten or attach ropes, cables, or guys to trees for anchorage unless specifically authorized, or dictated by special emergency use.
1. Work Area Limits: Prior to any construction, mark/fence/protect the areas that require work to be performed under this contract. Prior to construction, mark/fence/protect monuments, works of art, and any other markers to remain. Convey to all personnel the purpose of marking and protecting all marked and protected objects.
 2. Protection of Specific Regulated Elements: Wetlands and wetland buffers and other landscape features shown on the drawings to be preserved by marking, fencing, or using any other approved protective techniques.
 - a. Protect trees and shrubs to remain on site to protect from damage per contract details.
 - b. All damage to existing trees and shrubs shall be immediately repaired 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 only as needed to use to work the area to be developed. Form earthwork to final grade as shown as quickly as possible to minimize potential erosion damage. Immediately protect side slopes and back slopes upon completion of rough grading or clearing with appropriate material as defined in the Sediment and Erosion Control Plan.
 4. Temporary Protection of Disturbed Areas: Construct diversion ditches, benches, check dams and berms to retard and divert runoff

from the construction site to protected drainage areas as intended under paragraph 208 of the Clean Water Act.

- a. Sediment Basins: Trap sediment from construction areas in temporary or permanent sediment basins that accommodate the runoff of a local ___2___ (design year) storm. After each storm, pump the basins dry and remove the accumulated sediment. Control overflow/drainage with paved weirs or by vertical overflow pipes, that drain from the surface of the basin.
 - b. Reuse or conserve the collected topsoil sediment as directed by the PM. Topsoil use and requirements are specified in Section 31 20 11, EARTH MOVING .
 - c. Institute effluent quality monitoring programs as required by Federal, State, and local environmental agencies.
5. Erosion and Sedimentation Control Devices: Construct or install all temporary and permanent erosion and sedimentation control features shown on the Storm Water Pollution Plan to avoid violating water quality in accordance with federal and state regulations. Maintain temporary erosion and sediment control measures such as berms, dikes, drains, sedimentation basins, grassing, and mulching, straw waddles, fiber rolls, until permanent drainage and erosion control facilities are completed and operative.
 6. Manage and control borrow and spoil areas on Government property to minimize erosion and to prevent soil and/or sediment from entering nearby water courses or lakes.
 7. Protect adjacent areas from despoilment by temporary excavations and embankments.
 8. 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.
 9. Store chemical waste away from the work areas in corrosion resistant containers and dispose of waste in accordance with Federal, State, and local regulations.
 10. Handle discarded materials other than those included in the solid waste category as directed by the PM.

- 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 sediment basins prior to entering retention/detention ponds, allowing the suspended material to settle, the pollutants to separate, or the water to evaporate.
 - 2.
 3. Monitor water areas, wetlands and wetland buffers 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 protected 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 South Dakota Clean Air Act, by the South Dakota Commission on Environmental Quality, and Federal emission and performance laws and standards. Maintain ambient air quality standards set by the Environmental Protection Agency, for those construction operations and activities specified.
1. Particulates: Control dust particles, aerosols, and gaseous by-products from all construction activities, processing, and preparation of materials 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, 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, or other methods are permitted to

control particulates in the work area as approved in the Environmental Protection Plan.

3. Hydrocarbons and Carbon Monoxide: Control monoxide emissions from equipment to Federal and State allowable limits.
 4. Odors: Control odors of construction activities and prevent obnoxious odors from occurring.
- F. Noise Control: Minimize noise using every action possible. Perform noise-producing work in less sensitive hours of the day or week as directed by the PM. 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 7:00 a.m. and 7:00p.m unless otherwise permitted by local ordinance or the PM. Repetitive impact noise on the property shall not exceed the following Decibel A-scale (dBA) limitations:

| Time Duration of Impact Noise | Sound Level in dBA |
|-------------------------------------|--------------------|
| 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 as measured with an A-scale decibel measuring device at 15 m (50 feet) (dBA):

| CATEGORY OF EQUIPMENT | | | |
|-----------------------|-----------------|--------------------|-----------------|
| EARTHMOVING | | MATERIALS HANDLING | |
| EQUIPMENT STYLE | SOUND LEVEL dBA | EQUIPMENT STYLE | SOUND LEVEL dBA |
| 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. Provide soundproof housings or enclosures for noise-producing machinery.
 - c. Use efficient silencers on equipment air intakes.
 - d. Use efficient intake and exhaust mufflers on internal combustion engines that are maintained so equipment performs below noise levels specified.
 - e. Line hoppers and storage bins with sound deadening material.
 - f. 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 75 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 weighted sound level 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 PM 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 as approved by the PM. The site shall be left meeting the requirements of the local and state

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environmental requirements associated with the (SWPPP) Storm Water Pollution Protection Plan as submitted. Cleaning shall include off-cemetery 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, clearing, logging and general construction in accordance with state and local regulations and the contract.

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SECTION 01 74 19
CONSTRUCTION WASTE MANAGEMENT

PART 1 - GENERAL

1.1 DESCRIPTION

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

1.2 RELATED WORK

- A. Section 02 41 00, DEMOLITION.
- B. Section 01 00 00, GENERAL REQUIREMENTS.

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

1.3 QUALITY ASSURANCE

- A. Contractor shall practice efficient waste management when sizing, cutting and installing building products. Processes shall be employed to ensure the generation of as little waste as possible. Construction /Demolition waste includes products of the following:
1. Excess or unusable construction materials.
 2. Packaging used for construction products.
 3. Poor planning and/or layout.
 4. Construction error.
 5. Over ordering.
 6. Weather damage.
 7. Contamination.
 8. Mishandling.
 9. Breakage.
- B. Establish and maintain the management of non-hazardous building construction and demolition waste set forth herein. Conduct a site assessment to estimate the types of materials that will be generated by demolition and construction.
- C. Contractor shall develop and implement procedures to reuse and recycle new materials to a minimum of 50 percent.
- D. Contractor shall be responsible for implementation of any special programs involving rebates or similar incentives related to recycling. Any revenues or savings obtained from salvage or recycling shall accrue to the contractor.
- E. Contractor shall provide all demolition, removal and legal disposal of materials. Contractor shall ensure that facilities used for recycling, reuse and disposal shall be permitted for the intended use to the extent required by local, state, federal regulations. The Whole Building Design Guide website <http://www.wbdg.org/tools/cwm.php> provides a Construction Waste Management Database that contains information on companies that haul. Collect, and process recyclable debris from construction projects.
- F. Contractor shall assign a specific area to facilitate separation of materials for reuse, salvage, recycling, and return. Such areas are to be kept neat and clean and clearly marked in order to avoid contamination or mixing of materials.

- G. Contractor shall provide on-site instructions and supervision of separation, handling, salvaging, recycling, reuse and return methods to be used by all parties during waste generating stages.
- H. Record on daily reports any problems in complying with laws, regulations and ordinances with corrective action taken.

1.4 TERMINOLOGY

- A. Class III Landfill: A landfill that accepts non-hazardous resources such as household, commercial and industrial waste resulting from construction, remodeling, repair and demolition operations.
- B. Clean: Untreated and unpainted; uncontaminated with adhesives, oils, solvents, mastics and like products.
- C. Construction and Demolition Waste: Includes all non-hazardous resources resulting from construction, remodeling, alterations, repair and demolition operations.
- D. Dismantle: The process of parting out a building in such a way as to preserve the usefulness of its materials and components.
- E. Disposal: Acceptance of solid wastes at a legally operating facility for the purpose of land filling (includes Class III landfills and inert fills).
- F. Inert Backfill Site: A location, other than inert fill or other disposal facility, to which inert materials are taken for the purpose of filling an excavation, shoring or other soil engineering operation.
- G. Inert Fill: A facility that can legally accept inert waste, such as asphalt and concrete exclusively for the purpose of disposal.
- H. Inert Solids/Inert Waste: Non-liquid solid resources including, but not limited to, soil and concrete that does not contain hazardous waste or soluble pollutants at concentrations in excess of water-quality objectives established by a regional water board, and does not contain significant quantities of decomposable solid resources.
- I. Mixed Debris: Loads that include commingled recyclable and non-recyclable materials generated at the construction site.
- J. Mixed Debris Recycling Facility: A solid resource processing facility that accepts loads of mixed construction and demolition debris for the purpose of recovering re-usable and recyclable materials and disposing non-recyclable materials.

- K. Permitted Waste Hauler: A company that holds a valid permit to collect and transport solid wastes from individuals or businesses for the purpose of recycling or disposal.
- L. Recycling: The process of sorting, cleansing, treating, and reconstituting materials for the purpose of using the altered form in the manufacture of a new product. Recycling does not include burning, incinerating or thermally destroying solid waste.
 - 1. On-site Recycling - Materials that are sorted and processed on site for use in an altered state in the work, i.e. concrete crushed for use as a sub-base in paving.
 - 2. Off-site Recycling - Materials hauled to a location and used in an altered form in the manufacture of new products.
- M. Recycling Facility: An operation that can legally accept materials for the purpose of processing the materials into an altered form for the manufacture of new products. Depending on the types of materials accepted and operating procedures, a recycling facility may or may not be required to have a solid waste facilities permit or be regulated by the local enforcement agency.
- N. Reuse: Materials that are recovered for use in the same form, on-site or off-site.
- O. Return: To give back reusable items or unused products to vendors for credit.
- P. Salvage: To remove waste materials from the site for resale or re-use by a third party.
- Q. Source-Separated Materials: Materials that are sorted by type at the site for the purpose of reuse and recycling.
- R. Solid Waste: Materials that have been designated as non-recyclable and are discarded for the purposes of disposal.
- S. Transfer Station: A facility that can legally accept solid waste for the purpose of temporarily storing the materials for re-loading onto other trucks and transporting them to a landfill for disposal, or recovering some materials for re-use or recycling.

1.5 SUBMITTALS

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

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

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

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

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

1.6 APPLICABLE PUBLICATIONS

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

A. U.S. Green Building Council (USGBC):

LEED Green Building Rating System for New Construction

1.7 RECORDS

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

PART 2 - PRODUCTS

2.1 MATERIALS

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

PART 3 - EXECUTION

3.1 COLLECTION

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

3.2 DISPOSAL

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

3.3 REPORT

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

Black Hills National Cemetery
Renovate and Expand Administration and Maintenance Buildings
20901 Pleasant Valley Drive
Sturgis, SD 57785

NCA Project #884CM3015
10/31/22
BID DOCUMENTS

- 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 as summarized in the VA Sustainable Design Manual.
- 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. By submitting a change or substitution of materials or processes, contractor must demonstrate its diligence in performing the level of investigation and comparison required under federal mandates and VA policies.

1.2 RELATED WORK

- A. Section 01 57 19 TEMPORARY ENVIRONMENTAL CONTROLS.
- B. Section 01 74 19 CONSTRUCTION WASTE MANAGEMENT.
- C. Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

1.3 DEFINITIONS

- A. Total Materials Cost: A tally of actual material cost from specification divisions 03 through 10, 31 (applicable to foundations) and 32 (applicable to paving, site improvements, and planting). Alternatively, 45 percent of total construction hard costs in those specification divisions.
- B. 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.
- C. 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.
- D. Low Pollutant-Emitting Materials: Materials and products which are minimally odorous, irritating, or harmful to comfort and well-being of installers and occupants.
- E. 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 PM and Architect.
- B. Sustainability Action Plan:
 1. Submit documentation as required by this section; provide additional copies of typical submittals required under technical sections when sustainable construction requires copies of record submittals.
 2. Within 30 days after Preconstruction Meeting provide a narrative plan for complying with requirements stipulated within this section.
 3. Sustainability Action Plan must:

- a. Make reference to sustainable construction submittals defined by this section.
 - b. Address all items listed under PERFORMANCE CRITERIA.
 - c. Indicate individual(s) responsible for implementing the plan.
- C. Project Materials Cost Data Spreadsheet: Within 30 days after the Preconstruction Meeting provide a preliminary Project Materials Cost Data Spreadsheet. The Project Materials Cost Data Spreadsheet must be an electronic file and indicate all materials in Divisions 3 through 10, 31, and 32 used for Project (excluding labor costs and excluding all mechanical, electrical, and plumbing system components), and be organized by specification section. The spreadsheet must include the following:
1. Identify each reused or salvaged material, its cost, and its replacement value.
 2. Identify each recycled-content material, its post-consumer and pre-consumer recycled content as a percentage the product's weight, its cost, its combined recycled content value, defined as the sum of post-consumer recycled content value plus one-half of pre-consumer recycled content value, and total combined recycled content value for all materials as a percentage of total materials costs.
 3. Identify each biobased material, its source, its cost, and total value of biobased materials as a percentage of total materials costs.
 4. Total cost for Project and total cost of building materials used for Project.
- D. 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.
- E. 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.
- F. 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: Submittals for products to be installed or used included on the USDA BioPreferred program's product category lists. Data to include biobased content and source of biobased material; indicating name of manufacturer, cost of each 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, product documentation confirming Energy Star label and EPEAT certification.
- G. 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 and calculations to demonstrate compliance with thresholds based on materials costs.
 2. Include updated and current Project Materials Cost Data Spreadsheet.
 3. Include updated and current Low Pollutant-Emitting Materials Tracking Spreadsheet.
 4. 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.
- D. Closeout Submittals: Within 14 days after Substantial Completion provide the following:
1. Final version of Project Material Cost Data Spreadsheet.
 2. Final version of Low Pollutant-Emitting Materials Tracking Spreadsheet.
 3. 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.
 4. Manufacturer's cut sheets and product data highlighting the Minimum Efficiency Reporting Value (MERV) for final filtration media in air handling units.
 5. 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.
 6. 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 PM and Architect to discuss the Project Sustainable Action Plan content as it applies to submittals, project delivery, required Construction Indoor Air Quality (IAQ) Management Plan, and other Sustainable Construction Requirements. The purpose of this meeting is to develop a mutual understanding of the Sustainable Construction Requirements and coordination of contractor's management of these requirements with the Contracting Officer and the Construction Quality Manager.
- B. Construction Job Conferences: Status of compliance with Sustainable Construction Requirements of these specifications will be an agenda item at regular job meetings conducted during the course of work at the site.

1.7 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
- B. Green Seal Standard GS-11, Paints, 1st Edition, May 20, 1993.
- C. Green Seal Standard GC-03, Anti-Corrosive Paints, 2nd Edition, January 7, 1997.
- D. Green Seal Standard GC-36, Commercial Adhesives, October 19, 2000.
- E. South Coast Air Quality Management District (SCAQMD) Rule 1113, Architectural Coatings, rules in effect on January 1, 2004.
- F. South Coast Air Quality Management District (SCAQMD) Rule 1168, July 1, 2005 and rule amendment date of January 7, 2005.
- G. Sheet Metal and Air Conditioning National Contractors' Association (SMACNA) IAQ Guidelines for Occupied Buildings under Construction, 2nd Edition (ANSI/SMACNA 008-2008), Chapter 3.
- H. California Department of Public Health Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers, Version 1.1, Emission Testing method for California Specification 01350 (CDPH Standard Method V1.1-2010).

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

F. 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 product 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.

2. Provide building materials with recycled content such that post-consumer recycled content value plus half the pre-consumer recycled content value constitutes a minimum of 10 percent of cost of materials used for Project, exclusive of mechanical, electrical and plumbing components, specialty items such as elevators, and labor and delivery costs.

D. Biobased Content:

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

a. USDA BioPreferred program categories include:

- 1) Adhesive and Mastic Removers.
- 2) Carpets.
- 3) Cleaners.
- 4) Composite Panels.
- 5) Corrosion Preventatives.
- 6) Erosion Control Materials.
- 7) Dust Suppressants.
- 8) Fertilizers.
- 9) Floor Cleaners and Protectors.
- 10) Floor Coverings (Non-Carpet).
- 11) Glass Cleaners.
- 12) Hydraulic Fluids.
- 13) Industrial Cleaners.
- 14) Interior Paints and Coatings.
- 15) Mulch and Compost Materials.
- 16) Multipurpose Cleaners.
- 17) Multipurpose Lubricants.
- 18) Packaging Films.
- 19) Paint Removers.
- 20) Plastic Insulating Foam.
- 21) Pneumatic Equipment Lubricants.
- 22) Roof Coatings.
- 23) Wastewater Systems Coatings.
- 24) Water Tank Coatings.

25) Wood and Concrete Sealers.

26) Wood and Concrete Stains.

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

F. Materials, products, and equipment being installed which fall into a category covered by the Energy Star program must be Energy Star-labeled.

1. Energy Star product categories as of 05/19/2015 include:

a. Appliances:

- 1) Air Purifiers and Cleaners.
- 2) Clothes Dryers (Residential).
- 1) Clothes Washers (Commercial).
- 2) Dehumidifiers.

b. Electronics and Information Technology:

- 1) Audio/Video Equipment.
- 2) Computers: Desktops, Workstations, and Thin Clients.
- 3) Computers: Notebooks and Integrated Computers.
- 5) Small-Scale Servers.
- 6) Data Center Storage.
- 7) Displays.
- 8) Enterprise Servers.
- 9) Imaging Equipment.
- 10) Set-Top and Cable Boxes.
- 11) Telephones.
- 12) Televisions.
- 13) Uninterruptible Power Supplies.

c. Food Service Equipment (Commercial):

- 1) Dishwashers.
- 2) Fryers.
- 3) Griddles.
- 4) Hot Food Holding Cabinets.
- 5) Ice Machines, Air-Cooled.
- 6) Ovens.
- 7) Refrigerated Beverage Vending Machines.
- 8) Refrigerators and Freezers.

9) Steam Cookers.

d. Heating and Cooling Equipment:

- 1) Air-Source Heat Pumps (Residential).
- 2) Boilers (Residential).
- 3) Ceiling Fans (Residential).
- 4) Central Air Conditioners (Residential).
- 5) Gas Furnaces (Residential)
- 6) Gas Storage Water Heaters (Residential).
- 7) Gas Water Heaters (Commercial).
- 8) Geothermal Heat Pumps (Residential).
- 9) Heat Pump Water Heaters (Residential).
- 10) Light Commercial Heating and Cooling Equipment.
- 11) Room Air Conditioners (Residential).
- 12) Solar Water Heaters (Residential).
- 13) Ventilation Fans (Residential).
- 14) Whole-Home Tankless Water Heaters (Residential).

e. Other:

- 1) Cool Roof Products.
- 2) Decorative Light Strings.
- 3) Pool Pumps.
- 4) Water Coolers.
- 5) Windows, Doors, and Skylights.

G. Materials, products, and equipment being installed which fall into a category covered by the FEMP program must be FEMP-designated. FEMP-designated product categories as of 05/19/2015 include:

1. Food Service Equipment (Commercial):
 - a. Ice Machines, Water-Cooled.
2. Heating and Cooling Equipment:
 - a. Boilers (Commercial).
 - b. Electric Chillers, Air-Cooled (Commercial).
 - c. Electric Chillers, Water-Cooled (Commercial).
 - d. Electric Resistance Water Heaters (Residential).
3. Lighting Equipment:
 - a. Exterior Lighting.
 - b. Fluorescent Ballasts.
 - c. Fluorescent Luminaires.
 - d. Industrial Lighting (High/Low Bay).

- e. Suspended Luminaires.
- 4. Other Equipment:
 - a. Pre-Rinse Spray Valves.
- H. Electronic products and equipment being installed which fall into a category covered by EPEAT program must be EPEAT registered.
 - 1. Electronic products and equipment covered by EPEAT program as of 05/19/2015 include:
 - a. Computers: Desktops, Workstations, and Thin Clients.
 - b. Computers: Notebooks and Integrated Computers.
 - c. Displays.
 - d. Imaging Equipment.
 - e. Televisions.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

- A. Irrigation professionals must be certified under a WaterSense labeled certification program.
- B. Construction Indoor Air Quality Management:
 - 1. During construction, meet or exceed recommended control measures of ANSI/SMACNA 008-2008, Chapter 3.
 - 2. Protect stored on-site and installed absorptive materials from moisture damage.
 - 3. If permanently installed air handlers are used during construction, filtration media with a minimum efficiency reporting value (MERV) of 8 must be used at each return air grille, as determined by ASHRAE Standard 52.2-1999 (with errata but without addenda). Replace all filtration media immediately prior to occupancy.
 - 4. Perform building flush-out as follows:
 - a. After construction ends, prior to occupancy and with interior finishes installed, perform a building flush-out by supplying a total volume of 14000 cu. ft. of outdoor air per sq. ft. of floor area while maintaining an internal temperature of at least 60 degrees Fahrenheit and a relative humidity no higher than 60 percent. OR

- b. If occupancy is desired prior to flush-out completion, the space may be occupied following delivery of a minimum of 3500 cu. ft. of outdoor air per sq. ft. of floor area to the space. Once a space is occupied, it must be ventilated at a minimum rate of 0.30 cfm per sq. ft. of outside air or design minimum outside air rate determined in Prerequisite EQ 1, whichever is greater. During each day of flush-out period, ventilation must begin a minimum of three hours prior to occupancy and continue during occupancy. These conditions must be maintained until a total of 14000 cu. ft./sq. ft. of outside air has been delivered to the space.

-----END-----

SECTION 01 91 00

GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 COMMISSIONING DESCRIPTION

- A. This Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS shall form the basis of the construction phase commissioning process and procedures. The Commissioning Agent shall add, modify, and refine the commissioning procedures, as approved by the Department of Veterans Affairs (VA), to suit field conditions and actual manufacturer's equipment, incorporate test data and procedure results, and provide detailed scheduling for all commissioning tasks.
- B. Various sections of the project specifications require equipment startup, testing, and adjusting services. Requirements for startup, testing, and adjusting services specified in the Division 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 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 contract documents and according to the manufacturer's recommendations.
 2. Verify and document proper integrated performance of equipment and systems.
 3. Verify that Operations & Maintenance documentation is complete.
 4. Verify that all components requiring servicing can be accessed, serviced and removed without disturbing nearby components including ducts, piping, cabling or wiring.
 5. Verify that the VA's operating personnel are adequately trained to enable them to operate, monitor, adjust, maintain, and repair building systems in an effective and energy-efficient manner.
 6. Document the successful achievement of the commissioning objectives listed above.
- F. The commissioning process does not take away from or reduce the responsibility of the Contractor to provide a finished and fully functioning product.

1.2 CONTRACTUAL RELATIONSHIPS

- A. For this construction project, the Department of Veterans Affairs contracts with a Contractor to provide construction services. The contracts are administered by the VA Contracting Officer and the Resident Engineer as the designated representative of the Contracting Officer. On this project, the authority to modify the contract in any way is strictly limited to the authority of the Contracting Officer.
- B. In this project, only two contract parties are recognized and communications on contractual issues are strictly limited to VA Resident Engineer and the Contractor. It is the practice of the VA to require that communications between other parties to the contracts (Subcontractors and Vendors) be conducted through the Resident Engineer and Contractor. It is also the practice of the VA that communications between other parties of the project (Commissioning Agent and Architect/Engineer) be conducted through the Resident Engineer.

- C. Whole Building Commissioning is a process that relies upon frequent and direct communications, as well as collaboration between all parties to the construction process. By its nature, a high level of communication and cooperation between the Commissioning Agent and all other parties (Architects, Engineers, Subcontractors, Vendors, third party testing agencies, etc.) is essential to the success of the Commissioning effort.
- D. With these fundamental practices in mind, the commissioning process described herein has been developed to recognize that, in the execution of the Commissioning Process, the Commissioning Agent must develop effective methods to communicate with every member of the construction team involved in delivering commissioned systems while simultaneously respecting the exclusive contract authority of the Contracting Officer and Resident Engineer. Thus, the procedures outlined in this specification must be executed within the following limitations:
1. No communications (verbal or written) from the Commissioning Agent shall be deemed to constitute direction that modifies the terms of any contract between the Department of Veterans Affairs and the Contractor.
 2. Commissioning Issues identified by the Commissioning Agent will be delivered to the Resident Engineer and copied to the designated Commissioning Representatives for the Contractor and subcontractors on the Commissioning Team for information only 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 Resident Engineer to require either an official interpretation of the construction documents or require a modification of the contract documents, the Contracting Officer or Resident Engineer will issue an official directive to this effect.
 4. All parties to the Commissioning Process shall be individually responsible for alerting the Resident Engineer of any issues that they deem to constitute a potential contract change prior to acting on these issues.
 5. Authority for resolution or modification of design and construction issues rests solely with the Contracting Officer or Resident

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

1.3 RELATED WORK

- A. Section 01 00 00 GENERAL REQUIREMENTS.
- B. Section 01 32.16.13 PROJECT SCHEDULES
- C. Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES
- D. Section 01 81 13 SUSTAINABLE CONSTRUCTION REQUIREMENTS
- E. Section 22 08 00 COMMISSIONING OF PLUMBING SYSTEMS.
- F. Section 23 08 00 COMMISSIONING OF HVAC SYSTEMS.
- G. Section 26 08 00 COMMISSIONING OF ELECTRICAL SYSTEMS.
- H. Section 27 08 00 COMMISSIONING OF COMMUNICATIONS SYSTEMS.
- I. Section 28 08 00 COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS.
- J. Section 33 08 00 COMMISSIONING OF SITE UTILITIES.

1.4 SUMMARY

- A. This Section includes general requirements that apply to implementation of commissioning without regard to systems, subsystems, and equipment being commissioned.
- B. The commissioning activities have been developed to support the VA requirements to meet guidelines for Federal Leadership in Environmental, Energy, and Economic Performance.

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 |

| List of Acronyms | |
|------------------|--|
| Acronym | Meaning |
| 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 Resident Engineer |
| USGBC | United States Green Building Council |

1.6 DEFINITIONS

Acceptance Phase Commissioning: Commissioning tasks executed after most construction has been completed, most Site Observations and Static Tests have been completed and Pre-Functional Testing has been completed and accepted. The main commissioning activities performed during this

phase are verification that the installed systems are functional by conducting Systems Functional Performance tests and Owner Training.

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

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

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

Benchmarks: Benchmarks are the comparison of a building's energy usage to other similar buildings and to the building itself. For example, ENERGY STAR Portfolio Manager is a frequently used and nationally recognized building energy benchmarking tool.

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

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

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

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

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

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

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

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

Commissioning Issue: A condition identified by the Commissioning Agent or other member of the Commissioning Team that adversely affects the commissionability, operability, maintainability, or functionality of a system, equipment, or component. A condition that is in conflict with the Contract Documents and/or performance requirements of the installed systems and components. (See also - Commissioning Observation).

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

Commissioning Observation: An issue identified by the Commissioning Agent or other member of the Commissioning Team that does not conform to the project OPR, contract documents or standard industry best practices. (See also Commissioning Issue)

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

Commissioning Process: A quality focused process for enhancing the delivery of a project. The process focuses upon verifying and documenting that the facility and all of its systems, components, and assemblies are planned, designed, installed, tested, can be operated, and maintained to meet the Owner's Project Requirements.

Commissioning Report: The final commissioning document which presents the commissioning process results for the project. Cx reports include an executive summary, the commissioning plan, issue log, correspondence, and all appropriate check sheets and test forms.

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

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

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

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

Contract Documents (CD): Contract documents include design and construction contracts, price agreements and procedure agreements. Contract Documents also include all final and complete drawings, specifications and all applicable contract modifications or supplements.

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

Coordination Drawings: Drawings showing the work of all trades that are used to illustrate that equipment can be installed in the space allocated without compromising equipment function or access for maintenance and replacement. These drawings graphically illustrate and dimension manufacturers' recommended maintenance clearances. On mechanical projects, coordination drawings include structural steel,

ductwork, major piping and electrical conduit and show the elevations and locations of the above components.

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

Deferred System Test: Tests that cannot be completed at the end of the acceptance phase due to ambient conditions, schedule issues or other conditions preventing testing during the normal acceptance testing period.

Deficiency: See "Commissioning Issue".

Design Criteria: A listing of the VA Design Criteria outlining the project design requirements, including its source. These are used during the design process to show the design elements meet the OPR.

Design Intent: The overall term that includes the OPR and the BOD. It is a detailed explanation of the ideas, concepts, and criteria that are defined by the owner to be important. The design intent documents are utilized to provide a written record of these ideas, concepts and criteria.

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

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

Environmental Systems: Systems that use a combination of mechanical equipment, airflow, water flow and electrical energy to provide heating, ventilating, air conditioning, humidification, and dehumidification for the purpose of human comfort or process control of temperature and humidity.

Executive Summary: A section of the Commissioning report that reviews the general outcome of the project. It also includes any unresolved issues, recommendations for the resolution of unresolved issues and all deferred testing requirements.

Functionality: This defines a design component or construction process which will allow a system or component to operate or be constructed in a manner that will produce the required outcome of the OPR.

Functional Test Procedure (FTP): A written protocol that defines methods, steps, personnel, and acceptance criteria for tests conducted

on components, equipment, assemblies, systems, and interfaces among systems.

Industry Accepted Best Practice: A design component or construction process that has achieved industry consensus for quality performance and functionality. Refer to the current edition of the NEBB Design Phase Commissioning Handbook for examples.

Installation Verification: Observations or inspections that confirm the system or component has been installed in accordance with the contract documents and to industry accepted best practices.

Integrated System Testing: Integrated Systems Testing procedures entail testing of multiple integrated systems performance to verify proper functional interface between systems. Typical Integrated Systems Testing includes verifying that building systems respond properly to loss of utility, transfer to emergency power sources, re-transfer from emergency power source to normal utility source; interface between HVAC controls and Fire Alarm systems for equipment shutdown, interface between Fire Alarm system and elevator control systems for elevator recall and shutdown; interface between Fire Alarm System and Security Access Control Systems to control access to spaces during fire alarm conditions; and other similar tests as determined for each specific project.

Issues Log: A formal and ongoing record of problems or concerns - and their resolution - that have been raised by members of the Commissioning Team during the course of the Commissioning Process.

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

Maintainability: A design component or construction process that will allow a system or component to be effectively maintained. This includes adequate room for access to adjust and repair the equipment. Maintainability also includes components that have readily obtainable repair parts or service.

Manual Test: Testing using hand-held instruments, immediate control system readouts or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the 'observation').

Owner's Project Requirements (OPR): A written document that details the project requirements and the expectations of how the building and its

systems will be used and operated. These include project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.

Peer Review: A formal in-depth review separate from the commissioning review processes. The level of effort and intensity is much greater than a typical commissioning facilitation or extended commissioning review. The VA usually hires an independent third-party (called the IDIQ A/E) to conduct peer reviews.

Precision: The ability of an instrument to produce repeatable readings of the same quantity under the same conditions. The precision of an instrument refers to its ability to produce a tightly grouped set of values around the mean value of the measured quantity.

Pre-Design Phase Commissioning: Commissioning tasks performed prior to the commencement of design activities that includes project programming and the development of the commissioning process for the project

Pre-Functional Checklist (PFC): A form used by the contractor to verify that appropriate components are onsite, correctly installed, set up, calibrated, functional and ready for functional testing.

Pre-Functional Test (PFT): An inspection or test that is done before functional testing. PFT's include installation verification and system and component start up tests.

Procedure or Protocol: A defined approach that outlines the execution of a sequence of work or operations. Procedures are used to produce repeatable and defined results.

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

Resolution: This word has two meanings in the Cx Process. The first refers to the smallest change in a measured variable that an instrument can detect. The second refers to the implementation of actions that correct a tested or observed deficiency.

Site Observation Visit: On-site inspections and observations made by the Commissioning Agent for the purpose of verifying component, equipment, and system installation, to observe contractor testing, equipment start-up procedures, or other purposes.

Site Observation Reports (SO): Reports of site inspections and observations made by the Commissioning Agent. Observation reports are

intended to provide early indication of an installation issue which will need correction or analysis.

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

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

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

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

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

Testing: The use of specialized and calibrated instruments to measure parameters such as: temperature, pressure, vapor flow, air flow, fluid flow, rotational speed, electrical characteristics, velocity, and other data in order to determine performance, operation, or function.

Testing, Adjusting, and Balancing (TAB): A systematic process or service applied to heating, ventilating and air-conditioning (HVAC) systems and other environmental systems to achieve and document air and hydronic flow rates. The standards and procedures for providing these services are referred to as "Testing, Adjusting, and Balancing" and are described in the Procedural Standards for the Testing, Adjusting and Balancing of Environmental Systems, published by NEBB or AABC.

Thermal Scans: Thermographic pictures taken with an Infrared Thermographic Camera. Thermographic pictures show the relative temperatures of objects and surfaces and are used to identify leaks, thermal bridging, thermal intrusion, electrical overload conditions, moisture containment, and insulation failure.

Training Plan: A written document that details, in outline form the expectations of the operator training. Training agendas should include instruction on how to obtain service, operate, startup, shutdown and maintain all systems and components of the project.

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

Unresolved Commissioning Issue: Any Commissioning Issue that, at the time that the Final Report or the Amended Final Report is issued that has not been either resolved by the construction team or accepted by the VA. Validation: The process by which work is verified as complete and operating correctly:

1. First party validation occurs when a firm or individual verifying the task is the same firm or individual performing the task.
2. Second party validation occurs when the firm or individual verifying the task is under the control of the firm performing the task or has other possibilities of financial conflicts of interest in the resolution (Architects, Designers, General Contractors and Third Tier Subcontractors or Vendors).
3. Third party validation occurs when the firm verifying the task is not associated with or under control of the firm performing or designing the task.

Verification: The process by which specific documents, components, equipment, assemblies, systems, and interfaces among systems are confirmed to comply with the criteria described in the Owner's Project Requirements.

Warranty Phase Commissioning: Commissioning efforts executed after a project has been completed and accepted by the Owner. Warranty Phase Commissioning includes follow-up on verification of system performance, measurement and verification tasks and assistance in identifying warranty issues and enforcing warranty provisions of the construction contract.

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

Whole Building Commissioning: Commissioning of building systems such as Building Envelope, HVAC, Electrical, Special Electrical (Fire Alarm, Security & Communications), Plumbing and Fire Protection as described in this specification.

1.7 SYSTEMS TO BE COMMISSIONED

- A. Commissioning of a system or systems specified for this project is part of the construction process. Documentation and testing of these

systems, as well as training of the VA's Operation and Maintenance personnel, is required in cooperation with the VA and the Commissioning Agent.

B. The following systems will be commissioned as part of this project:

| Systems To Be Commissioned | |
|--|--|
| System | Description |
| Plumbing | |
| Domestic Water Distribution | Booster pumps, backflow preventers, water softeners, potable water storage tanks, lawn irrigation systems |
| Domestic Hot Water Systems | Water heaters, circulation pumps, point-of-use water heaters |
| HVAC | |
| Noise and Vibration Control | Noise and vibration levels for critical equipment such as heat pumps |
| Automatic Control System | Local control systems including thermostats, sensors, controllers, etc. |
| HVAC Ventilation/Exhaust Systems | Toilet exhaust |
| HVAC Energy Recovery Systems | Air-to-Air Heat Recovery |
| Decentralized Unitary HVAC Systems* | Split-system ductless HVAC systems, controls |
| Unitary Heat Pump Systems | DXsplit-system VRV heat pumps, AC units & controls |
| Electrical | |
| Medium-Voltage Electrical Distribution Systems | Medium-Voltage Switchgear, Medium-Voltage Switches, Underground ductbank and distribution, Pad-Mount Transformers, Medium-Voltage Load Interrupter Switches, |
| Grounding & Bonding Systems | Witness 3rd party testing, review reports |

| Systems To Be Commissioned | |
|--|---|
| System | Description |
| Electric Power Monitoring Systems | Metering, sub-metering, power monitoring systems, PLC control systems |
| Electrical System Protective Device Study | Review reports, verify field settings consistent with Study |
| Secondary Unit Substations | Medium-voltage components, transformers, low-voltage distribution, verify breaker testing results (injection current, etc) |
| Low-Voltage Distribution System | Normal power distribution system, Life-safety power distribution system, critical power distribution system, equipment power distribution system, switchboards, distribution panels, panelboards, verify breaker testing results (injection current, etc) |
| Lighting & Lighting Control Systems | Emergency lighting, occupancy sensors, lighting control systems, architectural dimming systems, theatrical dimming systems, exterior lighting and controls |
| Cathodic Protection Systems | Review 3rd party testing results. |
| Lightning Protection System | Witness 3rd party testing, review reports |
| Communications | |
| Grounding & Bonding System | Witness 3rd party testing, review reports |
| Structured Cabling System | Witness 3rd party testing, review reports |
| Master Antenna Television System | Witness 3rd party testing, review reports |
| Public Address & Mass Notification Systems | Witness 3rd party testing, review reports |

| Systems To Be Commissioned | |
|---------------------------------------|--|
| System | Description |
| Intercom & Program Systems | Witness 3rd party testing, review reports |
| Security Emergency Call Systems | Witness 3rd party testing, review reports |
| Electronic Safety and Security | |
| Grounding & Bonding | Witness 3rd party testing, review reports |
| Physical Access Control Systems | Witness 3rd party testing, review reports |
| Access Control Systems | Witness 3rd party testing, review reports |
| Security Access Detection Systems | Witness 3rd party testing, review reports |
| Video Surveillance System | Witness 3rd party testing, review reports |
| Electronic Personal Protection System | Witness 3rd party testing, review reports |
| Fire Detection and Alarm System | 100% device acceptance testing, battery draw-down test, verify system monitoring, verify interface with other systems. |
| Renewable Energy Sources | |
| Site Utilities | |
| Water Utilities | City Water Service Entrance, Backflow Prevention, Pressure Control, Booster Pumps, Irrigation Systems |
| | |
| Integrated Systems Tests | |
| Fire Alarm Response | Integrated System Response to Fire Alarm Condition and Return to Normal |

1.8 COMMISSIONING TEAM

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

B. Members Appointed by Contractor:

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

C. Members Appointed by VA:

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

1.9 VA'S COMMISSIONING RESPONSIBILITIES

- A. Appoint an individual, company or firm to act as the Commissioning Agent.
- B. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities including, but not limited to, the following:
 1. Coordination meetings.
 2. Training in operation and maintenance of systems, subsystems, and equipment.
 3. Testing meetings.
 4. Witness and assist in Systems Functional Performance Testing.
 5. Demonstration of operation of systems, subsystems, and equipment.
- C. Provide the Construction Documents, prepared by Architect and approved by VA, to the Commissioning Agent and for use in managing the commissioning process, developing the commissioning plan, systems manuals, and reviewing the operation and maintenance training plan.

1.10 CONTRACTOR'S COMMISSIONING RESPONSIBILITIES

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

- B. The Contractor shall ensure that the commissioning responsibilities outlined in these specifications are included in all subcontracts and that subcontractors comply with the requirements of these specifications.
- C. The Contractor shall ensure that each installing subcontractor shall assign representatives with expertise and authority to act on behalf of the subcontractor and schedule them to participate in and perform commissioning team activities including, but not limited to, the following:
1. Participate in commissioning coordination meetings.
 2. Conduct operation and maintenance training sessions in accordance with approved training plans.
 3. Verify that Work is complete and systems are operational according to the Contract Documents, including calibration of instrumentation and controls.
 4. Evaluate commissioning issues and commissioning observations identified in the Commissioning Issues Log, field reports, test reports or other commissioning documents. In collaboration with entity responsible for system and equipment installation, recommend corrective action.
 5. Review and comment on commissioning documentation.
 6. Participate in meetings to coordinate Systems Functional Performance Testing.
 7. Provide schedule for operation and maintenance data submittals, equipment startup, and testing to Commissioning Agent for incorporation into the commissioning plan.
 8. Provide information to the Commissioning Agent for developing commissioning plan.
 9. Participate in training sessions for VA's operation and maintenance personnel.
 10. Provide technicians who are familiar with the construction and operation of installed systems and who shall develop specific test procedures to conduct Systems Functional Performance Testing of installed systems.

1.11 COMMISSIONING AGENT'S RESPONSIBILITIES

- A. Organize and lead the commissioning team.

- B. Prepare the commissioning plan. See Paragraph 1.11-A of this specification Section for further information.
- C. Review and comment on selected submittals from the Contractor for general conformance with the Construction Documents. Review and comment on the ability to test and operate the system and/or equipment, including providing gages, controls and other components required to operate, maintain, and test the system. Review and comment on performance expectations of systems and equipment and interfaces between systems relating to the Construction Documents.
- D. At the beginning of the construction phase, conduct an initial construction phase coordination meeting for the purpose of reviewing the commissioning activities and establishing tentative schedules for operation and maintenance submittals; operation and maintenance training sessions; TAB Work; Pre-Functional Checklists, Systems Functional Performance Testing; and project completion.
- E. Convene commissioning team meetings for the purpose of coordination, communication, and conflict resolution; discuss status of the commissioning processes. Responsibilities include arranging for facilities, preparing agenda and attendance lists, and notifying participants. The Commissioning Agent shall prepare and distribute minutes to commissioning team members and attendees within five workdays of the commissioning meeting.
- F. Observe construction and report progress, observations and issues. Observe systems and equipment installation for adequate accessibility for maintenance and component replacement or repair, and for general conformance with the Construction Documents.
- G. Prepare Project specific Pre-Functional Checklists and Systems Functional Performance Test procedures.
- H. Coordinate Systems Functional Performance Testing schedule with the Contractor.
- I. Witness selected systems startups.
- J. Verify selected Pre-Functional Checklists completed and submitted by the Contractor.
- K. Witness and document Systems Functional Performance Testing.
- L. Compile test data, inspection reports, and certificates and include them in the systems manual and commissioning report.

- M. Review and comment on operation and maintenance (O&M) documentation and systems manual outline for compliance with the Contract Documents. Operation and maintenance documentation requirements are specified in Paragraph 1.25, Section 01 00 00 GENERAL REQUIREMENTS.
- N. Review operation and maintenance training program developed by the Contractor. Verify training plans provide qualified instructors to conduct operation and maintenance training.
- O. Prepare commissioning Field Observation Reports.
- P. Prepare the Final Commissioning Report.
- Q. Return to the site at 10 months into the 12 month warranty period and review with facility staff the current building operation and the condition of outstanding issues related to the original and seasonal Systems Functional Performance Testing. Also interview facility staff and identify problems or concerns they have operating the building as originally intended. Make suggestions for improvements and for recording these changes in the O&M manuals. Identify areas that may come under warranty or under the original construction contract. Assist facility staff in developing reports, documents and requests for services to remedy outstanding problems.
- R. Assemble the final commissioning documentation, including the Final Commissioning Report and Addendum to the Final Commissioning Report.

1.12 COMMISSIONING DOCUMENTATION

- A. Commissioning Plan: A document, prepared by Commissioning Agent, that outlines the schedule, allocation of resources, and documentation requirements of the commissioning process, and shall include, but is not limited, to the following:
 - 1. Plan for delivery and review of submittals, systems manuals, and other documents and reports. Identification of the relationship of these documents to other functions and a detailed description of submittals that are required to support the commissioning processes. Submittal dates shall include the latest date approved submittals must be received without adversely affecting commissioning plan.
 - 2. Description of the organization, layout, and content of commissioning documentation (including systems manual) and a detailed description of documents to be provided along with identification of responsible parties.
 - 3. Identification of systems and equipment to be commissioned.

4. Schedule of Commissioning Coordination meetings.
 5. Identification of items that must be completed before the next operation can proceed.
 6. Description of responsibilities of commissioning team members.
 7. Description of observations to be made.
 8. Description of requirements for operation and maintenance training.
 9. Schedule for commissioning activities with dates coordinated with overall construction schedule.
 10. Process and schedule for documenting changes on a continuous basis to appear in Project Record Documents.
 11. Process and schedule for completing prestart and startup checklists for systems, subsystems, and equipment to be verified and tested.
 12. Preliminary Systems Functional Performance Test procedures.
- B. Systems Functional Performance Test Procedures: The Commissioning Agent will develop Systems Functional Performance Test Procedures for each system to be commissioned, including subsystems, or equipment and interfaces or interlocks with other systems. Systems Functional Performance Test Procedures will include a separate entry, with space for comments, for each item to be tested. Preliminary Systems Functional Performance Test Procedures will be provided to the VA, Architect/Engineer, and Contractor for review and comment. The Systems Performance Test Procedure will include test procedures for each mode of operation and provide space to indicate whether the mode under test responded as required. Each System Functional Performance Test procedure, regardless of system, subsystem, or equipment being tested, shall include, but not be limited to, the following:
1. Name and identification code of tested system.
 2. Test number.
 3. Time and date of test.
 4. Indication of whether the record is for a first test or retest following correction of a problem or issue.
 5. Dated signatures of the person performing test and of the witness, if applicable.
 6. Individuals present for test.
 7. Observations and Issues.
 8. Issue number, if any, generated as the result of test.

- C. Pre-Functional Checklists: The Commissioning Agent will prepare Pre-Functional Checklists. Pre-Functional Checklists shall be completed and signed by the Contractor, verifying that systems, subsystems, equipment, and associated controls are ready for testing. The Commissioning Agent will spot check Pre-Functional Checklists to verify accuracy and readiness for testing. Inaccurate or incomplete Pre-Functional Checklists shall be returned to the Contractor for correction and resubmission.
- D. Test and Inspection Reports: The Commissioning Agent will record test data, observations, and measurements on Systems Functional Performance Test Procedure. The report will also include recommendation for system acceptance or non-acceptance. Photographs, forms, and other means appropriate for the application shall be included with data. Commissioning Agent Will compile test and inspection reports and test and inspection certificates and include them in systems manual and commissioning report.
- E. Corrective Action Documents: The Commissioning Agent will document corrective action taken for systems and equipment that fail tests. The documentation will include any required modifications to systems and equipment and/or revisions to test procedures, if any. The Commissioning Agent will witness and document any retesting of systems and/or equipment requiring corrective action and document retest results.
- F. Commissioning Issues Log: The Commissioning Agent will prepare and maintain Commissioning Issues Log that describes Commissioning Issues and Commissioning Observations that are identified during the Commissioning process. These observations and issues include, but are not limited to, those that are at variance with the Contract Documents. The Commissioning Issues Log will identify and track issues as they are encountered, the party responsible for resolution, progress toward resolution, and document how the issue was resolved. The Master Commissioning Issues Log will also track the status of unresolved issues.
1. Creating a Commissioning Issues Log Entry:
 - a. Identify the issue with unique numeric or alphanumeric identifier by which the issue may be tracked.
 - b. Assign a descriptive title for the issue.

- c. Identify date and time of the issue.
 - d. Identify test number of test being performed at the time of the observation, if applicable, for cross reference.
 - e. Identify system, subsystem, and equipment to which the issue applies.
 - f. Identify location of system, subsystem, and equipment.
 - g. Include information that may be helpful in diagnosing or evaluating the issue.
 - h. Note recommended corrective action.
 - i. Identify commissioning team member responsible for corrective action.
 - j. Identify expected date of correction.
 - k. Identify person that identified the issue.
2. Documenting Issue Resolution:
- a. Log date correction is completed or the issue is resolved.
 - b. Describe corrective action or resolution taken. Include description of diagnostic steps taken to determine root cause of the issue, if any.
 - c. Identify changes to the Contract Documents that may require action.
 - d. State that correction was completed and system, subsystem, and equipment are ready for retest, if applicable.
 - e. Identify person(s) who corrected or resolved the issue.
 - f. Identify person(s) verifying the issue resolution.
- G. Final Commissioning Report: The Commissioning Agent will document results of the commissioning process, including unresolved issues, and performance of systems, subsystems, and equipment. The Commissioning Report will indicate whether systems, subsystems, and equipment have been properly installed and are performing according to the Contract Documents. This report will be used by the Department of Veterans Affairs when determining that systems will be accepted. This report will be used to evaluate systems, subsystems, and equipment and will serve as a future reference document during VA occupancy and operation. It shall describe components and performance that exceed requirements of the Contract Documents and those that do not meet requirements of the Contract Documents. The commissioning report will include, but is not limited to, the following:

1. Lists and explanations of substitutions; compromises; variances with the Contract Documents; record of conditions; and, if appropriate, recommendations for resolution. Design Narrative documentation maintained by the Commissioning Agent.
 2. Commissioning plan.
 3. Pre-Functional Checklists completed by the Contractor, with annotation of the Commissioning Agent review and spot check.
 4. Systems Functional Performance Test Procedures, with annotation of test results and test completion.
 5. Commissioning Issues Log.
 6. Listing of deferred and off-season test(s) not performed, including the schedule for their completion.
- H. Addendum to Final Commissioning Report: The Commissioning Agent will prepare an Addendum to the Final Commissioning Report near the end of the Warranty Period. The Addendum will indicate whether systems, subsystems, and equipment are complete and continue to perform according to the Contract Documents. The Addendum to the Final Commissioning Report shall include, but is not limited to, the following:
1. Documentation of deferred and off season test(s) results.
 2. Completed Systems Functional Performance Test Procedures for off season test(s).
 3. Documentation that unresolved system performance issues have been resolved.
 4. Updated Commissioning Issues Log, including status of unresolved issues.
 5. Identification of potential Warranty Claims to be corrected by the Contractor.
- I. Systems Manual: The Commissioning Agent will gather required information and compile the Systems Manual. The Systems Manual will include, but is not limited to, the following:
1. Design Narrative, including system narratives, schematics, single-line diagrams, flow diagrams, equipment schedules, and changes made throughout the Project.
 2. Reference to Final Commissioning Plan.
 3. Reference to Final Commissioning Report.

4. Approved Operation and Maintenance Data as submitted by the Contractor.

1.13 SUBMITTALS

- A. Preliminary Commissioning Plan Submittal: The Commissioning Agent has prepared a Preliminary Commissioning Plan based on the final Construction Documents. The Preliminary Commissioning Plan is included as an Appendix to this specification section. The Preliminary Commissioning Plan is provided for information only. It contains preliminary information about the following commissioning activities:
 1. The Commissioning Team: A list of commissioning team members by organization.
 2. Systems to be commissioned. A detailed list of systems to be commissioned for the project. This list also provides preliminary information on systems/equipment submittals to be reviewed by the Commissioning Agent; preliminary information on Pre-Functional Checklists that are to be completed; preliminary information on Systems Performance Testing, including information on testing sample size (where authorized by the VA).
 3. Commissioning Team Roles and Responsibilities: Preliminary roles and responsibilities for each Commissioning Team member.
 4. Commissioning Documents: A preliminary list of commissioning-related documents, include identification of the parties responsible for preparation, review, approval, and action on each document.
 5. Commissioning Activities Schedule: Identification of Commissioning Activities, including Systems Functional Testing, the expected duration and predecessors for the activity.
 6. Pre-Functional Checklists: Preliminary Pre-Functional Checklists for equipment, components, subsystems, and systems to be commissioned. These Preliminary Pre-Functional Checklists provide guidance on the level of detailed information the Contractor shall include on the final submission.
 7. Systems Functional Performance Test Procedures: Preliminary step-by-step System Functional Performance Test Procedures to be used during Systems Functional Performance Testing. These Preliminary Systems Functional Performance procedures provide information on the level of testing rigor, and the level of Contractor support required during performance of system's testing.

- B. Final Commissioning Plan Submittal: Based on the Final Construction Documents and the Contractor's project team, the Commissioning Agent will prepare the Final Commissioning Plan as described in this section. The Commissioning Agent will submit three hard copies and three sets of electronic files of Final Commissioning Plan. The Contractor shall review the Commissioning Plan and provide any comments to the VA. The Commissioning Agent will incorporate review comments into the Final Commissioning Plan as directed by the VA.
- C. Systems Functional Performance Test Procedure: The Commissioning Agent will submit preliminary Systems Functional Performance Test Procedures to the Contractor, and the VA for review and comment. The Contractor shall return review comments to the VA and the Commissioning Agent. The VA will also return review comments to the Commissioning Agent. The Commissioning Agent will incorporate review comments into the Final Systems Functional Test Procedures to be used in Systems Functional Performance Testing.
- D. Pre-Functional Checklists: The Commissioning Agent will submit Pre-Functional Checklists to be completed by the Contractor.
- E. Test and Inspection Reports: The Commissioning Agent will submit test and inspection reports to the VA with copies to the Contractor and the Architect/Engineer.
- F. Corrective Action Documents: The Commissioning Agent will submit corrective action documents to the VA Resident Engineer with copies to the Contractor and Architect.
- G. Preliminary Commissioning Report Submittal: The Commissioning Agent will submit three electronic copies of the preliminary commissioning report. One electronic copy, with review comments, will be returned to the Commissioning Agent for preparation of the final submittal.
- H. Final Commissioning Report Submittal: The Commissioning Agent will submit four sets of electronically formatted information of the final commissioning report to the VA. The final submittal will incorporate comments as directed by the VA.
- I. Data for Commissioning:
1. The Commissioning Agent will request in writing from the Contractor specific information needed about each piece of commissioned equipment or system to fulfill requirements of the Commissioning Plan.

2. The Commissioning Agent may request further documentation as is necessary for the commissioning process or to support other VA data collection requirements, including Construction Operations Building Information Exchange (COBIE), Building Information Modeling (BIM), etc.

1.14 COMMISSIONING PROCESS

- A. The Commissioning Agent will be responsible for the overall management of the commissioning process as well as coordinating scheduling of commissioning tasks with the VA and the Contractor. As directed by the VA, the Contractor shall incorporate Commissioning tasks, including, but not limited to, Systems Functional Performance Testing (including predecessors) with the Master Construction Schedule.
- B. Within 14 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 14 days of contract award, the Contractor shall ensure that each subcontractor designates specific individuals as Commissioning Representatives (CXR) to be responsible for commissioning related tasks. The Contractor shall ensure the designated Commissioning Representatives participate in the commissioning process as team members providing commissioning testing services, equipment operation, adjustments, and corrections if necessary. The Contractor shall ensure that all Commissioning Representatives shall have sufficient authority to direct their respective staff to provide the services required, and to speak on behalf of their organizations in all commissioning related contractual matters.

1.15 QUALITY ASSURANCE

- A. Instructor Qualifications: Factory authorized service representatives shall be experienced in training, operation, and maintenance procedures for installed systems, subsystems, and equipment.
- B. Test Equipment Calibration: The Contractor shall comply with test equipment manufacturer's calibration procedures and intervals. Recalibrate test instruments immediately whenever instruments have been repaired following damage or dropping. Affix calibration tags to test

instruments. Instruments shall have been calibrated within six months prior to use.

1.16 COORDINATION

- A. Management: The Commissioning Agent will coordinate the commissioning activities with the VA and Contractor. The Commissioning Agent will submit commissioning documents and information to the VA. All commissioning team members shall work together to fulfill their contracted responsibilities and meet the objectives of the contract documents.
- B. Scheduling: The Contractor shall work with the Commissioning Agent and the VA to incorporate the commissioning activities into the construction schedule. The Commissioning Agent will provide sufficient information (including, but not limited to, tasks, durations and predecessors) on commissioning activities to allow the Contractor and the VA to schedule commissioning activities. All parties shall address scheduling issues and make necessary notifications in a timely manner in order to expedite the project and the commissioning process. The Contractor shall update the Master Construction as directed by the VA.
- C. Initial Schedule of Commissioning Events: The Commissioning Agent will provide the initial schedule of primary commissioning events in the Commissioning Plan and at the commissioning coordination meetings. The Commissioning Plan will provide a format for this schedule. As construction progresses, more detailed schedules will be developed by the Contractor with information from the Commissioning Agent.
- D. Commissioning Coordinating Meetings: The Commissioning Agent will conduct periodic Commissioning Coordination Meetings of the commissioning team to review status of commissioning activities, to discuss scheduling conflicts, and to discuss upcoming commissioning process activities.
- E. Pretesting Meetings: The Commissioning Agent will conduct pretest meetings of the commissioning team to review startup reports, Pre-Functional Checklist results, Systems Functional Performance Testing procedures, testing personnel and instrumentation requirements.
- F. Systems Functional Performance Testing Coordination: The Contractor shall coordinate testing activities to accommodate required quality assurance and control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing

and inspecting. The Contractor shall coordinate the schedule times for tests, inspections, obtaining samples, and similar activities.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. The Contractor shall provide all standard and specialized testing equipment required to perform Systems Functional Performance Testing. Test equipment required for Systems Functional Performance Testing will be identified in the detailed System Functional Performance Test Procedure prepared by the Commissioning Agent.
- B. Data logging equipment and software required to test equipment shall be provided by the Contractor.
- C. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the Specifications. If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers shall have a certified calibration within the past year to an accuracy of 0.5 °C (1.0 °F) and a resolution of + or - 0.1 °C (0.2 °F). Pressure sensors shall have an accuracy of + or - 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year. All equipment shall be calibrated according to the manufacturer's recommended intervals and following any repairs to the equipment. Calibration tags shall be affixed or certificates readily available.

PART 3 - EXECUTION

3.1 COMMISSIONING PROCESS ROLES AND RESPONSIBILITIES

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

| Construction Phase | | CxA = Commissioning Agent RE = Resident Engineer A/E = Design Arch/Engineer PC = Prime Contractor O&M = Gov't Facility O&M | | | | | L = Lead P = Participate A = Approve R = Review O = Optional |
|--|---|--|----|-----|----|-----|--|
| Commissioning Roles & Responsibilities | | | | | | | |
| Category | Task Description | CxA | RE | A/E | PC | O&M | Notes |
| Meetings | Construction Commissioning Kick Off meeting | L | A | P | P | O | |
| | Commissioning Meetings | L | A | P | P | O | |
| | Project Progress Meetings | P | A | P | L | O | |
| | Controls Meeting | L | A | P | P | O | |
| | | | | | | | |
| Coordination | Coordinate with [OGC's, AHJ, Vendors, etc.] to ensure that Cx interacts properly with other systems as needed to support the OPR and BOD. | L | A | P | P | N/A | |
| | | | | | | | |
| Cx Plan & Spec | Final Commissioning Plan | L | A | R | R | O | |
| | | | | | | | |
| Schedules | Duration Schedule for Commissioning Activities | L | A | R | R | N/A | |
| | | | | | | | |

| Construction Phase | | CxA = Commissioning Agent RE = Resident Engineer A/E = Design Arch/Engineer PC = Prime Contractor O&M = Gov't Facility O&M | | | | | L = Lead P = Participate A = Approve R = Review O = Optional |
|--|--|--|----|-----|----|-----|--|
| Commissioning Roles & Responsibilities | | | | | | | |
| Category | Task Description | CxA | RE | A/E | PC | O&M | Notes |
| OPR and BOD | Maintain OPR on behalf of Owner | L | A | R | R | O | |
| | Maintain BOD/DID on behalf of Owner | L | A | L | 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 | |
| | | | | | | | |
| | Status Reports | L | A | R | R | O | |

| Construction Phase | | CxA = Commissioning Agent RE = Resident Engineer A/E = Design Arch/Engineer PC = Prime Contractor O&M = Gov't Facility O&M | | | | | L = Lead P = Participate A = Approve R = Review O = Optional |
|--|-----------------------------------|--|----|-----|----|-----|--|
| Category | Task Description | CxA | RE | A/E | PC | O&M | Notes |
| Commissioning Roles & Responsibilities | | | | | | | |
| Reports and Logs | Maintain Commissioning Issues Log | L | A | R | R | O | |
| | | | | | | | |

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

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

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

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

Black Hills National Cemetery
 Renovate and Expand Administration and Maintenance Buildings
 20901 Pleasant Valley Drive

NCA Project #884CM3015
 10/31/22
 Bid Documents

| Warranty Phase | | CxA = Commissioning Agent | | | | | L = Lead |
|--|--|----------------------------|----|-----|----|-----|-----------------|
| Commissioning Roles & Responsibilities | | RE = Resident Engineer | | | | | P = Participate |
| | | 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 | 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// //4// weeks prior to equipment startup, the Contractor shall schedule startup and checkout with the VA and Commissioning Agent. The performance of the startup and checkout shall be directed and executed by the Contractor.
 - b. The Commissioning Agent will observe the startup procedures for selected pieces of primary equipment.
 - c. The Contractor shall execute startup and provide the VA and Commissioning Agent with a signed and dated copy of the completed startup checklists, and contractor tests.
 - d. Only individuals that have direct knowledge and witnessed that a line item task on the Startup Checklist was actually performed shall initial or check that item off. It is not acceptable for witnessing supervisors to fill out these forms.

3.3 DEFICIENCIES, NONCONFORMANCE, AND APPROVAL IN CHECKLISTS AND STARTUP

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

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

3.4 PHASED COMMISSIONING

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

3.5 DDC SYSTEM TRENDING FOR COMMISSIONING

- A. The Contractor shall provide the following information prior to Systems Functional Performance Testing. Any documentation that is modified after submission shall be recorded and resubmitted to the Resident Engineer and Commissioning Agent.
1. Point-to-Point checkout documentation;
 2. Sensor field calibration documentation including system name, sensor/point name, measured value, DDC value, and Correction Factor.
 3. A sensor calibration table listing the referencing the location of procedures to following in the O&M manuals, and the frequency at which calibration should be performed for all sensors, separated by system, subsystem, and type. The calibration requirements shall be submitted both in the O&M manuals and separately in a standalone document containing all sensors for inclusion in the commissioning documentation. The following table is a sample that can be used as a template for submission.

| SYSTEM | | |
|---------------------------|------------------------------|--|
| Sensor | Calibration Frequency | O&M Calibration Procedure Reference |
| Discharge air temperature | Once a year | Volume I Section D.3.aa |
| Discharge static pressure | Every 6 months | Volume II Section A.1.c |

4. Loop tuning documentation and constants for each loop of the building systems. The documentation shall be submitted in outline or table separated by system, control type (e.g. heating valve temperature control); proportional, integral and derivative constants, interval (and bias if used) for each loop. The following table is a sample that can be used as a template for submission.

| AIR HANDLING UNIT AHU-1 | | | | |
|--------------------------------|------------------------------|--------------------------|----------------------------|-----------------|
| Control Reference | Proportional Constant | Integral Constant | Derivative Constant | Interval |
| Heating Valve Output | 1000 | 20 | 10 | 2 sec. |

3.6 SYSTEMS FUNCTIONAL PERFORMANCE TESTING

- A. This paragraph applies to Systems Functional Performance Testing of systems for all referenced specification Divisions.
- B. Objectives and Scope: The objective of Systems Functional Performance Testing is to demonstrate that each system is operating according to the Contract Documents. Systems Functional Performance Testing facilitates bringing the systems from a state of substantial completion to full dynamic operation. Additionally, during the testing process, areas of noncompliant performance are identified and corrected, thereby improving the operation and functioning of the systems. In general, each system shall be operated through all modes of operation (seasonal, occupied, unoccupied, warm-up, cool-down, part- and full-load, fire alarm and emergency power) where there is a specified system response. The Contractor shall verify each sequence in the sequences of operation. Proper responses to such modes and conditions as power failure, freeze condition, low oil pressure, no flow, equipment failure, etc. shall also be tested.
- C. Development of Systems Functional Performance Test Procedures: Before Systems Functional Performance Test procedures are written, the

Contractor shall submit all requested documentation and a current list of change orders affecting equipment or systems, including an updated points list, program code, control sequences and parameters. Using the testing parameters and requirements found in the Contract Documents and approved submittals and shop drawings, the Commissioning Agent will develop specific Systems Functional Test Procedures to verify and document proper operation of each piece of equipment and system to be commissioned. The Contractor shall assist the Commissioning Agent in developing the Systems Functional Performance Test procedures as requested by the Commissioning Agent i.e. by answering questions about equipment, operation, sequences, etc. Prior to execution, the Commissioning Agent will provide a copy of the Systems Functional Performance Test procedures to the VA, the Architect/Engineer, and the Contractor, who shall review the tests for feasibility, safety, equipment and warranty protection.

D. Purpose of Test Procedures: The purpose of each specific Systems Functional Performance Test is to verify and document compliance with the stated criteria of acceptance given on the test form. Representative test formats and examples are found in the Commissioning Plan for this project. (The Commissioning Plan is issued as a separate document and is available for review.) The test procedure forms developed by the Commissioning Agent will include, but not be limited to, the following information:

1. System and equipment or component name(s)
2. Equipment location and ID number
3. Unique test ID number, and reference to unique Pre-Functional Checklists and startup documentation, and ID numbers for the piece of equipment
4. Date
5. Project name
6. Participating parties
7. A copy of the specification section describing the test requirements
8. A copy of the specific sequence of operations or other specified parameters being verified
9. Formulas used in any calculations
10. Required pretest field measurements
11. Instructions for setting up the test.

12. Special cautions, alarm limits, etc.
 13. Specific step-by-step procedures to execute the test, in a clear, sequential and repeatable format
 14. Acceptance criteria of proper performance with a Yes / No check box to allow for clearly marking whether or not proper performance of each part of the test was achieved.
 15. A section for comments.
 16. Signatures and date block for the Commissioning Agent. A place for the Contractor to initial to signify attendance at the test.
- E. Test Methods: Systems Functional Performance Testing shall be achieved by manual testing (i.e. persons manipulate the equipment and observe performance) and/or by monitoring the performance and analyzing the results using the control system's trend log capabilities or by standalone data loggers. The Contractor and Commissioning Agent shall determine which method is most appropriate for tests that do not have a method specified.
1. Simulated Conditions: Simulating conditions (not by an overwritten value) shall be allowed, although timing the testing to experience actual conditions is encouraged wherever practical.
 2. Overwritten Values: Overwriting sensor values to simulate a condition, such as overwriting the outside air temperature reading in a control system to be something other than it really is, shall be allowed, but shall be used with caution and avoided when possible. Such testing methods often can only test a part of a system, as the interactions and responses of other systems will be erroneous or not applicable. Simulating a condition is preferable. e.g., for the above case, by heating the outside air sensor with a hair blower rather than overwriting the value or by altering the appropriate setpoint to see the desired response. Before simulating conditions or overwriting values, sensors, transducers and devices shall have been calibrated.
 3. Simulated Signals: Using a signal generator which creates a simulated signal to test and calibrate transducers and DDC constants is generally recommended over using the sensor to act as the signal generator via simulated conditions or overwritten values.
 4. Altering Setpoints: Rather than overwriting sensor values, and when simulating conditions is difficult, altering setpoints to test a

sequence is acceptable. For example, to see the Air Conditioning compressor lockout initiate at an outside air temperature below 12 C (54 F), when the outside air temperature is above 12 C (54 F), temporarily change the lockout setpoint to be 2 C (4 F) above the current outside air temperature.

5. Indirect Indicators: Relying on indirect indicators for responses or performance shall be allowed only after visually and directly verifying and documenting, over the range of the tested parameters, that the indirect readings through the control system represent actual conditions and responses. Much of this verification shall be completed during systems startup and initial checkout.
- F. Setup: Each function and test shall be performed under conditions that simulate actual conditions as closely as is practically possible. The Contractor shall provide all necessary materials, system modifications, etc. to produce the necessary flows, pressures, temperatures, etc. necessary to execute the test according to the specified conditions. At completion of the test, the Contractor shall return all affected building equipment and systems, due to these temporary modifications, to their pretest condition.
- G. Sampling: No sampling is allowed in completing Pre-Functional Checklists. Sampling is allowed for Systems Functional Performance Test Procedures execution. The Commissioning Agent will determine the sampling rate. If at any point, frequent failures are occurring and testing is becoming more troubleshooting than verification, the Commissioning Agent may stop the testing and require the Contractor to perform and document a checkout of the remaining units, prior to continuing with Systems Functional Performance Testing of the remaining units.
- H. Cost of Retesting: The cost associated with expanded sample System Functional Performance Tests shall be solely the responsibility of the Contractor. Any required retesting by the Contractor shall not be considered a justified reason for a claim of delay or for a time extension by the Contractor.
- I. Coordination and Scheduling: The Contractor shall provide a minimum of 7 days' notice to the Commissioning Agent and the VA regarding the completion schedule for the Pre-Functional Checklists and startup of all equipment and systems. The Commissioning Agent will schedule

Systems Functional Performance Tests with the Contractor and VA. The Commissioning Agent will witness and document the Systems Functional Performance Testing of systems. The Contractor shall execute the tests in accordance with the Systems Functional Performance Test Procedure.

- J. Testing Prerequisites: In general, Systems Functional Performance Testing will be conducted only after Pre-Functional Checklists have been satisfactorily completed. The control system shall be sufficiently tested and approved by the Commissioning Agent and the VA before it is used to verify performance of other components or systems. The air balancing and water balancing shall be completed before Systems Functional Performance Testing of air-related or water-related equipment or systems are scheduled. Systems Functional Performance Testing will proceed from components to subsystems to systems. When the proper performance of all interacting individual systems has been achieved, the interface or coordinated responses between systems will be checked.
- K. Problem Solving: The Commissioning Agent will recommend solutions to problems found, however the burden of responsibility to solve, correct and retest problems is with the Contractor.

3.7 DOCUMENTATION, NONCONFORMANCE AND APPROVAL OF TESTS

- A. Documentation: The Commissioning Agent will witness, and document the results of all Systems Functional Performance Tests using the specific procedural forms developed by the Commissioning Agent for that purpose. Prior to testing, the Commissioning Agent will provide these forms to the VA and the Contractor for review and approval. The Contractor shall include the filled out forms with the O&M manual data.
- B. Nonconformance: The Commissioning Agent will record the results of the Systems Functional Performance Tests on the procedure or test form. All items of nonconformance issues will be noted and reported to the VA on Commissioning Field Reports and/or the Commissioning Master Issues Log.
1. Corrections of minor items of noncompliance identified may be made during the tests. In such cases, the item of noncompliance and resolution shall be documented on the Systems Functional Test Procedure.
 2. Every effort shall be made to expedite the systems functional Performance Testing process and minimize unnecessary delays, while not compromising the integrity of the procedures. However, the

Commissioning Agent shall not be pressured into overlooking noncompliant work or loosening acceptance criteria to satisfy scheduling or cost issues, unless there is an overriding reason to do so by direction from the VA.

3. As the Systems Functional Performance Tests progresses and an item of noncompliance is identified, the Commissioning Agent shall discuss the issue with the Contractor and the VA.
4. When there is no dispute on an item of noncompliance, and the Contractor accepts responsibility to correct it:
 - a. The Commissioning Agent will document the item of noncompliance and the Contractor's response and/or intentions. The Systems Functional Performance Test then continues or proceeds to another test or sequence. After the day's work is complete, the Commissioning Agent will submit a Commissioning Field Report to the VA. The Commissioning Agent will also note items of noncompliance and the Contractor's response in the Master Commissioning Issues Log. The Contractor shall correct the item of noncompliance and report completion to the VA and the Commissioning Agent.
 - b. The need for retesting will be determined by the Commissioning Agent. If retesting is required, the Commissioning Agent and the Contractor shall reschedule the test and the test shall be repeated.
5. If there is a dispute about item of noncompliance, regarding whether it is an item of noncompliance, or who is responsible:
 - a. The item of noncompliance shall be documented on the test form with the Contractor's response. The item of noncompliance with the Contractor's response shall also be reported on a Commissioning Field Report and on the Master Commissioning Issues Log.
 - b. Resolutions shall be made at the lowest management level possible. Other parties are brought into the discussions as needed. Final interpretive and acceptance authority is with the Department of Veterans Affairs.
 - c. The Commissioning Agent will document the resolution process.
 - d. Once the interpretation and resolution have been decided, the Contractor shall correct the item of noncompliance, report it to

the Commissioning Agent. The requirement for retesting will be determined by the Commissioning Agent. If retesting is required, the Commissioning Agent and the Contractor shall reschedule the test. Retesting shall be repeated until satisfactory performance is achieved.

- C. Cost of Retesting: The cost to retest a System Functional Performance Test shall be solely the responsibility of the Contractor. Any required retesting by the Contractor shall not be considered a justified reason for a claim of delay or for a time extension by the Contractor.
- D. Failure Due to Manufacturer Defect: If 10%, or three, whichever is greater, of identical pieces (size alone does not constitute a difference) of equipment fail to perform in compliance with the Contract Documents (mechanically or substantively) due to manufacturing defect, not allowing it to meet its submitted performance specifications, all identical units may be considered unacceptable by the VA. In such case, the Contractor shall provide the VA with the following:
1. Within one week of notification from the VA, the Contractor shall examine all other identical units making a record of the findings. The findings shall be provided to the VA within two weeks of the original notice.
 2. Within two weeks of the original notification, the Contractor shall provide a signed and dated, written explanation of the problem, cause of failures, etc. and all proposed solutions which shall include full equipment submittals. The proposed solutions shall not significantly exceed the specification requirements of the original installation.
 3. The VA shall determine whether a replacement of all identical units or a repair is acceptable.
 4. Two examples of the proposed solution shall be installed by the Contractor and the VA shall be allowed to test the installations for up to one week, upon which the VA will decide whether to accept the solution.
 5. Upon acceptance, the Contractor shall replace or repair all identical items, at their expense and extend the warranty accordingly, if the original equipment warranty had begun. The

replacement/repair work shall proceed with reasonable speed beginning within one week from when parts can be obtained.

- E. Approval: The Commissioning Agent will note each satisfactorily demonstrated function on the test form. Formal approval of the Systems Functional Performance Test shall be made later after review by the Commissioning Agent and by the VA. The Commissioning Agent will evaluate each test and report to the VA using a standard form. The VA will give final approval on each test using the same form, and provide signed copies to the Commissioning Agent and the Contractor.

3.8 DEFERRED TESTING

- A. Unforeseen Deferred Systems Functional Performance Tests: If any Systems Functional Performance Test cannot be completed due to the building structure, required occupancy condition or other conditions, execution of the Systems Functional Performance Testing may be delayed upon approval of the VA. These Systems Functional Performance Tests shall be conducted in the same manner as the seasonal tests as soon as possible. Services of the Contractor to conduct these unforeseen Deferred Systems Functional Performance Tests shall be negotiated between the VA and the Contractor.
- B. Deferred Seasonal Testing: Deferred Seasonal Systems Functional Performance Tests are those that must be deferred until weather conditions are closer to the systems design parameters. The Commissioning Agent will review systems parameters and recommend which Systems Functional Performance Tests should be deferred until weather conditions more closely match systems parameters. The Contractor shall review and comment on the proposed schedule for Deferred Seasonal Testing. The VA will review and approve the schedule for Deferred Seasonal Testing. Deferred Seasonal Systems Functional Performances Tests shall be witnessed and documented by the Commissioning Agent. Deferred Seasonal Systems Functional Performance Tests shall be executed by the Contractor in accordance with these specifications.

3.9 OPERATION AND MAINTENANCE TRAINING REQUIREMENTS

- A. Training Preparation Conference: Before operation and maintenance training, the Commissioning Agent will convene a training preparation conference to include VA's Resident Engineer, VA's Operations and Maintenance personnel, and the Contractor. The purpose of this

conference will be to discuss and plan for Training and Demonstration of VA Operations and Maintenance personnel.

- B. The Contractor shall provide training and demonstration as required by other Division 21, Division 22, Division 23, Division 26, Division 27, Division 28, and Division 31 sections. The Training and Demonstration shall include, but is not limited to, the following:
1. Review the Contract Documents.
 2. Review installed systems, subsystems, and equipment.
 3. Review instructor qualifications.
 4. Review instructional methods and procedures.
 5. Review training module outlines and contents.
 6. Review course materials (including operation and maintenance manuals).
 7. Review and discuss locations and other facilities required for instruction.
 8. Review and finalize training schedule and verify availability of educational materials, instructors, audiovisual equipment, and facilities needed to avoid delays.
 9. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.
- C. Training Module Submittals: The Contractor shall submit the following information to the VA and the Commissioning Agent:
1. Instruction Program: Submit two copies of outline of instructional program for demonstration and training, including a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module. At completion of training, submit two complete training manuals for VA's use.
 2. Qualification Data: Submit qualifications for facilitator and/or instructor.
 3. Attendance Record: For each training module, submit list of participants and length of instruction time.
 4. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.
 5. Demonstration and Training Recording:

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

D. Quality Assurance:

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

E. Training Coordination:

1. Coordinate instruction schedule with VA's operations. Adjust schedule as required to minimize disrupting VA's operations.
2. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
3. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by the VA.

F. Instruction Program:

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

evacuation, voice and data, and entertainment television equipment.

- n. Site utilities including lift stations, condensate pumping and return systems, and storm water pumping systems.

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

- 1. Basis of System Design, Operational Requirements, and Criteria:

Include the following:

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

- 2. Documentation: Review the following items in detail:

- a. Emergency manuals.
- b. Operations manuals.
- c. Maintenance manuals.
- d. Project Record Documents.
- e. Identification systems.
- f. Warranties and bonds.
- g. Maintenance service agreements and similar continuing commitments.

- 3. Emergencies: Include the following, as applicable:

- a. Instructions on meaning of warnings, trouble indications, and error messages.
- b. Instructions on stopping.
- c. Shutdown instructions for each type of emergency.
- d. Operating instructions for conditions outside of normal operating limits.
- e. Sequences for electric or electronic systems.
- f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:
 - a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
5. Adjustments: Include the following:
 - a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
 - a. Diagnostic instructions.
 - b. Test and inspection procedures.
7. Maintenance: Include the following:
 - a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.
8. Repairs: Include the following:
 - a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.

e. Review of spare parts needed for operation and maintenance.

H. Training Execution:

1. Preparation: Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a combined training manual. Set up instructional equipment at instruction location.
2. Instruction:
 - a. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Department of Veterans Affairs for number of participants, instruction times, and location.
 - b. Instructor: Engage qualified instructors to instruct VA's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 - 1) The Commissioning Agent will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
 - 2) The VA will furnish an instructor to describe VA's operational philosophy.
 - 3) The VA will furnish the Contractor with names and positions of participants.
3. Scheduling: Provide instruction at mutually agreed times. For equipment that requires seasonal operation, provide similar instruction at start of each season. Schedule training with the VA and the Commissioning Agent with at least seven days' advance notice.
4. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of an oral, or a written, performance-based test.
5. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

I. Demonstration and Training Recording:

1. General: Engage a qualified commercial photographer to record demonstration and training. Record each training module separately. Include classroom instructions and demonstrations, board diagrams,

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

----- END -----

**SECTION 02 41 10
DEMOLITION AND SITE CLEARING**

PART 1 - GENERAL

1.1 DESCRIPTION

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

1.2 RELATED WORK

- A. Demolition and removal of roads, walks, curbs, and on-grade slabs outside buildings to be demolished: Section 31 20 00, EARTH MOVING Section 31 20 11.
- B. Safety Requirements: GENERAL CONDITIONS Article, ACCIDENT PREVENTION.
- C. Disconnecting utility services prior to demolition: Section 01 00 00, GENERAL REQUIREMENTS.
- D. Reserved items that are to remain the property of the Government: Section 01 00 00, GENERAL REQUIREMENTS.
- E. Environmental Protection: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.
- F. Waste Management: Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT

1.3 PROTECTION

- A. Perform demolition in such manner as to eliminate hazards to persons and property; to minimize interference with use of adjacent areas, utilities and structures or interruption of use of such utilities; and to provide free passage to and from such adjacent areas of structures. Comply with requirements of GENERAL CONDITIONS Article, ACCIDENT PREVENTION.
- B. Provide safeguards, including warning signs, barricades, temporary fences, warning lights, and other similar items that are required for protection of all personnel during demolition and removal operations. Comply with requirements of Section 01 00 00, GENERAL REQUIREMENTS, Article 1.9 PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES AND IMPROVEMENTS.
- C. Maintain fences, barricades, lights, and other similar items around exposed excavations until such excavations have been completely filled
- D. 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.

- E. 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 4500 mm (15 feet) of fire hydrants.
- F. Before beginning any demolition work, survey the site and examine the drawings and specifications to determine the extent of the work. Take necessary precautions to avoid damages to existing items to remain in place, to be reused, or to remain the property of the Cemetery; any damaged items shall be repaired or replaced as approved by the Resident Engineer/Contracting Officer's Representative (RE/PM). Coordinate the work of this section with all other work. Construct and maintain shoring, bracing, and supports as required. Ensure that structural elements are not overloaded. Increase structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract. Provide new supports and reinforcement for existing construction weakened by demolition or removal works. Repairs, reinforcement, or structural replacement must have RE/PM's approval.
- G. The work shall comply with the requirements of Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.
- H. Perform demolition such that it is timed to avoid nesting periods of migratory birds on site and protected under the Migratory Bird Treaty Act.

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 SITE CLEARING

- A. General: Remove trees, shrubs, grass, and other vegetation, pavements, improvements, or obstructions, as required, to permit installation of new construction. Remove similar items elsewhere on site or premises as specifically indicated. Removal includes digging out and off-site disposal of stumps and roots.
 - 1. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
- B. Erosion Control: Provide erosion control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways. Install silt fence and inlet protection as shown and as per requirements of the SWPPP, prior to any soil disturbance activities. Provide temporary seeding as required by the SWPPP.
- C. Maintain site controls in accordance with Storm Water Pollution Prevention Plan and repair as directed by COTR to sustain compliance with SPDES permit. Maintain all records as required by the SWPPP. Perform inspections as required by the SWPPP.
- D. Topsoil - On-site: Topsoil is defined as friable clay loam surface soil found in a depth of not less than 150 mm (6 inches). Satisfactory topsoil is reasonably free and/or screened of subsoil, clay lumps, stones, and other objects over 25 mm (1 inch) in diameter, and without weeds, roots, and other objectionable material.
 - 1. Strip topsoil to whatever depths encountered in a manner to prevent intermingling with underlying subsoil or other objectionable material. Remove heavy growths of grass from areas before stripping.
 - a. Where existing trees are indicated to remain, leave existing topsoil in place within drip lines to prevent damage to root system.
 - 2. Stockpile topsoil in storage piles in areas indicated or directed. Construct storage piles to provide free drainage of surface water. Cover storage piles to prevent wind erosion in accordance with the Storm Water Pollution Prevention Plan. Refer to Division 32 Section

- 32 90 00, "Planting" for soil amendments required prior to spreading topsoil.
- a. Stockpile shall be contained with erosion and sediment controls (silt fence) and stabilized if undisturbed in accordance with the Storm Water Pollution Prevention Plan.
3. Dispose of unsuitable or excess topsoil as specified for disposal of waste material only after approval of the Architect.
- E. Clearing and Grubbing: Clear site of trees, shrubs, and other vegetation, except for those indicated to be left standing.
1. Completely remove stumps, roots, and other debris protruding through ground surface.
 2. Use only hand methods for grubbing inside drip line of trees indicated to remain.
 3. Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated.
 - a. Place fill material in horizontal layers not exceeding 150 mm (6 inches) loose depth, and thoroughly compact each layer to a density equal to adjacent original ground.
- F. Removal of Improvements: Remove existing above-grade and below-grade improvements as indicated and as necessary to facilitate new construction.
- G. Abandonment or removal of certain underground pipe or conduits may be indicated on mechanical or electrical drawings and is included under work of related Division 23 and 26 Sections. Removing abandoned underground piping or conduits interfering with construction is included under this Section, except as indicated to be abandoned in-place.
- H. Continue maintenance of erosion controls in compliance with the Storm Water Pollution Prevention Plan until the work is completed and the threat of erosion is gone by either around surface stabilizer or lawn "grow-in" is at 85% complete. Temporary erosion control devices shall not be removed until the area is certified as being stabilized by the Qualified Inspector.

3.2 DEMOLITION

- A. Selectively demolish and remove portions of buildings and structures, including all appurtenances related or connected thereto, as noted below:
1. As required for installation of new utility service lines.
 2. To full depth within an area defined by hypothetical lines located 1500 mm (5 feet) outside building lines of new structures.
 3. Demolish and remove existing building construction only to the extent required for new construction and as indicated, so that portions of the building to remain will be undamaged. Protect construction indicated to remain against damage and soiling during selective demolition. Neatly cut openings plumb square and true to dimensions required. Use cutting methods least likely to damage construction to remain.
 4. If removal of existing work exposes unfinished surfaces or work out of alignment, such surfaces shall be modified or replaced as necessary to make contiguous work uniform and harmonious.
 5. Infill masonry shall be toothed in.
- 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 Cemetery Property to avoid accumulation at the demolition site. Materials that cannot be removed daily shall be stored in areas specified by the RE/PM. Break up concrete slabs below grade that do not require removal from present location into pieces not exceeding 600 mm (24 inches) square to permit drainage. Contractor shall dispose debris in compliance with applicable federal, state or local permits, rules and/or regulations
- C. Remove and legally dispose of all materials, other than earth to remain as part of project work, from any trash dumps shown. Materials removed shall become property of contractor and shall be disposed of in compliance with applicable federal, state or local permits, rules and/or regulations. All materials in the indicated trash dump areas, including above surrounding grade and extending to a depth of 1500 mm (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 1500 mm (5 feet), or materials that are discovered to be hazardous, shall be

handled as unforeseen. The removal of hazardous material shall be referred to Hazardous Materials specifications. Burning is not permitted on the property.

- 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 RE/PM. When Utility lines are encountered that are not indicated on the drawings, the RE/PM shall be notified prior to further work in that area.

3.2 CLEAN-UP

- A. On completion of work of this section and after removal of all debris, leave site in clean condition satisfactory to RE/PM. Clean-up shall include off the Cemetery Property 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.

- - - E N D - - -

SECTION 03 30 53
(SHORT-FORM) CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies cast-in-place structural concrete and material and mixes for other concrete.

1.2 RELATED WORK

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Concrete roads, walks, and similar exterior site work: Section 32 05 23, CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS.
- D. Masonry Mortaring: Section 04 05 13 MASONRY MORTARING
- F. Joint Sealants: Section 07 92 00 JOINT SEALANTS
- F. Finishes: Section 09 06 00 SCHEDULE OF FINISHES

1.3 TOLERANCES

- A. ACI 117.
- B. Slab Finishes: ACI 117, F-number method in accordance with ASTM E1155.

1.4 REGULATORY REQUIREMENTS

- A. ACI SP-66 - ACI Detailing Manual.
- B. ACI 318 - Building Code Requirements for Reinforced Concrete.

1.5 SUSTAINABILITY REQUIREMENTS (NOT USED)

1.6 REGULATORY REQUIREMENTS FOR RECYCLED CONTENT

- A. Products and Materials with Post-Consumer Content and Recovered Materials Content:
1. Contractor is obligated by contract to satisfy Federal mandates for procurement of products and materials meeting recommendations for post-consumer content and recovered materials content; the list of designated product categories with recommendations has been compiled by the EPA - refer to <http://www.epa.gov/wastes/conserves/tools/cpg/products/>.
 2. Materials or products specified by this section may be obligated to satisfy this Federal mandate and Comprehensive Procurement Guidelines program.
 3. The EPA website also provides tools such as a Product Supplier Directory search engine and product resource guides.

1.7 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Concrete Mix Design.
- C. Shop Drawings:
 - 1. Submit Steel Reinforcement Shop Drawings and Product Data to include all information necessary for fabrication and placement of reinforcement.
 - 2. Indicate grades of reinforcing steel.
 - 3. Clearly indicate the splice length for every size and type of bar used.
 - 4. Indicate the type, size and location of all accessories required for the proper assembly, placement and support of the reinforcement.
 - 5. Provide layout drawings of all floor slabs and formed concrete indicating control and expansion joints.
- D. Manufacturer's Certificates: Air-entraining admixture, chemical admixtures, curing compounds.

1.8 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by the basic designation only. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
- B. American Concrete Institute (ACI):
 - 117-10 Tolerances for Concrete Construction and Materials and Commentary
 - 211.1-91 (R2009) Selecting Proportions for Normal, Heavyweight, and Mass Concrete
 - 301-10 Structural Concrete
 - 305R-10 Guide to Hot Weather Concreting
 - 306R-10 Guide to Cold Weather Concreting
 - SP-66-04 ACI Detailing Manual
 - 318/318M-11 Building Code Requirements for Structural Concrete and Commentary
 - 347R-04 Guide to Formwork for Concrete
- C. American Society for Testing and Materials (ASTM):

| | |
|------------------|---|
| A185/A185M-07 | Steel Welded Wire Reinforcement, Plain, for Concrete |
| A615/A615M-12 | Deformed and Plain Carbon Steel Bars for Concrete Reinforcement |
| A996/A996M-09b | Rail Steel and Axle Steel Deformed Bars for Concrete Reinforcement |
| C31/C31M-12 | Making and Curing Concrete Test Specimens in the Field |
| C33/C33M-13 | Concrete Aggregates |
| C39/C39M-12a | Compressive Strength of Cylindrical Concrete Specimens |
| C94/C94M-13 | Ready Mixed Concrete |
| C143/C143M-12 | Slump of Hydraulic Cement Concrete |
| C150/C150M-12 | Portland Cement |
| C171-07 | Sheet Materials for Curing Concrete |
| C172/C172M-10 | Sampling Freshly Mixed Concrete |
| C173/C173M-12 | Air Content of Freshly Mixed Concrete by the Volumetric Method |
| C192/C192M-12a | Making and Curing Concrete Test Specimens in the Laboratory |
| C231/C231M-10 | Air Content of Freshly Mixed Concrete by the Pressure Method |
| C260/C260M-10a | Air-Entraining Admixtures for Concrete |
| C494/C494M-13 | Chemical Admixtures for Concrete |
| C618-12a | Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete |
| D1751-04 (R2008) | Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types) |
| E1155-96 (2008) | Determining FF Floor Flatness and FL Floor Levelness Numbers |

PART 2 - PRODUCTS

2.1 FORMS

- A. Wood, plywood, metal, or other materials, approved by SRE/PM, of grade or type suitable to obtain type of finish specified.

B. Form releasing agents to be commercial formulations that will not bond with, stain or adversely affect concrete surfaces. Agents must not impair subsequent treatment of concrete surfaces depending upon bond or adhesion nor impede the wetting of surfaces to be cured with water or curing compounds. If special form liners are to be used, follow the recommendation of the form coating manufacturer. Submit manufacturer's recommendation on method and rate of application of form releasing agents.

2.2 MATERIALS

- A. Portland Cement: ASTM C150, Type I or II.
- B. Fly Ash: ASTM C618, Class C or F including supplementary optional requirements relating to reactive aggregates and alkalis, and loss on ignition (LOI) not to exceed 5 percent.
- C. Coarse Aggregate: ASTM C33, Size 67. Size 467 may be used for footings and walls over 300 mm (12 inches) thick. Provide Size 7 coarse aggregate for applied topping.
- D. Fine Aggregate: ASTM C33.
- E. Mixing Water: Fresh, clean, and potable.
- F. Air-Entraining Admixture: ASTM C260.
- G. Chemical Admixtures: ASTM C494.
- H. Vapor Barrier: ASTM E1745, 0.38 mm (15 mil).
- I. Reinforcing Steel: ASTM A615 or ASTM A996, deformed. See structural drawings for grade.
- J. Welded Wire Fabric: ASTM A185.
- K. Expansion Joint Filler: ASTM D1751.
- L. Sheet Materials for Curing Concrete: ASTM C171.
- M. Abrasive Aggregates: Aluminum oxide grains or emery grits.
- N. Liquid Densifier/Sealer: 100 percent active colorless aqueous silicate solution.
- O. Grout, Non-Shrinking: Premixed ferrous or non-ferrous, mixed and applied in accordance with manufacturer's recommendations. Grout cannot show settlement or vertical drying shrinkage at 3 days or thereafter based on initial measurement made at time of placement. Grout must produce a compressive strength of minimum 18 MPa (2500 psi) at 3 days and minimum 35 MPa (5000 psi) at 28 days.

P. Form Ties - Form ties utilized in areas of exposed concrete shall be of cone type breakaway, where metal is inset greater than ½ inch from surface.

2.3 CONCRETE MIXES

- A. Design of concrete mixes using materials specified as set forth under Option C of ASTM C94.
- B. Compressive strength at 28 days: Type B: Minimum 30 MPa - 4000 psi.
- C. Establish strength of concrete by testing prior to beginning concreting operation. Test consists of average of three cylinders made and cured in accordance with ASTM C192 and tested in accordance with ASTM C39.
- D. Maximum slump for vibrated concrete is 100 mm (4 inches) tested in accordance with ASTM C143.
- E. Cement and water factor (See Table I):

TABLE I - CEMENT AND WATER FACTORS FOR CONCRETE

| Type | Concrete: Strength Min. 28 Day Comp. Str. MPa (psi) | Non-Air-Entrained | | Air-Entrained | |
|----------|---|--|-------------------------------|---|-------------------------------|
| | | Min. Cement kg/m ³ (lbs/c. yd) | Max. Water Cement Ratio | Min. Cement kg/m ³ (lbs/c. yd) | Max. Water Cement Ratio |
| A | 35 (5000) ^{1,3} | 375 (630) | 0.45 | 385 (650) | 0.40 |
| B | 30 (4000)^{1,3} | 325 (550) | 0.55 | 340 (570) | 0.50 |
| C | 25 (3000) ^{1,3} | 280 (470) | 0.65 | 290 (490) | 0.55 |
| D | 25 (3000) ¹ | 300 (500) | * | 310 (520) | * |

1. If trial mixes are used, the proposed mix design must achieve a compressive strength 8.3 MPa (1200 psi) in excess of f'c. For concrete strengths above 35 Mpa (5000 psi), the proposed mix design must achieve a compressive strength 9.7 MPa (1400 psi) in excess of f'c.

3. For concrete exposed to high sulfate content soils maximum water cement ratio is 0.44.

* Determined by Laboratory in accordance with ACI 211.1 for normal concrete.

F. Air-entrainment is required for all exterior concrete and as required for Section 32 05 23, CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS. Air content must conform with ACI 318 Table 4.4.1.

2.4 BATCHING AND MIXING

A. Store, batch, and mix materials as specified in ASTM C94.

1. Job-Mixed: Mix in a batch mixer in manner specified for stationary mixers in ASTM C94.
2. Ready-Mixed: Comply with ASTM C94, except use of non-agitating equipment for transporting concrete to the site will not be permitted. With each load of concrete delivered to project, ready-mixed concrete producer must furnish, in duplicate, certification as required by ASTM C94.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Installation conforms to ACI 347. Sufficiently tight to hold concrete without leakage, sufficiently braced to withstand vibration of concrete, and to carry, without appreciable deflection while remaining within allowable construction tolerances, all dead and live loads to which they may be subjected.
- B. Treating and Wetting: Treat or wet contact forms as follows:
 1. Coat plywood and board forms with non-staining form sealer. In hot weather cool forms by wetting with cool water just before concrete is placed.
 2. Clean and coat removable metal forms with light form oil before reinforcement is placed. In hot weather, cool metal forms by thoroughly wetting with water just before placing concrete.
 3. Use sealer on reused plywood forms as specified for new material.
- C. Inserts, sleeves, and similar items: Flashing reglets, masonry ties, anchors, inserts, wires, hangers, sleeves, boxes for floor hinges and other items specified as furnished under this and other sections of specifications are required to be in their final position at time concrete is placed - properly located, accurately positioned, built into construction, and maintained securely in place.
- D. Construction Tolerances:
 1. Set and maintain concrete formwork to assure erection of completed work within tolerances specified to accommodate installation or other rough and finish materials.
 2. Cast-in-place concrete installed as part of, or in the complexes surrounding, columbarium elements to have concrete (on or above finished grade) constructed to dimensions indicated on Drawings within 6 mm (1/4 inch) of location and elevation.

3. Engage a professional surveyor to survey the form work for the exposed portions of the foundations for the columbarium, including wall segments, piers and/or columns, prior to concrete being poured. If the forms are not correct, they must be corrected and resurveyed. When correct, provide a written certification from the surveyor, to the RE/COR, that the forms are set according to the plans, within the allowable tolerances for elevation, location, orientation, and dimensions called for on the plans.
4. Properly brace the forms so the set concrete is correct within the allowable construction tolerances when the forms are removed.
5. Upon removal of the forms, the professional surveyor must survey the placed concrete and provide information to the RE/PM where the work is not in conformance with the design drawings, within the allowable construction tolerances. The work cannot progress until the exposed concrete for the foundations are brought into compliance.
6. Remedial work necessary for correcting installations that is in excess of allowable tolerances are the responsibility of the Contractor.
7. Erected work that exceeds specified tolerance limits must be remedied or removed and replaced, at no additional cost to the Government.
8. Any remediation work is subject to approval of the RE/PM in advance of the work.
9. Permissible surface irregularities for various classes of materials are defined as "finishes" in specification sections covering individual materials. They are to be distinguished from tolerances specified which are applicable to surface irregularities of structural elements.

3.2 REINFORCEMENT

- A. Details of concrete reinforcement, unless otherwise shown, in accordance with ACI 318 and ACI SP-66. Support and securely tie reinforcing steel to prevent displacement during placing of concrete.

3.3 VAPOR BARRIER

- A. Except where membrane waterproofing is required, place interior concrete slabs on a continuous vapor barrier.
- B. Place 100 mm (4 inches) of fine granular fill over the vapor barrier to act as a blotter for concrete slab.

- C. Lap joints 150 mm (6 inches) and seal with a compatible pressure-sensitive tape.
- D. Patch punctures and tears.

3.4 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 of SRE/PM before placing concrete. Provide screeds at required elevations for concrete slabs.
- B. Roughen and clean set concrete free from laitance, foreign matter, and loose particles, before placing new concrete on or against concrete which has set.
- C. Convey concrete from mixer to final place of deposit by method which 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. 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. Provide vibration continuously with placing of concrete.
- D. Hot weather placing of concrete: Follow recommendations of ACI 305R to prevent problems in the manufacturing, placing, and curing of concrete that can adversely affect the properties and serviceability of the hardened concrete.
- E. Cold weather placing of concrete: Follow recommendations of ACI 306R, to prevent freezing of thin sections less than 300 mm (12 inches) and to permit concrete to gain strength properly, except that use of calcium chloride cannot be used without written approval from RE/PM.

3.5 PROTECTION AND CURING

- A. Protect exposed surfaces of concrete from premature drying, wash by rain or running water, wind, mechanical injury, and excessively hot or cold temperature. Curing method is subject to approval by RE/PM.

3.6 FORM REMOVAL

- A. Forms remain in place until concrete has a sufficient strength to carry its own weight and loads supported. Removal of forms at any time is the Contractor's sole responsibility.

3.7 SURFACE PREPARATION

- A. Immediately remove loose materials, after forms have been removed and work has been examined and approved by SRE/PM, and patch all stone pockets, surface honeycomb, or similar deficiencies with cement mortar made with 1 part portland cement and 2 to 3 parts sand.
- B. For exposed surfaces of concrete for the columbarium walls in their complexes, follow the procedures identified in Paragraph FINISHES for Exterior Exposed Areas (finished).
- C. For columbarium and their complexes, immediately after forms are removed, take steps to prepare and smooth the exposed portions of the concrete. Remove the form marks, including joint marks, fins, burrs and similar projections to produce a smooth surface. Complete the surface finish to result in a uniform textured surface with homogeneous color, unless surface is to be otherwise treated. Work must be as approved during the review of the mock-up.

3.8 FINISHES

- A. Vertical and Overhead Surface Finishes:
 - 1. Unfinished Areas: Vertical and overhead concrete surfaces exposed in unfinished areas, above suspended ceilings in manholes, and other unfinished areas exposed or concealed will not require additional finishing.
 - 2. Interior and Exterior Exposed Areas (to be painted): Fins, burrs and similar projections on surface must be knocked off flush by mechanical means approved by SRE/PM and rubbed lightly with a fine abrasive stone or hone. Use an ample amount of water during rubbing without working up a lather of mortar or changing texture of concrete.
 - 3. Interior and Exterior Exposed Areas (finished): Provide grout finish of uniform color and smooth finish treated as follows:
 - a. After concrete has hardened and laitance, fins and burrs have been removed, scrub concrete with wire brushes. Clean stained concrete surfaces by use of a hone or stone.

- b. Apply grout composed of 1 part Portland cement and 1 part clean, fine sand (smaller than 600 micro-m (No. 30) sieve). Work grout into surface of concrete with cork floats or fiber brushes until all pits and honeycomb are filled.
 - c. After grout has hardened, but still plastic, remove surplus grout with a sponge rubber float and by rubbing with clean burlap.
 - d. In hot, dry weather use a fog spray to keep grout wet during setting period. Complete finish for any area in same day. Confine limits of finished areas to natural breaks in wall surface. Do not leave grout on concrete surface overnight.
 - e. At a minimum, provide grout finish 12" below finished grade where exposed concrete meets grade.
- B. Slab Finishes (Horizontal/Flatwork Finished):
- 1. Scratch Finish: Slab surfaces to receive a bonded applied cementitious application must be thoroughly raked or wire broomed after partial setting (within 2 hours after placing) to roughen surface and ensure a permanent bond between base slab and applied cementitious materials.
 - 2. Floating: Allow water brought to surface by float used for rough finishing to evaporate before surface is again floated or troweled. Do not sprinkle dry cement on surface to absorb water.
 - 3. Float Finish: Screen and float ramps, stair treads, and platforms, both interior and exterior, equipment pads, and slabs to receive non-cementitious materials, except as specified, to a smooth dense finish. Check for alignment using a straightedge or template after first floating and while surface is still soft. Correct high spots by cutting down with a trowel or similar tool and correct low spots by filling in with material of same composition as floor finish. Remove any surface projections on floated finish by rubbing or dry grinding. Refloat the slab to a uniform sandy texture.
 - 4. Steel Trowel Finish: Applied toppings, concrete surfaces to receive resilient floor covering or carpet, future floor roof and all monolithic concrete floor slabs exposed in finished work and for which no other finish is shown or specified must be steel troweled. Delay final steel troweling to secure a smooth, dense surface as long as possible, generally when the surface can no longer be dented with finger. During final troweling, tilt steel trowel at a slight

angle and exert heavy pressure on trowel to compact cement paste and form a dense, smooth surface. Finished surface must be free of trowel marks, uniform in texture and appearance.

5. Broom Finish: Finish all exterior slabs, ramps, and stair treads with a bristle brush moistened with clear water after the surfaces have been floated.
6. Finished slab flatness (FF) and levelness (FL) values must comply with the following minimum requirements:

| | |
|---|--|
| Slab On Grade | |
| Specified overall value F _F 25/F _L 20 | |
| Minimum local value F _F 17/F _L 15 | |

3.9 SURFACE TREATMENTS

- A. Mix and apply surface treatments in accordance with manufacturer's printed instructions.
- B. Liquid Densifier/Sealer: Use on all exposed concrete floors and concrete floors to receive carpeting except those specified to receive non-slip finish.
- C. Non-Slip Finish: Except where safety nosing and tread coverings are shown, apply non-slip abrasive aggregate to treads and platforms of all concrete steps and stairs, and to surfaces of exterior concrete ramps and platforms. Broadcast aggregate uniformly over concrete surface. Trowel concrete surface to smooth dense finish. After curing, rub the treated surface with abrasive brick and water sufficiently to slightly expose abrasive aggregate.

3.10 APPLIED TOPPING

- A. Separate concrete topping with thickness and strength shown with only enough water to insure a stiff, workable, plastic mix.
- B. Continuously place applied topping until entire section is complete, struck off with straightedge, compact by rolling or tamping, float and steel trowel to a hard smooth finish.

3.11 RESURFACING FLOORS

- A. Remove existing flooring, in areas to receive resurfacing, to expose existing structural slab and to extend not less than 25 mm (1 inch) below new finished floor level. Prepare exposed structural slab surface

by roughening, broom cleaning, wetting, and grouting. Apply topping as specified.

3.13 PRECAST CONCRETE ITEMS

- A. Cast precast concrete items, not specified elsewhere, using 25 MPa (3000 psi) air-entrained concrete to shapes and dimensions shown. Finish surfaces to match corresponding adjacent concrete surfaces. Reinforce with steel as necessary for safe handling and erection.

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**SECTION 04 05 13
MASONRY MORTARING**

PART 1 - GENERAL

1.1 DESCRIPTION:

Section specifies mortar materials and mixes.

1.2 RELATED WORK:

A. Mortar used in Section:

2. Section 04 05 16, MASONRY GROUTING.
3. Section 04 20 00, UNIT MASONRY.
4. Section 04 05 31, MASONRY TUCK POINTING.
5. Section 04 72 00, CAST STONE MASONRY.

B. Mortar Color: To match existing on Buildings 1001 and 3001 and as indicated on Drawings.

1.3 TESTING LABORATORY-CONTRACTOR RETAINED

- A. Engage a commercial testing laboratory approved by Resident Engineer to perform tests specified below.
- B. Submit information regarding testing laboratory's facilities and qualifications of technical personnel to Resident Engineer.

1.4 TESTS

- A. Test materials proposed for use for compliance with specifications in accordance with test methods contained in referenced specifications and as follows:
- B. Mortar:
 1. Test for compressive strength and water retention; ASTM C270.
 2. Mortar compressive strengths 28 days as follows:
 - Type M: Minimum 17230 kPa (2500 psi) at 28 days.
 - Type S: Minimum 12400 kPa (1800 psi) at 28 days.
 - Type N: Minimum 5170 kPa (750 psi) at 28 days.
- C. Cement:
 1. Test for water soluble alkali (nonstaining) when nonstaining cement is specified.
 2. Nonstaining cement shall contain not more than 0.03 percent water soluble alkali.
- D. Sand: Test for deleterious substances, organic impurities, soundness and grading.

1.5 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Certificates:
 - 1. Indicating that following items meet specifications:
 - a. Portland cement.
 - b. Masonry cement.
 - c. Mortar cement.
 - d. Hydrated lime.
 - e. Fine aggregate (sand).
- C. Laboratory Test Reports:
 - 1. Mortar, each type.
 - 2. Admixtures.
- D. Manufacturer's Literature and Data:
 - 1. Cement, each kind.
 - 2. Hydrated lime.
 - 3. Admixtures.
 - 4. Liquid acrylic resin.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver masonry materials in original sealed containers marked with name of manufacturer and identification of contents.
- B. Store masonry materials under waterproof covers on planking clear of ground, and protect damage from handling, dirt, stain, water and wind.

1.7 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of specification to extent referenced. Publications are referenced in text by basic designation only.
- B. American Society for Testing and Materials (ASTM):
 - C40-20.....Organic Impurities in Fine Aggregates for
Concrete
 - C91-18.....Masonry Cement
 - C109-21.....Compressive Strength of Hydraulic Cement
Mortars (Using 2-in. or 50-MM Cube Specimens)
 - C144-21.....Aggregate for Masonry Mortar
 - C150-22.....Portland Cement
 - C207-18.....Hydrated Lime for Masonry Purposes
 - C270-19ae1.....Mortar for Unit Masonry

- C595-21.....Blended Hydraulic Cement
- C780-20.....Preconstruction and Construction Evaluation of
Mortars for Plain and Reinforced Unit Masonry
- C979-16.....Pigments for Integrally Colored Concrete
- C1329-16a.....Mortar Cement

PART 2 - PRODUCTS

2.1 HYDRATED LIME

ASTM C207, Type S.

2.2 AGGREGATE FOR MASONRY MORTAR

- A. ASTM C144 and as follows:
 - 1. Light colored sand for mortar for laying face brick.
 - 2. White plastering sand meeting sieve analysis for mortar joints for pointing.
- B. Test sand for color value in accordance with ASTM C40. Sand producing color darker than specified standard is unacceptable.

2.3 BLENDED HYDRAULIC CEMENT

ASTM C595, Type IS, IP.

2.4 MASONRY CEMENT

A. ASTM C91. Type N, S, or M.

2.5 MORTAR CEMENT

ASTM C1329, Type N, S or M.

2.6 PORTLAND CEMENT

A. ASTM C150, Type I.

2.7 LIQUID ACRYLIC RESIN

A formulation of acrylic polymers and modifiers in liquid form designed for use as an additive for mortar to improve physical properties.

2.8 WATER

Potable, free of substances that are detrimental to mortar, masonry, and metal.

2.9 POINTING MORTAR

A. For Cast Stone or Precast Concrete: Proportion by volume; One part white Portland cement, two parts white sand, and 1/5 part hydrated lime.

2.10 MASONRY MORTAR

- A. Conform to ASTM C270.
- B. Admixtures:

1. Do not use mortar admixtures, except color admixtures if approved by Resident Engineer.
 2. Submit laboratory test report showing effect of proposed admixture on strength, water retention, and water repellency of mortar.
 3. Do not use antifreeze compounds.
- C. Colored Mortar:
1. Maintain uniform mortar color for exposed work throughout.
 2. Match mortar color in approved sample or mock-up.
 3. Color of mortar for exposed work in alteration work to match color of existing mortar unless specified otherwise in section 09 06 00, SCHEDULE FOR FINISHES.
- D. Color Admixtures:
1. Proportion as specified by manufacturer.
 2. For color, see Section 09 06 00, SCHEDULE FOR FINISHES.

2.11 COLOR ADMIXTURE

- A. Pigments: ASTM C979.
- B. Use mineral pigments only. Organic pigments are not acceptable.
- C. Pigments inert, stable to atmospheric conditions, nonfading, alkali resistant and water insoluble.

PART 3 - EXECUTION

3.1 MIXING

- A. Mix in a mechanically operated mortar mixer.
 1. Mix mortar for at least three minutes but not more than five minutes.
- B. Measure ingredients by volume. Measure using a container of known capacity.
- C. Mix water with dry ingredients in sufficient amount to provide a workable mixture which will adhere to vertical surfaces of masonry units.
- D. Mortar that has stiffened because of loss of water through evaporations:
 1. Re-tempered by adding water to restore to proper consistency and workability.
 2. Discard mortar that has reached its initial set or has not been used within two hours.
- E. Pointing Mortar:

Black Hills National Cemetery
Renovate and Expand Administration and Maintenance Buildings
20901 Pleasant Valley Drive
Sturgis, SD 57785

NCA Project #884CM3015
10/31/22
BID DOCUMENTS

1. Mix dry ingredients with enough water to produce a damp mixture of workable consistency which will retain its shape when formed into a ball.
2. Allow mortar to stand in dampened condition for one to 1-1/2 hours.
3. Add water to bring mortar to a workable consistency prior to application.

3.2 MORTAR USE LOCATION

- A. For brick veneer over frame back up walls, use Type N portland cement-lime mortar or Type S masonry cement or mortar cement mortar.
- D. Use Type N mortar for other masonry work, except as otherwise specified.
- E. Use Type N mortar for tuck pointing work.
- F. Use pointing mortar for items specified.

- - - E N D - - -

**SECTION 04 05 31
MASONRY TUCK POINTING**

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies requirements for tuck pointing of existing masonry and stonework at locations of masonry patching with salvaged masonry.

1.2 RELATED WORK

Mortars: Section 04 05 13, MASONRY MORTARING.

1.3 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in the text by basic designation only.
- B. American Society for Testing and Materials (ASTM):
 - C67-21.....Brick and Structural Clay Tile, Sampling and Testing
 - C216-22.....Facing Brick (Solid Masonry Units Made from Clay or Shale)
 - C270-19ae1.....Mortar for Unit Masonry
- C. International Masonry Institute: Recommended Practices and Guide Specifications for Cold Weather Masonry Construction.

PART 2 - PRODUCTS

2.1 TUCK POINTING MORTAR

As per appendix X3 of ASTM C270.

2.2 REPLACEMENT MASONRY UNITS

- A. Face Brick:
 - 1. Face brick for patching including toothing in of brick shall be salvaged brick of the existing building(s).

PART 3 - EXECUTION

3.1 CUT OUT OF EXISTING MORTAR JOINTS

- A. Cut out existing mortar joints (both bed and head joints) and remove by means of a toothing chisel or a special pointer's grinder, to a uniform depth of to 19 mm (3/4-inch), or until sound mortar is reached. Take care to not damage edges of existing masonry units to remain.

- B. Remove dust and debris from the joints by brushing, blowing with air or rinsing with water. Do not rinse when temperature is below freezing.

3.2 JOB CONDITIONS

- A. Protection: Protect newly pointed joints from rain, until pointed joints are sufficiently hard enough to prevent damage.
- B. Cold Weather Protection:
 - 1. Tuck pointing may be performed in freezing weather when methods of protection are utilized.
 - 2. Comply with applicable sections of "Recommended Practices for Cold Weather Construction" as published by International Masonry Industry All Weather Council.
 - 3. Existing surfaces at temperatures to prevent mortar from freezing or causing other damage to mortar.

3.3 INSTALLATION OF TUCK-POINTING MORTAR

- A. Immediately prior to application of mortar, dampen joints to be tuck pointed. Prior to application of pointing mortar, allow masonry units to absorb surface water.
- B. Tightly pack mortar into joints in thin layers, approximately 6 mm (1/4-inch) thick maximum.
- C. Allow layer to become "thumbprint hard" before applying next layer.
- D. Pack final layer flush with surfaces of masonry units. When mortar becomes "thumbprint hard", tool joints.

3.4 TOOLING OF JOINTS

- A. Tool joints with a jointing tool to produce a smooth, compacted, concaved joint.
- B. Tool joints in patch work with a jointing tool to match the existing surrounding joints.

3.5 REPLACEMENT OF MASONRY UNITS

- A. Cut out mortar joints surrounding masonry units that are to be removed and replaced.
 - 1. Units removed may be broken and removed, providing surrounding units to remain are not damaged.
 - 2. Once the units are removed, carefully chisel out the old mortar and remove dust and debris.
 - 3. If units are in exterior wythe of a cavity or veneer wall, exercise care to prevent debris falling into cavity.
- B. Dampen surfaces of the surrounding units before new units are placed.

1. Allow existing masonry to absorb surface moisture prior to starting installation of the new replacement units.
2. Butter contact surfaces of existing masonry and new replacement masonry units with mortar.
3. Center replacement masonry units in opening and press into position.
4. Remove excess mortar with a trowel.
5. Point around replacement masonry units to ensure full head and bed joints.
6. When mortar becomes "thumbprint hard", tool joints.

3.6 CLEANING

- A. Clean exposed masonry surfaces on completion.
- B. Remove mortar droppings and other foreign substances from wall surfaces.
- C. First wet surfaces with clean water, then wash down with a solution of soapless detergent specially prepared for cleaning brick.
- D. Brush with stiff fiber brushes while washing, and immediately thereafter hose down with clean water.
- E. Free clean surfaces from traces of detergent, foreign streaks, or stains. Protect materials during cleaning operations including adjoining construction.
- F. Use of muriatic acid for cleaning is prohibited.

- - - E N D - - -

SECTION 04 20 00
UNIT MASONRY

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies requirements for construction of masonry unit walls.

1.2 RELATED WORK

- A. Mortars and Grouts: Section 04 05 13, MASONRY MORTARING.
B. Steel Lintels and Shelf Angles: Section 05 50 00, METAL FABRICATIONS.
C. Cavity Insulation: Section 06 16 13, INSULATING SHEATHING.
D. Flashing: Section 07 60 00, FLASHING AND SHEET METAL.
E. Sealants and Sealant Installation: Section 07 92 00, JOINT SEALANTS.
F. Color and Texture of Masonry Units: To match existing adjacent facebrick for Building 1001 and 3001..

1.3 SUSTAINABILITY REQUIREMENTS

- A. Materials in this section may contribute towards contract compliance with sustainability requirements. See Section 01 81 11, SUSTAINABLE DESIGN REQUIREMENTS, for project local/regional materials, recycled content, requirements.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
B. 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. Anchors, and ties, one each and joint reinforcing 305 mm (12 inches) long.
C. Shop Drawings:
1. Indicate special masonry shapes.
2. Indicate reinforcement, applicable dimensions and methods of hanging soffit or lintel masonry and reinforcing masonry for embedment of anchors for hung fixtures.
3. Submit shop drawings for fabrication, bending, and placement of reinforcing bars prepared in accordance with ACI 315.

D. Certificates:

1. Submit certificates signed by manufacturer, including name and address of contractor, project location, and the quantity, and date or dates of shipment of delivery to which certificate applies.
2. Indicate that the following items meet specification requirements:
 - a. Face brick.
3. Identify testing laboratories facilities and qualifications of its principals and key personnel to perform tests specified.

E. Manufacturer's Literature and Data:

1. Anchors, ties, and reinforcement.

1.5 SAMPLE PANEL

- A. Before starting masonry, lay up a sample panel in accordance with Masonry Standards Joint Committee (MSJC) and Brick Industry Association (BIA).
 1. Use masonry units from random cubes of units delivered on site.
 2. Include ties, and anchors.
- B. Use sample panels approved by PM for standard of workmanship of new masonry work.
- C. Use sample panel to test cleaning methods.
- D. Sample Panel Size: Minimum 1220mm x 1220mm (4' x 4').

1.6 WARRANTY

- A. Warranty exterior masonry walls against moisture leaks and subject to terms of "Warranty of Construction", FAR clause 52.246-21, except that warranty period to be five years.

1.7 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by the basic designation only. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
- B. American Society for Testing and Materials (ASTM):

| | |
|---------------------|--|
| A615/A615M-22 | Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement |
| A675/A675M-14(2019) | Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties |
| A951/A951M-16e1 | Steel Wire for Masonry Joint Reinforcement |
| C67/C67M-21 | Sampling and Testing Brick and Structural Clay Tile |

Black Hills National Cemetery
Renovate and Expand Administration and Maintenance Buildings
20901 Pleasant Valley Drive
Sturgis, SD 57785

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- | | |
|---------------|--|
| C90-22 | Load bearing Concrete Masonry Units |
| C216-22 | Facing Brick (Solid Masonry Units Made From Clay or Shale) |
| C612-14(2019) | Mineral Fiber Block and Board Thermal Insulation |
| D1056-20 | Flexible Cellular Materials - Sponge or Expanded Rubber |
- C. American Welding Society (AWS):
- | | |
|---------------|---|
| D1.4/D1.4M-11 | Structural Welding Code - Reinforcing Steel |
|---------------|---|
- D. Brick Industry Association - Technical Notes on Brick Construction (BIA):
- | | |
|----------|---|
| 11-2001 | Brick Masonry, Part I |
| 11A-1988 | Brick Masonry, Part II |
| 11B-1988 | Brick Masonry, Part III Execution |
| 11C-1998 | for Brick Masonry Engineered Brick Masonry, Part IV |
| 11D-1988 | Brick Masonry Engineered Brick Masonry, Part IV continued |
| 11E-1991 | Brick Masonry, Part V |
- E. Masonry Industry Council:
Hot and Cold Weather Masonry Construction Manual, 1999
- F. Masonry Standards Joint Committee; Specifications for Masonry Structures (TMS 602-11/ACI 530.1-11/ASCE 6-11) (MSJC)
- G. American Concrete Institute (ACI):
- | | |
|-------------|----------------------|
| SP-66(2004) | ACI Detailing Manual |
|-------------|----------------------|

1.8 PRE-INSTALLATION CONFERENCE

- A. Convene a meeting on site, after submittals are received and approved but before any work, to review drawings and specifications, submittals, schedule, manufacturer instructions, site logistics and pertinent matters of coordination, temporary protection, governing regulations, tests and inspections; participants to include PM and all parties whose work is effected or related to the work of this section.

PART 2 - PRODUCTS

2.1 BRICK

- A. Basis of Design for Building #1001: Lakewood Brick Latte Modular Blend.
Color: Red Matt, Medium Matt, and Plum Matt.
- B. Basis of Design for Building #3001: Hebron Rugg Modular Blend
Color: Maroon Rugg, Red Rugg and Mahogany Rugg.
Contact Kevin Aker, Sales Manager with Hebron Brick Supply, Co. 1543
Deadwood Ave., Rapid City, SD 57702. (605) 385-0481, (605) 484-7334.
- C. Face Brick:
 - 1. ASTM C216, Grade SW, Type FBS.
 - 2. Brick when tested in accordance with ASTM C67: Classified slightly efflorescent or better.
 - 3. Size:
 - a. Modular.

2.2 CONCRETE MASONRY UNITS (NOT USED)

2.3 REINFORCEMENT

- A. Steel Reinforcing Bars: ASTM A615, deformed bars, 420 MPa (Grade 60)
for bars No. 10 to No. 57 (No. 3 to No. 18), except as otherwise
indicated.

2.4 ANCHORS, TIES, AND REINFORCEMENT

- A. Adjustable Veneer Anchor for Frame Walls:
 - 1. Two piece, adjustable anchor and tie.
 - 2. Anchor and tie may be either type; use only one type throughout.
 - 3. Loop Type:
 - a. Anchor: Screw-on galvanized steel anchor strap 2.75 mm (0.11 inch) by 19 mm (3/4 inch) wide by 225 mm (9 inches) long, with 9 mm (0.35 inch) offset and 100 mm (4 inch) adjustment. Provide 5 mm (0.20 inch) hole at each end for fasteners.
 - b. Ties: Triangular tie, fabricated of 5 mm (0.20 inch) diameter galvanized cold drawn steel wire. Ties long enough to engage the anchor and be embedded not less than 50 mm (2 inches) into the bed joint of the masonry veneer.
 - 4. 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.

2.5 PREFORMED COMPRESSIBLE JOINT FILLER

- A. Thickness and depth to fill the joint as specified.
- B. Closed Cell Neoprene: ASTM D1056, Type 2, Class A, Grade 1.
- C. Non-Combustible Type: ASTM C612, Type V, 1800 degrees F.

2.6 ACCESSORIES

- A. Weeps: Glass fiber ropes, 10 mm (3/8 inch) minimum diameter, 300 mm (12 inches) long.
- B. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, of length required to extend from exterior face of stone to cavity behind, in color selected from manufacturer's standard.
- C. Cavity Drain Material: Recycled polyester/polyethylene mesh trapezoidal shaped to maintain cavity air flow and drainage while suspending mortar droppings at unequal heights.
- D. Masonry Cleaner:
 - 1. Detergent type cleaner selected for each type of masonry used.
 - 2. Acid cleaners are not acceptable.
 - 3. Use soap-less type specially prepared for cleaning brick or concrete masonry as appropriate.

PART 3 - EXECUTION

3.1 JOB CONDITIONS

- A. Protection:
 - 1. Cover tops of walls with non-staining waterproof covering, when work is not in progress; secure to prevent wind blow off.
 - 2. On new work protect base of wall from mud, dirt, mortar droppings, and other materials that will stain face, until final landscaping or other site work is completed.
- B. Cold Weather Protection:
 - 1. Masonry may be laid in freezing weather when methods of protection are utilized.
 - 2. Comply with MSJC and "Hot and Cold Weather Masonry Construction Manual".

3.2 CONSTRUCTION TOLERANCES

- A. Lay masonry units plumb, level and true to line within the tolerances as per MSJC requirements and as follows:
- B. Maximum variation from plumb:

1. In 3,000 mm (10 feet) - 6 mm (1/4 inch).
 2. In 6,000 mm (20 feet) - 10 mm (3/8 inch).
- C. Maximum variation from level:
1. In any bay or up to 6,000 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 6,000 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).

3.3 INSTALLATION GENERAL

- A. Keep finish work free from mortar smears or spatters, and leave neat and clean.
- B. Anchor masonry as specified in Paragraph, ANCHORAGE.
- C. Wall Openings:
1. Fill hollow metal frames built into masonry walls and partitions solid with mortar as laying of masonry progresses.
 2. If 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 a 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. Lintels:
1. Lintels are not required for openings less than 1,000 mm (3 feet 4 inches) wide that have hollow metal frames.

2. Openings 610 mm (2 feet 0 inches) wide to 1600 mm (5 feet 4 inches) wide with no structural steel lintel or frames, require a lintel formed of concrete masonry lintel or bond beam units filled with grout per ASTM C476 and reinforced with 1- #15m (1-#5) rod top and bottom for each 100 mm (4 inches) of nominal thickness unless shown otherwise.
 3. Use steel lintels, for openings over 1600 mm (5 feet 4 inches) wide, and brick masonry unless shown otherwise.
 4. Provide length for minimum bearing of 100 mm (4 inches) at ends.
- F. Before connecting new masonry with previously laid, remove loosened masonry or mortar, and clean and wet work in place as specified under wetting.
- G. When new masonry partitions start on existing floors, machine cut existing floor finish material down to concrete surface.
- H. Wetting and Wetting Test:
1. Test and wet brick in accordance with BIA 11B.

3.4 ANCHORAGE

- A. Veneer to Frame or Masonry Walls:
1. Use adjustable veneer anchors.
 2. Fasten anchor to stud through sheathing with self-drilling and tapping screw, one at each end of loop type anchor. In masonry backup stagger ties in alternate courses.
 3. Space anchors not more than 400 mm (16 inches) on center vertically at each stud or 600 mm (24 inches) maximum horizontally.

3.5 REINFORCEMENT (NOT USED)

3.6 BRICK EXPANSION JOINTS

- A. Provide brick expansion (BEJ) joints where shown on drawings.
- B. Keep joint free of mortar and other debris.
- C. Where 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 each side of shear key unless otherwise specified.
 3. Install filler, backer rod, and sealant on exposed faces.
- E. Fill opening in exposed face of expansion joints with sealant as specified in Section 07 92 00, JOINT SEALANTS.

3.7 BUILDING EXPANSION AND SEISMIC JOINTS (NOT USED)

3.8 BRICKWORK

- A. Lay clay brick in accordance with BIA Technical Note 11 series.
- B. Laying:
 - 1. Lay brick in running bond with course of masonry bonded at corners unless shown otherwise. Match bond of existing building on alterations and additions.
 - 2. Maintain bond pattern throughout.
 - 3. Do not use brick smaller than half-brick at any angle, corner, break or jamb.
 - 4. Where length of cut brick is greater than one half but less than a whole brick, maintain the vertical joint location of such units.
 - 5. Lay exposed brickwork joints symmetrical about center lines of openings.
 - 6. Before starting work, lay facing brick on foundation wall and adjust bond to openings, angles, and corners.
 - 7. Lay brick for sills with wash and drip.
 - 8. 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 (eight inches) vertically, unless shown otherwise.
 - 2. Rake joints for pointing with colored mortar when colored mortar is not full depth.
- 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 the 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 cavity drain material.
- E. Cavity Type Exterior Walls:
 - 1. Keep air space clean of mortar accumulations and debris.
 - a. Clean cavity by use of hard rubber, wood or metal channel strips having soft material on sides contacting wythes.

- b. Lift strips with wires before placing next courses of horizontal joint reinforcement or individual ties or adjustable cavity wall ties.
2. Insulated Cavity Type Exterior Walls:
 - a. Install the insulation against the cavity face of inner masonry wythe.
 - b. Place insulation between rows of ties or joint reinforcing or bond to masonry surface with a bonding agent as recommended by the manufacturer of the insulation.
 - c. Lay the outer masonry wythe up with an 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.

3.9 CONCRETE MASONRY UNITS (NOT USED)

3.10 GROUTING (NOT USED)

3.11 PLACING REINFORCEMENT (NOT USED)

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 a solution of soap-less detergent. Do not use muriatic acid.
2. Brush with stiff fiber brushes while washing, and immediately thereafter hose down with clean water.
3. Free clean surfaces of traces of detergent, foreign streaks, or stains of any nature.

- - - E N D - - -

SECTION 04 72 00
CAST STONE MASONRY

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies concrete building units manufactured and installed to simulate natural cut stone. Cast Stone is made from fine and coarse aggregates, Portland cement, mineral oxide color pigments, chemical admixtures, and water to simulate a natural stone.
- B. Unless specifically indicated otherwise, cast stone provided for this project is to be wet-cast type.

1.2 RELATED WORK

- A. Setting and Pointing Mortar: Section 04 05 13, MASONRY MORTARING
- B. Joint Sealant and Application: Section 07 92 00, JOINT SEALANTS.
- C. Color and texture to match adjacent existing windowsills in Building 3001.

1.3 SUSTAINABILITY REQUIREMENTS

- A. Materials in this section may contribute towards contract compliance with sustainability requirements.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Samples:
 - 1. Provide cast stone sample panel of windowsill piece.
- C. Shop Drawings:
 - 1. Cast stone showing exposed faces, profiles, cross sections, anchorage, reinforcing, jointing and sizes.
- D. Certificates: Test results indicating that the cast stone meets specification requirements and proof of plant certification; certification documents must be current within one year of preconstruction meeting.
- E. List of jobs furnished by the manufacturer, which were similar in scope and at least three (3) years of age.
- F. Installer Qualifications: Provide documentation of requirements specified herein.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Store cast stone under waterproof covers on planking clear of ground.
- B. Protect from handling, dirt, stain, and water damage.
- C. Mark production units with the identification marks as shown on the shop drawings.
- D. Package units and protect them from staining or damage during shipping and storage.
- E. Provide an itemized list of products to support the bill of lading.

1.6 WARRANTY

- A. Warranty exterior masonry walls against moisture leaks, any defects and subject to terms of "Warranty of Construction", FAR clause 52.246-21, except that warranty period to be two years.

1.7 APPLICABLE PUBLICATIONS

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

B. American Concrete Institute (ACI):

C. Architectural Precast Association; certification program.

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

| | |
|-----------------|--|
| ADJA0185 | Adjunct to A185 Steel, Welded Wire Reinforcement, Plain, for Concrete |
| A240/A240M-22 | Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications |
| A276/A276M-17 | Stainless Steel Bars and Shapes |
| A615/A615M-22 | Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement |
| A666-15 | Annealed or Cold-Worked Austenitic Stainless-Steel Sheet, Strip, Plate, and Flat Bar |
| C33/C33M-18 | Concrete Aggregates |
| C150/C150M-22 | Portland Cement |
| C260/C260M-10a | Air-Entraining Admixtures for Concrete |
| C426-22 | Linear Drying Shrinkage of Concrete Masonry Units |
| C494/C494M-19e1 | Chemical Admixtures for Concrete |

| | |
|-----------------|--|
| C503/C503M-15 | Marble Dimension Stone |
| C568/C568M-15 | Limestone Dimension Stone |
| C615/C615M-18e1 | Granite Dimension Stone |
| C616/C616M-15 | Quartz-Based Dimension Stone |
| C618-22 | Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete |
| C979/C979M-16 | Pigments for Integrally Colored Concrete |
| C989/C989M-18a | Slag Cement for Use in Concrete and Mortars |
| C1194-19 | Compressive Strength of Architectural Cast Stone |
| C1195-21 | Absorption of Architectural Cast Stone |
| C1364-19 | Architectural Cast Stone |
| D2244-21 | Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates |

E. Cast Stone Institute Technical Manual and Cast Stone Institute standard specifications.

1.8 QUALITY ASSURANCE

A. Manufacturer:

1. Must have five years minimum continuous operating experience and have facilities for producing cast stone of the shapes, quantities and size required for this project.
2. Must be a producer certified by the Cast Stone Institute or the Architectural Precast Association.
3. Producer assumes responsibility for engineering units to comply with performance requirements and use indicated, including a comprehensive engineering analysis by a qualified professional engineer who is licensed in their place of practice and who is experienced in providing engineering services of the kind indicated.
4. Shop drawings to bear seal and signature of professional engineer responsible for the design and preparation.

B. Installer:

1. Must provide documentation demonstrating that they have a minimum of five years' experience setting cast or natural building stone.

2. Provide procedures for inspection and identification of any exposed damage, with procedures for immediate marking of the units to be removed and replaced prior to grouting or sealing of joints.

1.9 MANUFACTURING TOLERANCES

- A. Cross section dimensions must not deviate by more than + 3 mm (1/8 in.) from approved dimension.
- B. Length of units must not deviate by more than length 3 mm (/360 or + 1/8 in.), whichever is greater, not to exceed 6 mm (+ 1/4 in.) Maximum length of any unit must not exceed 15 times the average thickness of such unit unless otherwise agreed by the manufacturer.
- C. Warp bow or twist of units must not exceed length 3 mm (/360 or + 1/8 in.), whichever is greater.
- D. Location of dowel holes, anchor slots, flashing grooves, false joints and similar features - On formed sides of unit, 3 mm (1/8 in.), on unformed sides of unit, 9 mm (3/8 in.) maximum deviation.

1.10 MOCK-UP

- A. Provide full size unit(s) for use in construction of exterior wall, as part of Unit Masonry Mock-up requirement. The mockup becomes the standard of workmanship for the project.

1.11 PROJECT CONDITIONS

- A. Field Measurements: Verify actual conditions to receive cast stone components by field measurements before production.
- B. Dimensions on shop drawings to be based upon field measurements.

PART 2 - PRODUCTS

2.1 ARCHITECTURAL CAST STONE

- A. Comply with ASTM C1364.
- B. Physical Properties: Provide the following:
 1. Compressive Strength - ASTM C1194: 45 Mpa (6,500 psi) minimum for products at 28 days.
 2. Absorption - ASTM C1195: 6 percent maximum by the cold water method, or 10 percent maximum by the boiling method for products as 28 days.
 3. Air Content for Wet Cast Product - ASTM C173 or C231: 4-8 percent for units exposed to freeze-thaw environments.
 4. Freeze Thaw - ASTM C1364: The cumulative percent weight loss (CPWL) less than 5 percent after 300 cycles of freezing and thawing.
 5. Linear Shrinkage - ASTM C426: Maximum 0.065 percent.

2.2 RAW MATERIALS

- A. Portland Cement: Type I or Type III, white and/or grey, ASTM C150.
- B. Coarse Aggregates: Granite, quartz or limestone, ASTM C33, except for gradation, and are optional for the vibrant dry tamp (VDT) casting method.
- C. Fine Aggregates: Manufactured or natural sands, ASTM C33, except for gradation.
- D. Colors: Inorganic iron oxide pigments, ASTM C979 except that carbon black pigments cannot be used.
- E. Admixtures: Comply with the following:
 - 1. ASTM C260 for air-entraining admixtures.
 - 2. ASTM C494/C495M Types A-G for water reducing, retarding, accelerating and high range admixtures.
 - 3. Other Admixtures: Integral water repellents and other chemicals, for which no ASTM Standard exists, must be previously established as suitable for use in concrete by proven field performance or through laboratory testing.
 - a. Produce units with water repellent accepted by fabricator within mix design; product for mix design and setting mortar to be from same source.
 - 4. ASTM C618; do not use mineral admixtures of dark and variable colors in surfaces intended to be exposed to view.
 - 5. ASTM C989; granulated blast furnace slag may be used to improve physical properties, as verified by testing documentation.
- F. Water: Potable.
- G. Reinforcing Bars:
 - 1. ASTM A615/A615M, Grades 40 or 60 steel galvanized, or epoxy coated when cover is less than 37 mm (1.5 in.).
 - 2. Welded Wire Fabric: ASTM A185 where applicable for wet cast units.
- H. Provide anchors, dowels and other anchoring devices and shims that are standard building stone anchors commercially available in a non-corrosive material such as zinc plated, galvanized steel, brass, or stainless-steel Type 302 or 304.

2.3 COLOR AND FINISH

- A. /Match color and texture of existing adjacent windowsills
- B. Provide fine-grained texture similar to natural stone, for surfaces intended to be exposed to view. Air voids are not permitted in excess of 0.8 mm (1/32 in.), and the density of such voids must be less than 3 occurrences per any 25 mm² (1 in²). Air voids are not permitted when obvious under direct daylight illumination at a 1.5 m (5 ft.) distance.
- C. Units must exhibit a texture //approximately equal to//of no less quality than// the approved sample when viewed under direct daylight illumination at a 3 m (10 ft.) distance.
- D. Units to comply with ASTM D2244 permissible variation in color between units of comparable age subjected to similar weathering exposure.
 - 1. Total color difference - not greater than 6 units.
 - 2. Total hue difference-not greater than 2 units.
- E. Chipping on edges or surfaces of caps, where they will be visible in the final installation, whether resulting from shipment, delivery or other factors or causes is not acceptable, and the units must be removed and replaced with new units. For units, other than caps, minor chips may be allowed if they are not obvious under direct daylight illumination from a 1 m (3 ft.) distance as determined by the PM.
- F. The occurrence of crazing or efflorescence may constitute a cause for rejection, at the sole discretion of the PM.
- G. Remove cement film, if required, from exposed surface prior to packaging for shipment.

2.4 REINFORCING

- A. Reinforce the units as required by the shop drawings, and prepared under direction of professional engineer, for safe handling and structural stress. For wall caps, include adequate reinforcing to prevent the caps from breaking when supported by shims at the ends of the units, and having workers on top of the units.
 - 1. Reinforcing to be minimum 0.25 percent of the cross-section area.
- B. Provide non-corrosive reinforcement where faces exposed to weather are covered with less than 38 mm (1.5 in.) of concrete material. Provide reinforcement with minimum concrete coverage of twice the diameter of the bars.

2.5 EMBEDDED ANCHORS AND OTHER INSERTS

- A. Fabricate from stainless steel complying with ASTM A240/A240M, ASTM A276, or ASTM A666, Type 304.

2.6 CURING

- A. Cure units in a warm curing chamber 537.8 C (1000 F) at 95 percent relative humidity for approximately 12 hours, or cure in a 95 percent moist environment at a minimum 371.1 C (700 F) for 16 hours after casting. Provide additional yard curing at 95 percent relative humidity and 350-degree-days (i.e. 7 days at 260.0 C (500 F) or 5 days at 371.1 C (700 F) prior to shipping. Protect form-cured units from moisture evaporation with curing blankets or curing compounds after casting.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Check cast stone materials for damage, coloration, finish, crazing, efflorescence, fit and finish prior to installation. Do not set unacceptable units.

3.2 SETTING TOLERANCES

- A. Comply with the more stringent tolerances of the Cast Stone InstituteSM Technical Manual or this section.
- B. Set stones 3 mm (1/8 in.) or less, within the plane of adjacent units.
- C. Joints, plus - 1.5 mm (1/6 in.), minus - 3 mm (1/8 in.).

3.3 JOINTING

- A. Joint Size:
 - 1. At stone/brick joints 9.5 cm (3/8 in.).
- B. Joint Materials:
 - 1. Mortar, Type N, ASTM C270.
 - 2. Use a full bed of mortar at all bed joints.
 - 3. Flush vertical joints full with mortar.
 - 4. Leave all joints with exposed tops or under relieving angles open for sealant.
 - 5. Leave head joints in coping and projecting components open for sealant.
- C. Location of Joints:
 - 1. As shown on shop drawings.
 - 2. At control and expansion joints unless otherwise shown.

3.4 SETTING

A. Mortar Bed Setting:

1. Drench units with clean water prior to setting.
2. Fill dowel holes and anchor slots completely with mortar or non-shrink grout.
3. Set units in full bed of mortar containing water repellent, unless otherwise detailed.
4. Rake mortar joints 18 mm (3/4 in.) for pointing.
5. Remove excess mortar from unit faces immediately after setting.
6. Tuck point unit joints to a slight concave profile.

3.5 JOINT PROTECTION

- A. Comply with requirements of Section 07 92 00, JOINT SEALANTS.
- B. Prime ends of units, insert properly sized backing rod at the correct depth and install required sealant.

3.6 REPAIR AND CLEANING

- A. Repair chips with touchup materials furnished by manufacturer.
- B. Saturate units to be cleaned prior to applying an approved masonry cleaner.
- C. Consult with manufacturer for appropriate cleaners.

3.7 INSPECTION AND ACCEPTANCE

- A. Inspect finished installation according to Bulletin #36 published by the Cast Stone Institute except distance for measuring acceptability to be reduced to 1 m (3 ft.).

- - - E N D - - -

SECTION 05 50 00
METAL FABRICATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies items and assemblies fabricated from structural steel shapes and other materials as shown and specified.
- B. Items specified.
 - 1. Support for Wall and Ceiling Mounted Items: (SD055000-01, SD055000-02, SD102113-01, SD102600-01, SD123100-01 & SD123100-02)
 - 2. Loose Lintels
 - 3. Railings

1.2 RELATED WORK

- A. Colors, finishes, and textures: Section 09 06 00, SCHEDULE FOR FINISHES.
- B. Prime and finish painting: Section 09 91 00, PAINTING.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. 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.
- C. Manufacturer's Certificates:
 - 1. Anodized finish as specified.
 - 2. Live load designs as specified.
- D. Design Calculations for specified live loads including dead loads.
- E. Furnish setting drawings and instructions for installation of anchors to be preset into concrete and masonry work, and for the positioning of items having anchors to be built into concrete or masonry construction.

1.4 QUALITY ASSURANCE

- A. Each manufactured product shall meet, as a minimum, the requirements specified, and shall be a standard commercial product of a manufacturer regularly presently manufacturing items of type specified.
- B. Each product type shall be the same and be made by the same manufacturer.
- C. Assembled product to the greatest extent possible before delivery to the site.
- D. Include additional features, which are not specifically prohibited by this specification, but which are a part of the manufacturer's standard commercial product.

1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society of Mechanical Engineers (ASME):
 - 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-19.....Structural Steel
 - A47/A47m-99(2018)e1.....Malleable Iron Castings
 - A48-22.....Gray Iron Castings
 - A53-22.....Pipe, Steel, Black and Hot-Dipped, Zinc-Coated
Welded and Seamless
 - A123-17.....Zinc (Hot-Dip Galvanized) Coatings on Iron and
Steel Products
 - A240/A240M-22.....Standard Specification for Chromium and
Chromium-Nickel Stainless Steel Plate, Sheet
and Strip for Pressure Vessels and for General
Applications.
 - A269/A269M-15a(2019)....Seamless and Welded Austenitic Stainless-Steel
Tubing for General Service
 - A307-21.....Carbon Steel Bolts and Studs, 60,000 PSI
Tensile Strength
 - A391/A391M-22.....Grade 80 Alloy Steel Chain
 - A786/A786M-15(2021).....Rolled Steel Floor Plate

- B221-21.....Aluminum and Aluminum-Alloy Extruded Bars,
Rods, Wire, Shapes, and Tubes
- B456-17.....Electrodeposited Coatings of Copper Plus Nickel
Plus Chromium and Nickel Plus Chromium
- B632/B632M-18.....Aluminum-Alloy Rolled Tread Plate
- C1107/C1107M-20.....Packaged Dry, Hydraulic-Cement Grout
(Nonshrink)
- D3656/D3656M-13(2021)...Insect Screening and Louver Cloth Woven from
Vinyl-Coated Glass Yarns
- F436-19.....Hardened Steel Washers
- F468-16.....Nonferrous Bolts, Hex Cap Screws, Socket Head
Cap Screws and Studs for General Use
- F593-17.....Stainless Steel Bolts, Hex Cap Screws, and
Studs
- F1667/F1667M-21a.....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 521-01(R2012).....Pipe Railing Manual
 - AMP 500-06.....Metal Finishes Manual
 - MBG 531-09(R2017).....Metal Bar Grating Manual
 - MBG 532-09.....Heavy Duty Metal Bar Grating 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. Design fabrications to support the dead loads.

2.2 MATERIALS

- A. Structural Steel: ASTM A36.
- B. Stainless Steel: ASTM A240, Type 302 or 304.

C. Steel Pipe (Bollard): ASTM A53.

1. Galvanized for exterior locations.
2. Type S, Grade A unless specified otherwise.
3. NPS (inside diameter) as shown.

D. Primer Paint: As specified in Section 09 91 00, PAINTING.

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.

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.
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) Nonferrous metals: Comply with MAAMM-500 series.

G. Protection:

1. 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 or wood stud framed walls.
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.

2.6 FRAMES (NOT USED)

2.7 GUARDS (NOT USED)

2.8 COVERS AND FRAMES FOR PITS AND TRENCHES (NOT USED)

2.9 GRATINGS (NOT USED)

2.10 LOOSE LINTELS

- A. Furnish lintels of sizes shown. Where size of lintels is not shown, provide the sizes specified.
- B. Fabricate lintels with not less than 150 mm (6 inch) bearing at each end for nonbearing masonry walls, and 200 mm (8 inch) bearing at each end for bearing walls.
- C. Provide one angle lintel for each 100 mm (4 inches) of masonry thickness as follows except as otherwise specified or shown.
 - 1. Openings 750 mm to 1800 mm (2-1/2 feet to 6 feet) - 100 x 90 x 8 mm (4 x 3-1/2 x 5/16 inch).
 - 2. Openings 1800 mm to 3000 mm (6 feet to 10 feet) - 150 x 90 x 9 mm (6 x 3-1/2 x 3/8 inch).
- D. For 150 mm (6 inch) thick masonry openings 750 mm to 3000 mm (2-1/2 feet to 10 feet) use one angle 150 x 90 x 9 mm (6 x 3-1/2 x 3/8 inch).
- E. Provide bearing plates for lintels where shown.
- F. Weld or bolt upstanding legs of double angle lintels together with 19 mm (3/4 inch bolts) spaced at 300 mm (12 inches) on centers.
- G. Insert spreaders at bolt points to separate the angles for insertion of metal windows, louver, and other anchorage.
- H. Where shown or specified, punch upstanding legs of single lintels to suit size and spacing of anchor bolts.
- I. Elevator Entrance:
 - 1. Fabricate lintel from plate bent to channel shape, and provide a minimum of 100 mm (4 inch) bearing each end.
 - 2. Cut away the front leg of the channel at each end to allow for concealment behind elevator hoistway entrance frame.

2.11 SHELF ANGLES (NOT USED)

2.12 PLATE DOOR SILL (NOT USED)

2.13 SAFETY NOSINGS (NOT USED)

2.14 LADDERS (NOT USED)

2.15 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 pipe sleeves where railings occur.

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.

E. Aluminum Railings:

1. Fabricate from extruded aluminum.
2. Use tubular posts not less than 3 mm (0.125 inch) wall thickness for exterior railings.
3. Punch intermediate rails and bottom of top rails for passage of posts and machine to a close fit.
4. Where shown use extruded channel sections for top rail with 13 mm (1/2 inch) thick top cover plates and closed ends.
5. Fabricate brackets of extruded or wrought aluminum as shown.
6. Fabricate stainless pipe sleeves with closed bottom at least six inches deep having internal dimensions at least 13 mm (1/2 inch) greater than external dimensions of posts where set in concrete.

2.16 CATWALKS (NOT USED)

2.17 TRAP DOOR AND FRAMES WITH CEILING HATCH (NOT USED)

2.18 SIDEWALK DOOR (NOT USED)

2.19 SCREENED ACCESS DOORS AND FRAMES (NOT USED)

2.20 STEEL COUNTER OR BENCH TOP FRAME AND LEGS (NOT USED)

2.21 STEEL PIPE BOLLARD (NOT USED)

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. Field weld in accordance with AWS.
1. Design and finish as specified for shop welding.
 2. Use continuous weld unless specified otherwise.
- D. 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.
- E. 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.
- F. Isolate aluminum from dissimilar metals and from contact with concrete and masonry materials as required to prevent electrolysis and corrosion.
- G. 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.
- C. Supports for Wall Mounted items:
1. Locate center of support at anchorage point of supported item.
 2. Locate support at top and bottom of wall hung cabinets.
 3. Locate support at top of floor cabinets and shelving installed against walls.
 4. Locate supports where required for items shown.

3.3 COVERS AND FRAMES FOR PITS AND TRENCHES (NOT USED)

3.4 FRAMES FOR LEAD LINED DOORS (NOT USED)

3.5 DOOR FRAMES (NOT USED)

3.6 OTHER FRAMES (NOT USED)

3.7 GUARDS (NOT USED)

3.8 GRATINGS (NOT USED)

3.9 STEEL LINTELS

- A. Use lintel sizes and combinations shown or specified.
- B. Install lintels with longest leg upstanding, except for openings in 150 mm (6 inch) masonry walls install lintels with longest leg horizontal.
- C. Install lintels to have not less than 150 mm (6 inch) bearing at each end for nonbearing walls, and 200 mm (8 inch) bearing at each end for bearing walls.

3.10 SHELF ANGLES (NOT USED)

3.11 PLATE DOOR SILL (NOT USED)

3.12 SAFETY NOSINGS (NOT USED)

3.13 LADDERS NOT USED)

3.14 RAILINGS

- B. Aluminum Railing Posts:
 - 1. Install pipe sleeves in concrete formwork.
 - 2. Set posts in sleeve and pour grout to surface on exterior locations and to within 6 mm (1/4 inch) of surface for interior locations except to where posts are required to be removable.
 - 3. Apply beveled bead of urethane sealant over sleeve at post perimeter for exterior posts and flush with surface for interior posts as specified in Section 07 92 00, JOINT SEALANTS.
- 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.
- G. Handrails:
 - 1. Anchor brackets for metal handrails as detailed.

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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.

3.15 CATWALK AND PLATFORMS (NOT USED)

3.16 SIDEWALK DOOR, TRAP DOORS, AND FRAMES (NOT USED)

3.17 SCREENED ACCESS DOOR (NOT USED)

3.18 STEEL COMPONENTS FOR MILLWORK ITEMS (NOT USED)

3.19 INSTALLATION OF STEEL PIPE BOLLARD (NOT USED)

3.20 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.

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SECTION 06 10 00
ROUGH CARPENTRY

PART 1 - GENERAL

1.1 DESCRIPTION

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

1.2 RELATED WORK

- A. Milled Woodwork: Section 06 20 00, FINISH CARPENTRY.
- B. Attic ventilation and baffles: Section 07 21 13, LOOSE FILL INSULATION.
- C. Roof top ventilation and ridge vents: Section 07 31 13, ASPHALT SHINGLES.
- D. Vents: Section 08 90 00, LOUVERS AND VENTS.

1.3 PERFORMANCE REQUIREMENTS

- A. Sustainably Harvested Wood: Comply with requirements of Section 01 81 11, SUSTAINABLE DESIGN REQUIREMENTS.
- B. Engineered Wood Products:
 - 1. Provide products with no added urea formaldehyde; determine formaldehyde concentrations in air from wood products under test conditions of temperature and relative humidity in accordance with ASTM D6007 or E1333.
 - 2. Bio-based Content:
 - a. Interior Panels: Engineered products designed specifically for interior applications and providing a surface that is impact-, scratch-, and wear-resistant and that does not absorb or retain moisture; provide minimum 55 percent bio-based content.
 - b. Structural Interior Panels: Engineered products designed for use in structural construction applications; provide minimum 89 percent bio-based content.
 - c. Structural Wall Panels: Engineered products designed for use in structural walls, curtain walls, floors and roofs; provide minimum 94 percent bio-based content.
 - 3. VOC Emissions:
 - a. Provide low VOC products with Green Seal Certification to GS-36 and description of the basis for certification .

1.4 SUSTAINABILITY REQUIREMENTS

- A. Materials in this section may contribute towards contract compliance with sustainability requirements. See Section 01 81 11, SUSTAINABLE DESIGN REQUIRMENTS, for project local/regional materials, recycled content, certified wood requirements.
- B. Biobased Material: For products designated by the USDA's BioPreferred® program, provide products that meet or exceed USDA recommendations for biobased content, subject to the products compliance with performance requirements in this Section. For more information regarding the product categories covered by the BioPreferred® program, visit <http://www.biopreferred.gov>.

1.5 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Provide documentation of conformance with performance requirements of this section.
- C. Prepare shop drawings showing framing connection details, fasteners, connections, and dimensions.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Protect lumber and other products from dampness both during and after delivery at site.
- B. Pile lumber in stacks in such manner as to provide air circulation around surfaces of each piece.
- C. Stack plywood and other board products so as to prevent warping.
- D. Locate stacks on well drained areas, supported at least 150 mm (6 inches) above grade and cover with well-ventilated sheds having firmly constructed over hanging roof with sufficient end wall to protect lumber from driving rain.

1.7 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by the basic designation only. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
- B. American Forest and Paper Association (AF&PA):
Wood Structural Design Data
- C. American Lumber Standard Committee, Incorporated (ALSC):
ALSC Board of Review

- D. American National Standards Institute (ANSI):
- ANSI A190.1-2012 Structural Glued Laminated Timber
- E. American Plywood Association (APA):
- E30-2011 Engineered Wood Construction Guide
- F. American Society of Mechanical Engineers (ASME):
- B18.2.1-2012 Square, Hex, Heavy Hex and Askew Head Bolts and
Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag
Screws
 - B18.2.2-2010 Hex Nuts for General Applications
 - B18.6.1-81 (R2008) Wood Screws
 - B18.6.4-98 (R2005) Thread Forming and Thread Cutting Tapping
Screws and Metallic Drive Screws
- G. American Society for Testing and Materials (ASTM):
- A307-21 Carbon Steel Bolts and Studs, 60,000 PSI
Tensile Strength
 - C954-22 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
 - C1002-22 Steel Self-Piercing Tapping Screws for the
Application of Gypsum Panel Products or Metal
Plaster Bases to Wood Studs or Steel Studs
 - D6007-14 Determining Formaldehyde Concentration in Air
from Wood Products Using a Small-Scale Chamber
 - E1333-14 Determining Formaldehyde Concentrations in Air
and Emission Rates from Wood Products Using a
Large Chamber
 - F844-19 Washers, Steel, Plan (Flat) Unhardened for
General Use
 - F1667/F1667m-21a Nails, Spikes, and Staples
- H. American Wood Protection Association (AWPA)
- I. FM Global Group (FM):
- FM 4435 Approval Standard for Edge Systems Used with
Low Slope Roofing Systems
- J. Green Seal (GS):
- GS-36 (2013) Commercial Adhesives
- K. South Coast Air Quality Management District (SCAQMD):

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SCAQMD Rule 1168 (1989; R2005) Adhesive and Sealant Applications

L. U.S. Department of Commerce/National Institute of Science and
Technology:

PS 1-09 Structural Plywood

PS 20-10 American Softwood Lumber Standard

PART 2 - PRODUCTS

2.1 LUMBER

- A. Unless otherwise specified, each piece of lumber to bear a grade mark, stamp, or other identifying marks indicating grades of material, and rules or standards under which produced.
 - 1. Identifying marks in accordance with rule or standard under which material is produced, including requirements for qualifications and authority of the inspection organization, usage of authorized identification, and information included in the identification.
 - 2. Inspection agency for lumber approved by the Board of Review, American Lumber Standards Committee, to grade species used.
- B. Structural Members: Species and grade as listed in the AF&PA, National Design Specification for Wood Construction having design stresses as shown. Stair stringers shall be structurally sound without splits or checks, and without knots within 2" of the edges. Provide three stringers for the stair width.
- 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. Framing lumber: Minimum extreme fiber stress in bending of 1100.
 - 3. Furring, blocking, nailers and similar items 100 mm (4 inches) and narrower Standard Grade; and members 150 mm (6 inches) and wider, Number 2 Grade.
- D. Sizes:
 - 1. Conforming to Prod. Std. PS20.
 - 2. Size references are nominal sizes, unless otherwise specified, actual sizes within manufacturing tolerances allowed by standard under which produced.
- E. Moisture Content:
 - 1. At time of delivery and maintained at the site.

2. Boards and lumber 50 mm (2 inches) and less in thickness: 19 percent or less.

3. Lumber over 50 mm (2 inches) thick: 25 percent or less.

F. Preservative Treatment:

1. Do not treat Heart Redwood and Western Red Cedar.

2. Products containing chromium or arsenic will not be permitted.

3. Provide products with waterborne or boron-based preservatives.

4. 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.

G. Waterborne Wood Preservatives:

1. Treat wood products with waterborne wood preservatives listed in Section 4 of AWPA Standards U1, excluding those which contain arsenic and/or chromium.

2. Pressure treatment of wood products must conform to the requirements of AWPA Standards U1 and T1.

3. Retention of preservatives as prescribed in AWPA Standard U1 for the following Use Categories (material conforming to a higher AWPA Use Category may be specified):

a. UC1: Interior construction - above ground, dry conditions.

b. UC2: Interior construction - above ground, damp conditions.

c. UC3A: Exterior construction - above ground, coated and with rapid water runoff.

d. UC3B: Exterior construction - above ground, uncoated or poor water runoff.

e. UC4A: General purpose soil or freshwater contact - heavy duty above ground.

f. UC4B: Heavy duty soil or freshwater contact - critical or difficult to replace components.

g. UC4C: Extreme duty soil or freshwater contact - critical structural components.

H. Boron-based Preservatives: Impregnate lumber with preservative treatment conforming to AWPA Standard U1.

I. Fire-retardant Treatment:

1. Fire-retardant-treated wood products to be free of halogens, sulfates, ammonium phosphate and formaldehyde.
2. Fire retardant treatment of wood products to conform to the requirements of AWPA Standard U1, Commodity Specification H and AWPA Standard T1, Section H.

2.2 PLYWOOD

- A. Comply with Prod. Std. PS 1 and APA E30.
- B. Bear the mark of a recognized association or independent inspection agency that maintains continuing control over quality of plywood which identifies compliance by veneer grade, group number, span rating where applicable, and glue type.
- C. Sheathing:
 1. APA rated Exposure 1 or Exterior, panel grade CD or better.
 2. Wall Sheathing:
 - a. Minimum 9 mm (11/32 inch) thick with supports 400 mm (16 inches) on center and 12 mm (15/32 inch) thick with supports 600 mm (24 inches) on center unless specified otherwise.
 - b. Minimum 1200 mm (48 inches) wide at corners without corner bracing of framing.
 3. Roof Sheathing:
 - a. Minimum 9 mm (11/32 inch) thick with span rating 24/0 or 12 mm (15/32 inch) thick with span rating for supports 400 mm (16 inches) on center unless specified otherwise.
 - b. Minimum 15 mm (19/32 inch) thick or span rating of 40/20 or 18 mm (23/32 inch) thick or span rating of 48/24 for supports 600 mm (24 inches) on center.

2.3 ROUGH HARDWARE

- A. Anchor Bolts: ASTM A307, size as indicated, complete with nuts and washers.
- B. Washers:
 1. ASTM F844.
 2. Use zinc or cadmium coated steel or cast iron for washers exposed to weather.
- C. Screws:

1. Wood to Wood: ANSI B18.6.1 or ASTM C1002.
2. Wood to Steel: ASTM C954, or ASTM C1002.

D. Nails:

1. ASTM F1667:
 - a. Common: Type I, Style 10.
 - b. Concrete: Type I, Style 11.
 - c. Barbed: Type I, Style 26.
 - d. Underlayment: Type I, Style 25.
 - e. Masonry: Type I, Style 27.

2.4 BLOCKING

- A. General: Provide miscellaneous lumber as indicated and lumber support or attachment for other construction, including the following:
 1. Blocking.
 2. Nailers.
 3. Furring.
- B. Provide Standard or No. 2 Grade lumber.
- C. Structural components including blocking, brackets or other anchorage shall be an integral part of the buildings structure and designed to support the required loads. This includes the wood stair design.

2.5 Rough Carpentry Products shall comply with following standards for biobased materials:

| Material Type | Percent by Weight |
|---------------|------------------------------|
| Lumber | 25 percent biobased material |
| plywood | 55 percent biobased material |

The minimum-content standards are based on the weight (not the volume) of the material in the insulating core only.

PART 3 - EXECUTION

3.1 INSTALLATION OF FRAMING AND MISCELLANEOUS WOOD MEMBERS

- A. Conform to applicable requirements of the following:
 1. Comply with APA standards for installation of plywood.
- C. Anchors in Concrete:
 1. Except where indicated otherwise, embed anchor bolts not less than 200 mm (8 inches) in poured concrete walls and provide each with a nut and a 50 mm (2 inch) diameter washer at bottom end.
 2. A bent end may be substituted for the nut and washer; bend to be not less than 90 degrees.

3. Powder-actuated fasteners spaced 900 mm (3 feet) o.c. may be provided instead of bolts for single thickness plates on concrete.

D. Sheathing:

1. Lay panels with joints staggered, with edge and ends 3 mm (1/8 inch) apart and nailed over bearings as specified.
2. Set nails not less than 9 mm (3/8 inch) from edges.
3. Install 50 mm by 100 mm (2 inch by 4 inch) blocking spiked between studs to support edge or end joints of panels.
4. At maintenance building roof edges, cut vent slots into roof deck sheathing as directed by manufacturer instructions indicated within asphalt shingles specifications section.

E. Wood Roof Nailers, Edge Strips: Provide sizes and configurations indicated or specified and anchored securely to continuous construction.

1. Roof Edge Strips and Nailers: Provide at perimeter of roof, around openings through roof, and where roofs abut walls, curbs, and other vertical surfaces.
2. Except where indicated otherwise, nailers to be 150 mm (6 inches) wide and the same thickness as the insulation. Anchor nailers securely to underlying construction.

F. Wood Blocking: Provide proper sizes and shapes at proper locations for the installation and attachment of wood and other finish materials, fixtures, equipment, and items indicated or specified.

H. Wood Furring:

1. Provide where shown and as necessary for facing materials specified.
2. Except as shown otherwise, furring strips to be nominal one by 3, continuous, and spaced 400 mm (16 inches) o.c. Erect furring vertically or horizontally as necessary.
4. Do not use wood plugs.
5. Provide furring strips around openings, behind bases, and at angles and corners.
6. Furring to be plumb, rigid, and level and shimmed as necessary to provide a true, even plane with surfaces suitable to receive the finish required.

3.2 PROTECTION

- A. Protect rough carpentry from weather.

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20901 Pleasant Valley Drive

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- B. If rough carpentry becomes wet, apply EPA-registered borate treatment complying with EPA registered label.

- - - E N D - - -

SECTION 06 16 13
INSULATED SHEATHING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes insulating wall sheathing with integral water-resistive barrier and air barrier.

1.2 REFERENCE

- A. American Society of Mechanical Engineers (ASME): www.asme.org
1. ASME B18.6.1 - Wood Screws (Inch Series)
- B. ASTM International (ASTM): www.astm.org
1. ASTM A153/A153M - Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 2. ASTM C1289 - Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
 3. ASTM D779 - Test Method for Water Resistance of Paper, Paperboard, and Other Sheet Materials by the Dry Indicator Method
 4. ASTM D1621 - Test Method for Compressive Properties Of Rigid Cellular Plastics
 5. ASTM D2247 - Practice for Testing Water Resistance of Coatings in 100% Relative Humidity
 6. ASTM E96/E 96M - Test Methods for Water Vapor Transmission of Materials
 7. ASTM E331 - Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
 8. ASTM E2357 - Test Method for Determining Air Leakage of Air Barrier Assemblies
 9. ASTM F1667 - Specification for Driven Fasteners: Nails, Spikes, and Staples
 10. ASTM G154 - Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials
- C. US Department of Commerce (DOC): <http://gsi.nist.gov/global/index.cfm/L1-5/12-44/A-355>
1. DOC PS 2 - Performance Standard for Wood-Based Structural Panels
- D. International Code Council (ICC): www.iccsafe.org
1. ICC IBC - International Building Code
- E. ICC Evaluation Service, Inc. (ICC-ES): www.icc-es.org
1. ICC-ES AC12 - Acceptance Criteria for Foam Plastic Insulation
 2. ICC-ES AC38 - Acceptance Criteria for Water-Resistive Barriers

INSULATED SHEATHING

3. ICC-ES AC116 - Acceptance Criteria for Nails and Spikes
4. ICC-ES AC148 - Acceptance Criteria for Flexible Flashing Materials
5. ICC-ES AC201 - Acceptance Criteria for Staples
6. ICC-ES AC269 - Acceptance Criteria for Racking Shear Evaluation of Proprietary Sheathing Materials attached to Light-Frame Wall Construction or Code-Complying Sheathing Attached to Light-Framed Walls with Proprietary Fasteners
7. ICC-ES AC310 - Acceptance Criteria for Water-Resistive Membranes Factory-bonded to Wood-based Structural Sheathing, Used as Water-Resistive Barriers
8. ICC-ES ESR-1539 - Power Driven Staples and Nails for Use in Engineered and Non-Engineered Connections
9. ICC-ES NER-272 - Power Driven Staples and Nails for Use in All Types of Building Construction

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of sheathing product specified.

1.4 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: From ICC-ES, for wood sheathing and seam tape.
- B. Product Certifications: From manufacturer, indicating that sheathing products comply with ICC-ES AC269 and ICC-ES AC310.

1.5 CLOSEOUT SUBMITTALS

- A. Warranty: Executed copy of manufacturer special warranties.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Provide wood products from manufacturer certified by SFI, FSC, or comparable sustainable forestry program acceptable to Architect.
- B. Provide wall sheathing products meeting requirements for water-resistive barrier in accordance with ICC-ES AC310.
- C. Provide wall sheathing products meeting requirements of ICC-ES AC269.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's written instructions for protection of sheathing products from weather prior to installation.

1.8 WARRANTY

- A. Special Manufacturer's Warranty: Manufacturer's standard form in which sheathing manufacturer agrees to repair or replace sheathing products that demonstrate deterioration or failure under normal use

due to manufacturing defects within warranty period specified, when installed according to manufacturer's instructions.

1. Warranty Period for Sheathing Products: 30 years following date of Substantial Completion.
2. Warranty Conditions: Special warranties exclude deterioration or failure due to structural movement resulting in stresses on sheathing products exceeding manufacturer's written specifications, or due to air or moisture infiltration resulting from cladding failure or mechanical damage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Provide sheathing products manufactured by Huber Engineered Woods LLC, Charlotte NC; Phone: (800) 933-9220; Website: www.zipsystem.com.

2.2 PERFORMANCE REQUIREMENTS

- A. Air-Barrier Assembly Air Leakage: Less than 0.04 cfm/sq. ft. at 1.57 lbf/sq. ft. (0.2 L/s x sq. m at 75 Pa), per ASTM E2375.
- B. Water-Vapor Permeance, Facer: Minimum 12 perms (689 ng/Pa x s x sq. m), ASTM E96/E96M.
- C. Weather Exposure: Manufacturer warranty applies for maximum allowable exposure period of 180 days.

2.3 MATERIALS

- A. Oriented Strand Board: DOC PS 2, made with binder containing no added urea formaldehyde.
- B. Rigid Foam Plastic Insulating Board: Rigid polyisocyanurate foam core complying with ASTM C1289 Type II, Class 2, and ICC-ES AC12, with coated glass fiber facers on both sides, with the following characteristics:
 1. Nominal Density: 2.0 pcf (32 kg/cu. m).
 2. Compressive Strength, ASTM D1621: Not less than 20 psi (150 kPa).
 3. Vapor Permeance, ASTM E96/E96M: Less than 1.0 perm.
 4. Edge Configuration: Square finished.

2.4 COMPOSITE INSULATING WALL SHEATHING

- A. Composite Insulating Wall Sheathing: Oriented-strand-board Exposure 1 sheathing 7/16 inch (11.1 mm) thick, with factory-laminated water-resistive barrier exterior facer, and with rigid foam plastic insulating board laminated to interior face.

INSULATED SHEATHING

1. Basis-of-Design Product: Provide **Huber Engineered Woods LLC; ZIP System R Sheathing**.
2. Span Rating and Performance Category of Sheathing Layer: Not less than 24/16; 7/16 Performance Category.
3. Thickness: 1-1/2 inch (38 mm) and 2 inch (51 mm).
4. Thermal Resistivity (R Value): 6.6 and 9.6 deg F x h x sq. ft./Btu x in. at 75 deg F.
5. Edge Profile: Square edge.
6. Exterior Facer: Medium-density, phenolic-impregnated polymer-modified sheet material meeting requirements for ASTM D779 Grade D weather-resistive barrier in accordance with ICC AC38 and AC310, with fastener spacing symbols on exterior facer for 16-inch (406 mm) and 24-inch (610 mm) on center spacing, with the following characteristics
 - a. Water Resistance of Coatings, ASTM D2247: Pass 14-day exposure test.
 - b. Moisture Vapor Transmission, ASTM E96/E96M-22: Not less than 12 perms.
 - c. Water Penetration, ASTM E331: Pass at 2.86 lbf/sq. ft. (137 Pa).
 - d. Wind Driven Rain, TAS-100: Pass.
 - e. Accelerated Weathering, ASTM G154: Pass.

2.5 FASTENERS

- A. Fasteners, General: Size and type complying with manufacturer's written instructions for Project conditions and requirements of authorities having jurisdiction.
 1. Corrosion Resistance: [Hot-dip zinc coating, ASTM A153/A153M-16a or Type 304 stainless steel.
- B. Nails, Brads, and Staples: ICC AC116 and ICC AC201.
- C. Power-Driven Fasteners: ICC-ES-1539 or NER-272.
- D. Wood Screws: ASME B18.6.1.

2.6 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIAL

- A. Self-Adhering Seam and Flashing Tape: Pressure-sensitive, self-adhering, cold-applied, seam tape consisting of polyolefin film with acrylic adhesive, meeting ICC AC148.
 1. Basis-of-Design Product: Provide **Huber Engineered Woods; ZIP System Tape**.
 2. Thickness: 0.012 inch (0.3 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing spacing and alignment to determine if work is ready to receive sheathing. Proceed with sheathing work once conditions meet requirements.

3.2 SHEATHING INSTALLATION

- A. Install sheathing panels in accordance with manufacturer's written instructions, requirements of applicable Evaluation Reports, and requirements of authorities having jurisdiction.
- B. Air and Moisture Barrier: Coordinate sheathing installation with flashing and joint sealant installation and with adjacent building air and moisture barrier components to provide complete, continuous air-and moisture- barrier.
- C. Do not bridge expansion joints; allow joint spacing equal to spacing of structural supports.
- D. Install panels with laminated facer to exterior. Stagger end joints of adjacent panel runs.
- E. Attach sheathing panels securely to substrate with manufacturer-approved fasteners in compliance with the following:
 - 1. ICC-ES ESR-1539 or ICC-NES NER-272 for power-driven fasteners.
 - 2. IBC: Table 2304.9.1 Fastening Schedule.
- F. Apply seam tape at all panel seams, penetrations, and facer defects or cracks to form continuous weathertight surface. Apply tape according to manufacturer's written instructions and requirements of ICC-ES applicable to tape application.

END OF SECTION

SECTION 06 17 53
METAL PLATE CONNECTED WOOD TRUSSES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Engineering, fabrication, and erection of metal plate connected wood trusses to withstand the design loads as shown on the drawings and herein specified.
- B. All fastening devices and bridging requirements related to the manufacture or erection of the wood trusses.
- C. Structural notes indicated on the drawings regarding metal-plate-connected wood trusses shall be considered part of this specification.

1.2 RELATED WORK

- A. Pertinent Sections of Division 01.
- B. Section 06 10 00 - Rough Carpentry.

1.3 REFERENCES

- A. Codes and Standards: Comply with the provisions of the following codes, specifications, and standards except where more stringent requirements are shown or specified. Where any provision of other pertinent codes and standards conflict with this specification, the more stringent provision shall govern.
 - 1. AFPA - American Forest & Paper Association.
 - 2. ANSI/TPI 1 - National Design Standard for Metal Plate Connected Wood Truss Construction.
 - 3. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 4. AWC - Manual for Engineered Wood Construction.
 - 5. BCSI - Guide to Good Practice for Handling, Installing, Restraining & Bracing of Metal Plate Connected Wood Trusses.
 - 6. NDS - National Design Specification for Wood Construction with Commentary.
 - 7. NDS Supplement - National Design Specification Values for Wood Construction.
 - 8. SBCA - Structural Building Components Association.
 - 9. TPI - Truss Plate Institute.

10. WTCA - Wood Truss Council of America.
11. WTCA - Metal Plate Connected Wood Truss Handbook.

1.4 QUALITY ASSURANCE

- A. Fabrication and Erection Qualifications:
 1. Engage a fabricator who participates in a recognized quality-assurance program that involves inspection by Western Wood Products Association (WWPA), West Coast Lumber Inspection Bureau (WCLIB), or National Lumber Grades Authority (NLGA); Timber Products Inspection, Inc.; Truss Plate Institute (TPI); or other independent inspecting and testing agency acceptable to authorities having jurisdiction.
- B. Design Qualifications:
 1. Engage a fabricator who uses a qualified Professional Engineer, licensed in the state where the trusses are to be installed, to prepare calculations, shop drawings and other structural data for metal-plate-connected wood trusses.

1.5 SYSTEM PERFORMANCE REQUIREMENTS

- A. Trusses shall be designed in accordance with NDS, AFPA, TPI, WTCA and the local code of jurisdiction.
- B. Comply with applicable requirements and recommendations of ANSI/TPI 1, "Guide to Good Practice for Handling, Installing, Restraining & Bracing of Metal Plate Connected Wood Trusses" (BCSI), and "Metal Plate Connected Wood Truss Handbook" (WTCA).
- C. Comply with applicable requirements of the "National Design Specification for Wood Construction" and it's "Supplement."
- D. Single-Source Engineering Responsibility:
 1. Provide trusses engineered by a metal-plate connector manufacturer to support superimposed dead and live loads indicated, with design approved and certified by a qualified Professional Engineer who is legally authorized to practice in the jurisdiction where the project is located and who is experienced in the design of metal-plate-connected wood trusses.
- E. Structural Performance:
 1. Design Loads: As indicated on the drawings.

2. Maximum Deflection Under Design Loads:
 - a. Roof Trusses: L/360 live, snow, and wind load deflections and L/240 total load deflection.

1.6 SUBMITTALS

- A. Product Data: For metal-plate connectors, metal framing anchors, bolts and fasteners.
- B. Prepare and submit truss shop drawings and structural analysis calculations signed and sealed by the qualified Professional Engineer registered in the State where the project is located. Shop drawings and calculations shall include, but not be limited to, the following:
 1. Building code used for design.
 2. Plan detailing location.
 3. Pitch, span, camber, configuration and spacing of each truss type.
 4. Lumber species, sizes and stress grades.
 5. Metal connector plate type, size, and thickness.
 6. Number of plies.
 7. Required bearing details.
 8. Location of all joints, splices and support locations, including connections to the structure where indicated on the drawings.
 9. Temporary and/or permanent bracing.
 10. Design loads.
 11. Adjustments to wood member or metal connector plate design values.
 12. Maximum reactions and direction, including uplift reactions.
 13. Truss-to-truss connections or truss field assembly requirements.
 14. Deflection ratio.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. All metal-plate-connected wood trusses shall be stored clear of the ground to prevent deterioration or damage due to moisture, temperature changes, contaminants, and corrosion.
- B. All items shall be transported, stored and erected in a manner that will avoid any further damage or deformation. Bent or deformed items

will be rejected and shall be replaced or repaired at the expense of the responsible party.

- C. Handling during erection shall be in accordance with recommended practices set forth in BCSI's "Guide to Good Practice for Handling, Installing, Restraining & Bracing of Metal Plate Connected Wood Trusses."

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Lumber Standards:
1. Comply with DOC PS 20 and with applicable grading rules of inspection agencies certified by American Lumber Standards Committee (ALSC) Board of Review.
- B. Grade and Species:
1. Provide dimension lumber of any species for truss chord and web members, graded visually or mechanically, and capable of supporting required loads without exceeding allowable design values according to NDS' "National Design Specifications for Wood Construction" and its "Supplement."
- C. Metal Connector Plates:
1. Fabricate connector plates from structural-quality steel sheet, zinc coated by hot-dip process complying with TPI 1 and ASTM A 653, G60 coating designation; Designation SS Grade 33 and not less than 0.036-inch coated thickness.

2.2 FASTENERS

- A. Provide fasteners of size and type indicated that comply with requirements specified below for material and manufacture. Where truss members are exposed to weather or to high relative humidity, provide fasteners with a hot-dip zinc coating per ASTM A153 or of stainless steel, Type 304 or 316.
1. Nails, Wire, Brads, and Staples: FS FF-N-105.
 2. Power Driven Fasteners: CABO NER-272.
 3. Wood Screws: ASME B18.6.1.
 4. Lag Bolts and Screws: ASME B18.2.1.
 5. Bolts: Steel bolts complying with ASTM A307, Grade A (ASTM F568M, Property Class 4.6); with ASTM A563 hex nuts and where indicated, flat washers.

2.3 METAL FRAMING ANCHORS

- A. Provide metal framing anchors with allowable design loads, as published by manufacturer, that meet or exceed those indicated, of the following metal and finish:
 - 1. Galvanized Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A653, G60 coating designation; structural, commercial, or lock-forming quality, as standard with manufacturer for type of anchor indicated.

2.4 MISCELLANEOUS MATERIAL

- A. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035, with dry film containing a minimum of 94 percent zinc dust by weight.

2.5 FABRICATION

- A. Assemble truss members in design configuration indicated using jigs or other means to ensure uniformity and accuracy of assembly with joints closely fitted to comply with the requirements of NDS and TPI.
- B. Fabricate wood trusses in compliance with the requirements in NDS and TPI.
- C. Connect truss members by metal connector plates located and securely embedded simultaneously by air or hydraulic press into both sides of wood members.
- D. Trusses shall be fabricated in a properly equipped manufacturing facility of a permanent nature. Trusses shall be manufactured by experienced workmen, using precision cutting, jiggling and pressing equipment under the requirements of NDS and TPI.
- E. Fabricate metal connector plates in sizes, configurations, thicknesses and anchorage details as required to withstand design loads for types of joint designs indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install and brace trusses according to recommendations of TPI. Space trusses as indicated; install plumb, square, and true to line; and securely fasten to supporting construction.
- B. Anchor trusses securely at all bearing points using metal framing anchors and fasten according to metal framing anchor manufacturer's fastening schedules and written instructions.

- C. Securely connect each truss ply required for forming built-up girder trusses. Anchor trusses to girder trusses as indicated.
- D. Install and fasten temporary and/or permanent bracing during truss erection and before construction loads are applied to prevent toppling. Anchor ends of permanent bracing where terminating at walls or beams.
- E. Install wood trusses within installation tolerances required by TPI 1.
- F. Cutting, removal, or altering of trusses is not permitted without written authorization from the Structural Engineer of Record.
- G. Return wood trusses that are damaged or do not meet requirements to fabricator and replace with trusses that do meet requirements.

3.2 REPAIR

- A. Repair damaged galvanized coatings on exposed surfaces with galvanized repair paint according to ASTM A780 and manufacturer's written instructions.

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SECTION 06 20 00
FINISH CARPENTRY

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies exterior and interior millwork.

1.2 RELATED WORK

- A. Fabricated Metal brackets, bench supports and countertop legs: Section 05 50 00, METAL FABRICATIONS.
- B. Framing, furring and blocking: Section 06 10 00, ROUGH CARPENTRY.
- C. Wood doors: Section 08 14 00, WOOD DOORS.
- D. Color and texture of finish: Section 09 06 00, SCHEDULE FOR FINISHES.
- E. Stock Casework: Section 12 32 00, MANUFACTURED WOOD CASEWORK.
- F. Electrical light fixtures and duplex outlets: Division 26, ELECTRICAL.

1.3 PERFORMANCE REQUIREMENTS

- A. Sustainably Harvested Wood: Comply with requirements of Section 01 81 11, SUSTAINABLE DESIGN REQUIREMENTS.
- B. Engineered Wood Products:
 - 1. Provide products with no added urea formaldehyde; determine formaldehyde concentrations in air from wood products under test conditions of temperature and relative humidity in accordance with ASTM D6007 or E1333.
 - 2. Bio-based Content:
 - a. Interior Panels: Engineered products designed specifically for interior applications and providing a surface that is impact-, scratch-, and wear-resistant and that does not absorb or retain moisture; provide minimum 55 percent bio-based content.
 - b. Structural Interior Panels: Engineered products designed for use in structural construction applications; provide minimum 89 percent bio-based content.
 - c. Structural Wall Panels: Engineered products designed for use in structural walls, curtain walls, floors and roofs; provide minimum 94 percent bio-based content.
 - 3. VOC Emissions:
 - a. Provide low VOC products with Green Seal Certification to GS-36 and description of the basis for certification .

1.4 SUSTAINABILITY REQUIREMENTS

- A. Materials in this section may contribute towards contract compliance with sustainability requirements.

1.5 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Provide documentation of conformance with performance requirements of this section.
- C. Shop Drawings:
 - 1. Millwork: Half size scale for sections and details; 1:50 (1/4-inch) for elevations and plans.
 - 2. Indicate materials and details of construction, methods of fastening, erection, and installation.
- E. Certificates:
 - 1. Indicate preservative treatment of materials meet the requirements specified.
 - 2. Indicating moisture content of materials meet the requirements specified.
- F. List of acceptable sealers for fire retardant and preservative treated materials.
- G. Manufacturer's literature and data:
 - 1. Finish hardware.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Protect lumber and millwork from dampness, maintaining moisture content specified both during and after delivery at site.
- B. Store finishing lumber and millwork in weathertight well-ventilated structures or in space in existing buildings designated by PM. Store at a minimum temperature of 21°C (70°F) for not less than 10 days before installation.
- C. Pile lumber in stacks in such manner as to provide air circulation around surfaces of each piece.

1.7 APPLICABLE PUBLICATIONS

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

B. American Society of Testing and Materials (ASTM):

| | |
|---------------|--|
| A167-99(2009) | Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip |
| B26/B26M-12 | Aluminum-Alloy Sand Castings |
| B221-13 | Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes |
| D6007-02 | Determining Formaldehyde Concentration in Air from Wood Products Using a Small Scale Chamber |
| E1333-10 | Determining Formaldehyde Concentrations in Air and Emission Rates from Wood Products Using a Large Chamber |

C. American Hardboard Association (AHA):

| | |
|-----------|-----------------|
| A135.4-12 | Basic Hardboard |
|-----------|-----------------|

D. American Lumber Standard Committee, Incorporated (ALSC):

ALSC Board of Review

E. American National Standards Institute (ANSI):

| | |
|-----------------|---|
| NPA A208.1-2009 | Particleboard (published by National Particleboard Association/Composite Panel Association) |
|-----------------|---|

| | |
|-----------|--------------------|
| Z124.3-05 | Plastic Lavatories |
|-----------|--------------------|

F. American Society of Mechanical Engineers (ASME):

| | |
|--------------|--|
| B18.2.1-2012 | Square, Hex, Heavy Hex and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws |
|--------------|--|

| | |
|--------------|---|
| B18.2.2-2010 | Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series) |
|--------------|---|

G. American Wood-Preservers' Association (AWPA)

H. Architectural Woodwork Institute (AWI):

Architectural Woodwork Standards and Quality Certification Program
(2009)

I. Builders Hardware Manufacturers Association (BHMA):

| | |
|-----------|----------------------------|
| A156.9-10 | Concealed Cabinet Hardware |
|-----------|----------------------------|

| | |
|------------|---------------|
| A156.11-10 | Cabinet Locks |
|------------|---------------|

| | |
|------------|--------------------|
| A156.16-02 | Auxiliary Hardware |
|------------|--------------------|

| | |
|------------|--------------------------|
| A156.18-12 | Exposed Cabinet Hardware |
|------------|--------------------------|

J. Green Seal (GS):

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GS-36 (2013) Commercial Adhesives

K. Hardwood Plywood and Veneer Association (HPVA):

HP-1-2011 Hardwood Plywood Handbook

L. National Electrical Manufacturers Association (NEMA):

LD 3-05 High-Pressure Decorative Laminates

M. National Hardwood Lumber Association (NHLA)

N. South Coast Air Quality Management District (SCAQMD):

SCAQMD Rule 1168 (1989; R2005) Adhesive and Sealant Applications

O. U.S. Department of Commerce/National Institute of Science and
Technology:

PS1-09 Construction and Industrial Plywood

PS20-10 American Softwood Lumber Standard

PART 2 - PRODUCTS

2.1 LUMBER

A. Grading and Marking:

1. Lumber to bear the grade mark, stamp, or other identifying marks indicating grades of material.
2. Such identifying marks on a material to be in accordance with the rule or standard under which the material is produced, including requirements for qualifications and authority of the inspection organization, usage of authorized identification, and information included in the identification.
3. The inspection agency for lumber to be approved by the Board of Review, American Lumber Standards Committee, to grade species used.

B. Sizes:

1. Lumber size references, unless otherwise specified, are nominal sizes; actual sizes to be within manufacturing tolerances allowed by the standard under which product is produced.
2. Millwork, standing and running trim, and rails: Actual size as shown or specified.

C. Hardwood: FAS Grade of NHLA, species as specified for each item.

D. Softwood: PS-20, exposed to view appearance grades:

1. Use C select, or D select, vertical grain for transparent finish including stain transparent finish.
2. Use Prime for painted or opaque finish.

E. Use edge grain wood members exposed to weather.

2.2 PLYWOOD

A. Softwood Plywood:

1. Prod. Std.
2. Grading and Marking:
 - a. Each sheet of plywood must bear the mark of a recognized association or independent inspection agency that maintains continuing control over the quality of the plywood.
 - b. The mark must identify the plywood by species group or identification index, and show glue type, grade, and compliance with PS1.
3. Plywood, 13 mm (1/2 inch) and thicker; not less than five ply construction, except 32 mm (1-1/4 inch) thick plywood not less than seven ply.

2.3 PARTICLEBOARD (NOT USED)

2.4 PLASTIC LAMINATE (NOT USED)

2.5 SOLID SURFACE COUNTERTOPS

- A. Comply with AWI Section 400 and ANSI Z124.3 requirements for countertops.

2.6 BUILDING BOARD (HARDBOARD) (NOT USED)

2.7 ADHESIVE

2.8 STAINLESS STEEL (NOT USED)

2.9 ALUMINUM CAST (NOT USEDE)

2.10 ALUMINUM EXTRUDED (NOT USED)

2.11 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 electric-galvanizing process. Provide galvanized where indicated.
2. Use galvanized coating on ferrous metal for exterior work unless non-ferrous metals or stainless is used.
3. Fasteners:
 - a. Bolts with Nuts: ASME B18.2.1 and ASME B18.2.2.
 - b. Screws: ASMC B18.6.1.

2.12 MOISTURE CONTENT

- A. Moisture content of lumber and millwork at time of delivery to site.

1. Moisture content of other materials to be in accordance with the standards under which the products are produced.

2.13 FIRE-RETARDANT TREATMENT

- A. Fire-retardant-treated wood products to be free of halogens, sulfates, ammonium phosphate and formaldehyde.
- B. Fire retardant treatment of wood products to conform to the requirements of AWPA Standard U1, Commodity Specification H and AWPA Standard T1, Section H.

2.14 FABRICATION

- A. General:
 1. Provide interior woodwork complying with referenced quality standard.
 2. Use AWI Custom Grade for architectural woodwork and interior millwork, except as otherwise indicated.
 3. Finish woodwork must be free from pitch pockets.
 4. Provide trim as standard stock molding and members of the same species, except where special profiles are shown.
 5. Plywood cannot be less than 13 mm (1/2 inch), unless otherwise shown or specified.
 6. Edges of members in contact with concrete or masonry to have a square corner caulking rebate.
 7. Fabricate members less than 4 m (14 feet) in length from one piece of lumber, back channeled and molded as shown.

PART 3 - EXECUTION

3.1 ENVIRONMENTAL REQUIREMENTS

- A. Maintain work areas and storage areas to a minimum temperature of 21⁰C (70⁰F) for not less than 10 days before and during installation of interior millwork.
- B. Do not install finish lumber or millwork in any room or space where wet process systems such as concrete, masonry, or plaster work are not complete and dry.

3.2 INSTALLATION

- A. General:
 1. Install to comply with AWI 1700.
 2. Millwork receiving transparent finish to be primed and back-painted on concealed surfaces; do not set millwork until primed and back-painted.

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3. Secure trim with fine finishing nails, screws, or glue as required.
 4. Set nails for putty stopping. Use washers under bolt heads where no other bearing plate occurs.
 5. Seal cut edges of preservative and fire retardant treated wood materials with a certified acceptable sealer.
 6. Coordinate with plumbing and electrical work for installation of fixtures and service connections in millwork items.
 7. Plumb and level items unless shown otherwise.
 8. Nail finish at each blocking, lookout, or other nailer and intermediate points; toggle or expansion bolt in place where nails are not suitable.
 9. Exterior Work: Provide joints that are close fitted, mitered, tongue and grooved, rebated, or lapped to exclude water filled and sealed.
 10. Install woodwork plumb and level to a tolerance of 3 mm in 2400 mm (1/8 inch in 96 inches).
- B. Install with butt joints in straight runs and miter at corners.

- - - E N D - - -

**SECTION 07 01 50.19
PREPARATION FOR RE-ROOFING**

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Partial roof removal for new roof system installation.

B. Existing Roofing System: Asphalt shingle system . System components include:

1. Asphalt shingles roofing.

2. Underlayment felts.

3. Wood decking.

1.2 RELATED WORK

A. Section 06 10 00, ROUGH CARPENTRY: Replacement Roof Deck .

B. Section 07 31 13, ASPHALT SHINGLES: New Roofing System.

C. Section 07 60 00, FLASHING AND SHEET METAL: Sheet Metal Counterflashing.

1.3 APPLICABLE PUBLICATIONS

A. Comply with references to extent specified in this section.

B. American National Standards Institute/Single-Ply Roofing Institute (ANSI/SPRI):

FX-1 (R2016).....Standard Field Test Procedure for Determining the Withdrawal Resistance of Roofing Fasteners.

C. American Society for Nondestructive Testing (ASNT):

SNT-TC-1A (2019).....Personnel Qualification and Certification for Nondestructive Testing.

D. ASTM International (ASTM):C1278/C1278M-17 Standard Specification Fiber-Reinforced Gypsum Panel.

E. U.S. Department of Commerce National Institute of Standards and Technology (NIST):

DOC PS 1-19.....Structural Plywood.

DOC PS 2-18.....Performance Standard for Wood-Based Structural-Use Panels.

1.4 PREINSTALLATION MEETINGS

A. Conduct preinstallation meeting minimum 30 days before beginning Work of this section.

1. Required Participants:

- a. Contracting Officer's Representative.
 - b. Contractor.
 - c. Installer.
 - d. Manufacturer's field representative.
 - e. Other installers responsible for adjacent and intersecting work, including mechanical and electrical equipment installers.
2. Meeting Agenda: Distribute agenda to participants minimum 3 days before meeting.
- a. Removal and installation schedule.
 - b. Removal and installation sequence.
 - c. Preparatory work.
 - d. Protection before, during, and after installation.
 - e. Removal and installation.
 - f. Transitions and connections to other work.
 - g. Inspecting .
 - h. Other items affecting successful completion.
3. Document and distribute meeting minutes to participants to record decisions affecting installation.

1.5 SUBMITTALS

- A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Submittal Drawings:
 1. Show size, configuration, and installation details.
- C. Manufacturer's Literature and Data:
 1. Description of each product.
 2. List of patching materials.
 3. Preparation instructions to receive new roofing.
 4. Existing roofing warrantor's instructions.
- D. Photographs: Document existing conditions potentially affected by roofing operations before work begins.
- E. Field Inspection Reports:
 1. Certify warrantor inspected completed roofing and existing warranty remains in effect.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications:
 1. Same installer as Section 07 31 , ASPHALT SHINGLES

2. Approved by existing roofing system warrantor when work affects existing roofing system under warranty.

1.7 FIELD CONDITIONS

- A. Building Occupancy: Perform work after occupants have been relocated to temporary facilities.
- B. Existing Roofing Available Information:
 1. The following are available for Contractor reference:
 - a. Construction drawings .
 2. Examine available information before beginning work of this section.
- C. Weather Limitations: Proceed with reroofing preparation only during dry weather conditions as specified for new roofing installation in Section Section 07 31 13, ASPHALT SHINGLES.
 1. Remove only as much roofing in one day as can be made watertight in same day.
- D. Hazardous materials are not expected in existing roofing system.
 1. Do not disturb suspected hazardous materials. When discovered, notify Contracting Officer's Representative.
 2. Hazardous materials discovered during execution of the work will be removed by Government as work of a separate contract.

1.8 WARRANTY

- A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."
- B. Existing Warranties: Perform work to maintain existing roofing warranty in effect.
 1. Notify warrantor before beginning, and upon completion of reroofing.
 2. Obtain warrantor's instructions for maintaining existing warranty.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Patching Materials: Match existing roofing system materials.
- B. Plywood Sheathing: See Section 06 10 00, ROUGH CARPENTRY.
- C. Metal Flashing: See Section 07 60 00, FLASHING AND SHEET METAL.
- D. Fasteners: Type and size required by roof membrane manufacturer to resist wind uplift.

PART 3 - EXECUTION

3.1 EXAMINATION (NOT USED)

3.2 PREPARATION

- A. Examine and verify substrate suitability for product installation.

- B. Protect existing roofing system indicated to remain.
 - 1. Cover roof membrane with temporary protection materials without impeding drainage.
 - 2. Limit traffic and material storage to protected areas.
 - 3. Maintain temporary protection until replacement roofing is completed.
- C. Protect existing construction and completed work from damage.
- D. Protect landscaping from damage.
- E. Maintain access to existing walkways and adjacent occupied facilities.
- F. Coordinate use of rooftop fresh air intakes with Contracting Officer's Representative to minimize effect on indoor air quality.
- G. Ensure temporary protection materials are available for immediate use in case of unexpected rain.
- H. Ensure roof drainage remains functional.
 - 1. Keep drainage systems clear of debris.
 - 2. Prevent water from entering building and existing roofing system.

3.3 RE-ROOFING PREPARATION - GENERAL

- A. Notify Contracting Officer's Representative of planned operations, daily.
 - 1. Identify location and extent of roofing removal.
 - 2. Request authorization to proceed.

3.4 OVERBURDEN REMOVAL (NOT USED)

3.5 COMPLETE ROOFING SYSTEM REMOVAL (NOT USED)

3.6 PARTIAL ROOFING SYSTEM REMOVAL

- A. Remove existing roofing completely, exposing structural roof deck at locations and to extent indicated on drawings.
 - 1. Remove or cut-off roofing system fasteners.

3.7 ROOFING MEMBRANE AND SELECTIVE ROOFING SYSTEM COMPONENT REMOVAL (NOT USED)

3.8 DECK PREPARATION

- A. Inspect structural roof deck after roofing system removal.
- B. Wood Roof Decks:
 - 1. Visually inspect and confirm roof deck is dry.
 - a. Proceed with roofing work only when moisture is not observed, and existing damaged wood deck is repaired.
 - 2. Secure roof deck with additional fastenings as determined by Contracting Officer's Representative.

3. Replace roof deck as determined by Contracting Officer's Representative.

b. Replacement Roof Deck: See Section 06 10 00, ROUGH CARPENTRY.

3.9 TEMPORARY ROOFING (NOT USED)

3.10 EXISTING MEMBRANE PREPARATION FOR NEW ROOFING (NOT USED)

3.11 BASE FLASHING REMOVAL

A. Expose base flashings to permit removal.

1. Two-Piece Counterflashings: Remove cap flashing and store for reuse.
2. Single Piece Counterflashings: Carefully bend counterflashing.
3. Metal Copings: Remove decorative cap and store for reuse.

B. Remove existing base flashings.

1. Clean substrates to receive new flashings.

C. Replace counterflashings damaged during removal.

1. Counterflashings: See Section 07 60 00 FLASHING AND SHEET METAL.

3.12 RECOVER BOARD INSTALLATION (NOT USED)

3.13 FIELD QUALITY CONTROL

A. Existing Roofing System Warrantor Services:

1. Inspect reroofing preparation and roofing installation to verify compliance with existing warranty conditions.
2. Submit reports of field inspections, and supplemental instructions issued during inspections.

3.14 DISPOSAL

A. Collect waste materials in containers.

B. Remove waste materials from project site, regularly, to prevent accumulation.

C. Legally dispose of waste materials.

- - E N D - -

**SECTION 07 21 13
THERMAL INSULATION**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies thermal and acoustical insulation for buildings.
- B. Acoustical insulation is identified by thickness and words "Acoustical Insulation".

1.2 RELATED WORK

- A. Safing Insulation: Section 07 84 00, FIRESTOPPING.

1.3 SUSTAINABILITY REQUIREMENTS

- A. Materials in this section may contribute towards contract compliance with sustainability requirements. See Section 01 81 11, SUSTAINABLE DESIGN REQUIRMENTS, for project local/regional materials, low-emitting materials, recycled content, requirements.
- B. Biobased Material: For products designated by the USDA's BioPreferred® program, provide products that meet or exceed USDA recommendations for biobased content, subject to the products compliance with performance requirements in this Section. For more information regarding the product categories covered by the BioPreferred® program, visit <http://www.biopreferred.gov>.

1.4 REGULATORY REQUIREMENTS FOR RECYCLED CONTENT

- A. Products and Materials with Post-Consumer Content and Recovered Materials Content:
 - 1. Contractor is obligated by contract to satisfy Federal mandates for procurement of products and materials meeting recommendations for post-consumer content and recovered materials content; the list of designated product categories with recommendations has been compiled by the EPA - refer to <http://www.epa.gov/wastes/conservation/tools/cpg/products/>.

2. Materials or products specified by this section may be obligated to satisfy this Federal mandate and Comprehensive Procurement Guidelines program.

3. The EPA website also provides tools such as a Product Supplier Directory search engine and product resource guides.

B. Fulfillment of regulatory requirements does not relieve the Contractor of satisfying sustainability requirements stipulated by Section 01 81 11, SUSTAINABLE DESIGN REQUIREMENTS, as it relates to recycled content; additional product and material selections with recycled content may be required, as determined by Contractor's Sustainability Action Plan.

1.5 SUBMITTALS

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

B. Manufacturer's Literature and Data:

1. Insulation, each type used.

2. Adhesive, each type used.

3. Tape.

C. Certificates: Stating the type, thickness and "R" value (thermal resistance) of the insulation to be installed.

1.6 SUSTAINABLE DESIGN CERTIFICATION

A. Provide third party certified product in accordance with ULE GREENGUARD, SCS Global Indoor Advantage Certification or equal; certification must be current and performed annually.

B. Provide documentation to demonstrate fiberglass insulation does not contain urea-formaldehyde.

1.7 STORAGE AND HANDLING

A. Store insulation materials in weathertight enclosure.

B. Protect insulation from damage from handling, weather and construction operations before, during, and after installation.

1.8 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by the

basic designation only. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

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

| | |
|------------------|--|
| C270-19ae1 | Mortar for Unit Masonry |
| C553-13(2019) | Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications |
| C578-22 | Rigid, Cellular Polystyrene Thermal Insulation |
| C591-21 | Unfaced Preformed Rigid Cellular Polyisocynurate Thermal Insulation |
| C665-17 | Mineral Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing |
| D312/D312M-16a | Asphalt Used in Roofing |
| F1667/F1667M-21a | Driven Fasteners: Nails, Spikes and Staples |

C. Scientific Certification Systems (SCS Global): SCS Indoor Advantage certification.

D. UL Environment, GREENGUARD (ULE GREENGUARD): The GREENGUARD Product Guide (online)

PART 2 - PRODUCTS

2.1 INSULATION - GENERAL

- A. Where thermal resistance ("R" value) is specified or shown for insulation, the thickness shown on the drawings is nominal. Use only insulation with actual thickness that is not less than that required to provide the thermal resistance specified.
- B. Where "R" value is not specified for insulation, use the thickness shown on the drawings.
- C. Comply with following minimum content standards for recovered materials:

| Material Type | Percent by Weight |
|---|------------------------------|
| Polyisocyanurate/polyurethane/polystyrene | 9 percent recovered material |
| Glass fiber reinforced | 6 percent recovered material |

D. The minimum-content standards are based on the weight (not the volume) of the material in the insulating core only.

E. Insulation Products shall comply with following standards for biobased materials:

| Material Type | Percent by Weight |
|-----------------------|-----------------------------|
| Fiberglass Insulation | 5 percent biobased material |
| Spray Foam Insulation | 7 percent biobased material |

The minimum-content standards are based on the weight (not the volume) of the material in the insulating core only.

2.2 POLYISOCYANURATE BOARD INSULATION

A. ASTM C591, Type I, faced with a vapor retarder having a perm rating of not more than 0.5.

2.3 POLYSTYRENE BOARD

A. ASTM C578, Type IV, V, VI, VII, or IX where covered by soil or concrete.

2.4 GLASS FIBER AND STONE WOOL INSULATION

A. Unfaced Insulation: ASTM C665, Type I or ASTM C533.

B. Faced Insulation: ASTM C665, Type III, Faced.

C. Acoustical Insulation: Preformed, friction-fit type, unfaced; insulation type conforming to ASTM C665 or C553.

2.5 FASTENERS

A. Staples or Nails: ASTM F1667, zinc coated, size and type best suited for purpose.

2.6 ADHESIVE

A. As recommended by the manufacturer of the insulation.

B. Asphalt: ASTM D312, Type III or IV.

C. Mortar: ASTM C270, Type 0.

2.7 TAPE

- A. Pressure sensitive adhesive on one face.
- B. Perm rating of not more than 0.50.

2.8 BLOCKING AROUND HEAT PRODUCING DEVICES

- A. Provide non-combustible blocking around heat producing devices to provide the following clearances:
 - 1. Recessed lighting fixtures, including wiring compartments, ballasts, and other heat producing devices, unless certified for installation surrounded by insulation: 75 mm 3 inches from outside face of fixtures and devices or as required by NFPA 70 and, if insulation is to be placed above fixture or device, 600 mm 24 inches above fixture.
 - 2. Vents and vent connectors used for venting products of combustion, flues, and chimneys: minimum clearances as required by NFPA 211.

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL

- A. Install insulation with the vapor barrier facing the heated side, unless specified otherwise.
- B. Install rigid insulating units with joints close and flush, in regular courses and with cross joints broken.
- C. Install batt insulation with tight joints and filling framing void completely. Seal cuts, tears, and unlapped joints with tape.
- D. Fit insulation tight against adjoining construction and penetrations, unless specified otherwise.
- E. Do not install insulation in a manner that would sandwich electrical wiring between two layers of insulation.
- F. Place insulation to the outside of pipes.
- G. Butt tightly against adjoining boards, studs, rafters, joists, sill plates, headers and obstructions. Provide continuity and integrity of insulation at corners, wall to ceiling joint, roof, and floor. Avoid creating any thermal bridges or voids.

3.2 POLYISO BOARD

- A. Bond polyisocyanurate board, to surfaces with adhesive as recommended by insulation manufacturer.

3.3 POLYSTYRENE BOARD

- A. Vertical Insulation:
 - 1. Fill joints of insulation with same material used for bonding.
 - 2. Bond polystyrene board to surfaces with adhesive and applied in accordance with recommendations of insulation manufacturer.

3.4 GLASS FIBER BATT

- A. Pack insulation around door frames and windows and in building expansion joints, door soffits and other voids. Pack behind outlets around pipes, ducts, and services encased in walls. Open voids are not permitted. Hold insulation in place with pressure sensitive tape.
- B. Lap vapor retarder flanges together over face of framing for continuous surface. Seal all penetrations through the insulation.
- C. Fasten blanket insulation between metal studs or framing and exterior wall furring by continuous pressure sensitive tape along flanged edges.
- D. Roof Rafter Insulation or Floor Joist Insulation: Place mineral fiber blankets between framing to provide not less than a 50 mm (two inch) air space between insulation and gypsum board ceiling for rafters or floor decking and floor joist over crawl space.
- E. Ceiling Insulation and Soffit Insulation:
 - 1. Fasten blanket insulation between wood framing or joist with nails or staples through flanged edges of insulation.
 - 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. Tape insulation tightly together so no gaps occur, and metal framing members are covered by insulation.
 - 3. In areas where suspended ceilings adjoin areas without suspended ceilings, install blanket, batt, or mineral fiberboard extending from the suspended ceiling to underside

of deck or slab above. Secure in place to prevent collapse or separation of hung blanket, batt, or board insulation and maintain in vertical position. Secure blanket or batt with continuous cleats to structure above.

3.5 ACOUSTICAL INSULATION

- A. Fasten blanket insulation between metal studs and wall furring with continuous pressure sensitive tape along edges or adhesive.
- B. Pack insulation around door frames and windows and in cracks, expansion joints, control joints, door soffits and other voids. Pack behind outlets, around pipes, ducts, and services encased in wall or partition. Hold insulation in place with pressure sensitive tape or adhesive.
- C. Do not compress insulation below required thickness except where embedded items prevent required thickness.
- D. Where acoustical insulation is installed above suspended ceilings install blanket at right angles to the main runners or framing. Extend insulation over wall insulation systems not extending to structure above.

- - - E N D - - -

**SECTION 07 21 23
LOOSE-FILL INSULATION**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section covers loose fill insulation, vapor barrier and all necessary blocking to install insulation in attic spaces where shown in existing buildings and building additions.
- B. Install insulation in sufficient thickness to provide thermal resistance "R" values of "R"48 in attics as shown.

1.2 SUSTAINABILITY REQUIREMENTS

- A. Materials in this section may contribute towards contract compliance with sustainability requirements. See Section 01 81 11, SUSTAINABLE DESIGN REQUIRMENTS, for project local/regional materials, low-emitting materials, recycled content, requirements.

1.3 REGULATORY REQUIREMENTS FOR RECYCLED CONTENT

- A. Products and Materials with Post-Consumer Content and Recovered Materials Content:
 - 1. Contractor is obligated by contract to satisfy Federal mandates for procurement of products and materials meeting recommendations for post-consumer content and recovered materials content; the list of designated product categories with recommendations has been compiled by the EPA - refer to <http://www.epa.gov/wastes/conservation/tools/cpg/products/>.
 - 2. Materials or products specified by this section may be obligated to satisfy this Federal mandate and Comprehensive Procurement Guidelines program.
 - 3. The EPA website also provides tools such as a Product Supplier Directory search engine and product resource guides.
- B. Fulfillment of regulatory requirements does not relieve the Contractor of satisfying sustainability requirements stipulated by Section 01 81 11, SUSTAINABLE DESIGN REQUIREMENTS, as it relates to recycled content; additional product and material

selections with recycled content may be required, as determined by Contractor's Sustainability Action Plan.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Samples:
 - 1. Loose fill insulation in pint size containers.
 - 2. Blocking: 150 mm (6-inch) long strips.
 - 3. Vapor Retarder: 150 mm x 150 mm (6-inch by 6-inch) pieces.
- C. Manufacturer's Literature:
 - 1. Submit current copies of the insulation manufacturer's printed fact sheet literature, including descriptive data, insulation characteristics, and instructions for installation and protection of insulation.
 - 2. Submit copy of "Bag Label".

1.5 SUSTAINABLE DESIGN CERTIFICATION

- A. Provide third party certified product in accordance with ULE Greenguard, SCS Scientific Certification Systems Indoor Advantage or equal. Certification must be current and performed annually.

1.6 DELIVERY

- A. Deliver materials to the site in the original sealed containers or packages bearing the manufacturer's name and brand designation.
- B. The containers or packages of insulation to bear the referenced specification number, type and class as applicable, recommended method of installation (pneumatic or pouring), minimum net weight of insulation, coverage charts, "R" values, and required warning statements.

1.7 STORAGE

- A. Inspect materials delivered to the site for damage and unload and store with a minimum of handling.

- B. Establish storage spaces in dry locations, not subject to open flames or sparks, and permitting easy access for inspection and handling.

1.8 APPLICABLE PUBLICATIONS

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

- B. American Society of Testing and Materials (ASTM):

| | |
|----------------|---|
| C612-14(2019) | Mineral Fiber Block and Board Thermal Insulation |
| C728-17a(2022) | Perlite Thermal Insulation Board |
| C739-21a | Cellulosic Fiber Loose-Fill Thermal Insulation |
| C755-20 | Selection of Water Vapor Retarders for Thermal Insulation |
| C764-19 | Mineral Fiber Loose-Fill Thermal Insulation |
| C930-19 | Potential Health and Safety Concerns Associated with Thermal Insulation Materials and Accessories |
| C1015-17 | Installation of Cellulosic and Mineral Fiber Loose-Fill Thermal Insulation |
| D4397-16 | Polyethylene Sheeting for Construction, Industrial, and Agriculture Applications |
| E96/E96M-22 | Water Vapor Transmission of Materials |

- C. National Fire Protection Associations (NFPA):

| | |
|--------|--|
| 211-13 | Chimneys, Fireplaces, Vents, and Solid Fuel Burning Appliances |
|--------|--|

- C. Scientific Certification Systems (SCS Global): SCS Indoor Advantage certification.

- D. UL Environment, GREENGUARD (ULE GREENGUARD): The GREENGUARD Product Guide (online)

1.9 SAFETY PRECAUTIONS

- A. Provide installers with dust/mist respirators, training in their use, and protective clothing.
- B. Consider other safety concerns and measures as outlined in ASTM C930.

PART 2 - PRODUCTS

2.1 LOOSE FILL INSULATION

- B. Mineral Fiber Loose Fill: ASTM C764, Type I or II.
- C. Prohibited Materials:
 - 1. Asbestos-containing materials.
 - 2. Urea Formaldehyde-containing materials.
 - 3. Ammonium Sulfate-containing materials.

2.2 BLOCKING

- A. Wood, metal, mineral fiber or perlite boards or other materials approved by the PM.
- B. Mineral Fiber Board: ASTM C612, Type IB.

2.3 VAPOR RETARDER

- A. Provide 0.15 mm thick polyethylene sheeting conforming to ASTM D4397 and having a water vapor permeance of 57.5 ng/Pa.s.sqm (1 perm) or less when tested in accordance with ASTM E96/E96M.
- B. Self-adhesive tape having a perm rating equal to the polyethylene.

2.4 INSULATION BAFFLE

- A. Provide one-piece attic ventilation baffle with 1.4 inches air channel depth. Baffles shall be waterproof and will block moisture and wind from penetrating the attic.
- B. See structural drawings for truss/joist spacing.
- C. Baffles to conform with manufacturer instructions for vent strips at soffits and ridge vents.

2.5 RECOVERED MATERIAL

- A. Comply with following minimum content standards for recovered materials:

| Material Type | Percent by Weight |
|-----------------------------------|--|
| Cellulose Loose-fill and spray-on | 75 percent post-consumer recovered paper |
| Perlite composite board | 23 percent post-consumer |
| Rock wool material | 75 percent recovered material |

B. The minimum-content standards are based on the weight (not the volume) of the material in the insulating core only.

2.6 BIOBASED CONTENT

Insulation Products shall comply with following standards for biobased materials:

| Material Type | Percent by Weight |
|----------------------|-------------------------------|
| Cellulose Insulation | 25 percent biobased material |
| Cotton Insulation | 25 percent biobased material |
| Wool Insulation | 25 percent biobased materials |

The minimum-content standards are based on the weight (not the volume) of the material in the insulating core only.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Where possible, inspect attic(s) to receive insulation for conditions which will adversely affect the execution of the work or create a safety hazard. Report unsatisfactory conditions to the PM.
- B. Do not install insulation until unsatisfactory conditions have been corrected.
- C. Follow ASTM C1015 and check for the following:
 - 1. Defects in electrical fixtures, equipment, wiring, junction boxes, receptacles, and switches that will cause hazards.
 - 2. Openings through which the loose fill insulation material may escape.
 - 3. Air ducts which appear to have joints that are not secure or sealed.

3.2 PREPARATION

- A. Prior to the installation of insulation, provide blocking as specified herein and in accordance with ASTM C1015.
- B. Install blocking around ceiling access-panel(s), if the level to which the unsettled insulation will be installed exceeds their height. Cover openings into the attic with temporary blocking to prevent insulation from falling into the opening, including spaces enclosed by blockings.
- C. Install blocking around heat producing devices with minimum clearances as specified herein.
 - 1. Install blocking 50 mm (two inches) above the height of the finished insulation installation and in a manner that ensures that devices which may require maintenance or servicing remain accessible after the insulation is installed.
 - 2. Minimum clearances for blocking around heat producing devices to be as follows:
 - a. Masonry chimneys for equipment and incinerator(s) operating at a temperature of not more than 800 degrees C (1500 degrees F): 100 mm (Four inches) from the outside face of the masonry.
 - b. Vents, chimney and vent connectors, and chimneys other than masonry chimneys: Minimum clearances as required by NFPA 211.

3.3 INSTALLATION

- A. Vapor Retarder:
 - 1. Install vapor retarder below insulation. Do not install a vapor retarder over existing insulation or where there is a vapor retarder under existing insulation.
 - 2. Take care to prevent tears, breaks, or ruptures of any kind which might interfere with the effectiveness of the vapor retarder and install in a manner which will assure a continuous seal.
 - 3. Lap joints or breaks in vapor retarder in a manner that will assure a vapor retarder capable of effectively controlling

moisture transmission. Tape laps to retain vapor barrier in place.

4. Use self-adhesive tape for laps and for sealing breaks and holes in the vapor retarder.

B. Insulation:

1. Install insulation in accordance with ASTM C1015 and the requirements specified.
2. Do not install insulation until the requirements specified in the INSPECTION and PREPARATION paragraphs have been carried out and any defects which were identified have been corrected and their cause eliminated.
3. Pneumatic installation of thermal insulation must comply with OSHA. Supply and utilize the personnel protective equipment and engineering controls necessary for a safe effective installation. Use only pneumatic equipment in accordance with the manufacturer's instructions.
4. Install the insulation allowing it to settle to its natural density. Do not tamp or rod the insulation.
5. Install insulation in sufficient depth to provide the thermal value specified after settlement of the insulation. To obtain a minimum "R" value of 48 or as shown, install insulation to a minimum thickness of 16 inches or as shown, using the number of bags per 90 m² (1000 squares feet) as shown on the manufacturer's "Bag Label".
6. For pneumatic installations, use the least air pressure meeting the manufacturer's instructions.
7. Do not blow the insulation into electrical devices, baffles, and vents which open into the attic and other spaces to be insulated.
8. Fit the attic side of access panels with perlite or mineral fiber insulation boards. Insulate the attic side of trap doors unless prevented by a retractable ladder.

C. Post Installation Procedures:

1. In accordance with ASTM C1015.

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BID DOCUMENTS

Sturgis, SD 57785

2. Remove temporary blockings over vent openings in attic(s).

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SECTION 07 27 26
FLUID-APPLIED MEMBRANE AIR BARRIERS, VAPOR PERMEABLE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fluid-applied vapor-permeable air barrier at exterior above grade wall assemblies.
2. Connection to adjacent air barrier components providing a durable, continuous, full building air barrier.

1.2 RELATED WORK

- A. Section 01 45 29 TESTING LABORATORY SERVICES: General Quality Assurance and Quality Control Requirements.
- B. Section 01 81 13 SUSTAINABLE CONSTRUCTION REQUIREMENTS: General Sustainable Construction Requirements.
- C. Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS: Commissioning of building envelope components.
- D. Section 04 20 00 UNIT MASONRY: Masonry Unit Air Barrier Substrates.
- E. Section 07 60 00 FLASHING AND SHEET METAL: Metal Flashing Requiring Air Barrier Transitions.
- F. Section 07 92 00, JOINT SEALANTS: Joint Sealants.
- G. Division 08 sections for windows, louvers and vents, and Exterior Wall Openings Requiring Air Barrier Transitions.
- H. Section 09 29 00 GYPSUM BOARD: Wall Sheathings Air Barrier Substrates.
- I. Section 06 10 00 ROUGH CARPENTRY: Plywood Sheathing.

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(2021).....Vulcanized Rubber and Thermoplastic
Elastomers-Tension.
E96/E96M-22.....Water Vapor Transmission of Materials.
E162-22.....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.
- E2178-21a.....Air Permanence of Building Materials.
- E2357-18.....Determining Air Leakage of Air Barrier
Assemblies.

1.4 SUBMITTALS

- A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA,
AND SAMPLES.
 - 1. Show size, configuration, and fabrication and installation details.
- B. Manufacturer's Literature and Data:
 - 1. Description of each product.
 - 2. Installation instructions.
- C. Sustainable Construction Submittals:
 - 1. Low Pollutant-Emitting Materials:
 - a. Identify volatile organic compound types and quantities.
- D. Test reports:
 - 1. Submit field inspection and test reports.
- E. Certificates: Certify each product complies with specifications.
 - 1. Compatibility: Certify products are compatible with adjacent
materials.
- F. Qualifications: Substantiate qualifications comply with specifications.
 - 1. Manufacturer with project experience list.
 - 2. Installer with project experience list.
 - a. Include personnel qualifications.
 - b. Field supervisor qualifications.
 - c. Certify installer approval by air barrier manufacturer.

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.
- C. Installer Qualifications:
 - 1. Regularly and presently installs specified products.

2. Approved by manufacturer.
3. Applicators trained and certified by manufacturer of air barrier system.
4. Full time on-site field supervisor has completed three projects of similar scope within last year.
5. 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. Staff experienced in installation of specified system and qualified to perform observation and inspection specified and determine compliance with project requirements.

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. Surface Requirements: visibly dry, and complying with manufacturer's instructions.

1.9 WARRANTY

- A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."

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. Provide full system of compatible materials under conditions of service and application required. Compatibility based on testing by material manufacturer.
- C. Perform as continuous vapor permeable air barrier and moisture drainage plane.
- D. Transition to adjacent flashings and discharge water to building exterior.
- E. 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 CONSTRUCTION REQUIREMENTS for the following products:
 - a. Non-Flooring Adhesives and Sealants.

2.3 AIR BARRIER

- A. Fluid-Applied, Vapor-Permeable Membrane Air Barrier:
 - 1. Elastomeric, modified bituminous or synthetic polymer membrane.
 - 2. 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.
 - 3. Vapor Permeance: ASTM E96/E96M: Minimum 580 ng/Pa/s/square meter (10 perms).
 - 4. Elongation: Ultimate, ASTM D412, Die C: 200 percent, minimum.
 - 5. Thickness: Minimum 1.0 mm (40 mils) dry film thickness, applied in single continuous coat.
 - 6. Surface Burning Characteristics: When tested according to ASTM E84.
 - a. Flame Spread Rating: 25 maximum.
 - b. Smoke Developed Rating: 450 maximum.

2.4 ACCESSORIES

- A. Primer: Waterborne primer complying with VOC requirements, recommended air barrier manufacturer to suit application.
- B. Counterflashing Sheet: Modified bituminous, minimum 1.0 mm (40 mils) thick, self-adhering composite sheet consisting of minimum 0.8 mm (33 mils) of rubberized asphalt laminated to polyethylene film.
- C. Substrate Patching Material: Manufacturer's standard trowel-grade filler material.
- D. Sprayed Polyurethane Foam Sealant: Foamed-in-place, 24 to 32 kg/cu. m (1.5 to 2.0 pcf) density, with maximum flame-spread index of 25 when tested according to ASTM E84.
- E. Flexible Opening Transition: Cured low-modulus silicone extrusion with reinforcing ribs, sized to fit opening widths, designed for adhesion to or insertion into aluminum framing extrusions, and compatible with air barrier system materials and accessories.
- F. Joint Sealant: ASTM C920, single-component, neutral-curing silicone; Class 100/50 (low modulus), Grade NS, Use NT related to exposure, approved by membrane air barrier manufacturer for adhesion and compatibility with membrane air barrier and accessories.

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. Correct substrate deficiencies:
 - 1. Remove projections and excess materials and fill voids with substrate patching material.
 - 2. Remove contaminants capable of affecting subsequently installed product's performance.
- D. Prepare and treat substrate joints and cracks according to ASTM C1193 and membrane air barrier manufacturer's instructions.

3.2 INSTALLATION - AIR BARRIER

- 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. Apply primer.

- C. Install transition strips and accessory materials.
- D. Seal air barrier to adjacent components of building air barrier system.
- E. Install flexible opening transition at each opening perimeter. Extend transition onto each substrate minimum 75 mm (3 inches).
 - 1. Fill gaps at perimeter of openings with foam sealant.
- F. At penetrations, seal transition strips around penetrating objects with termination mastic.
 - 1. Fill gaps at perimeter of penetrations with sprayed polyurethane foam sealant.
- G. At top of through-wall flashings, seal with continuous transition strip of manufacturer's recommended material to suit application.
- H. Apply air barrier in full contact with substrate to produce continuous seal with transitions.
- I. Apply fluid membrane in thickness recommended by manufacturer, and minimum specified thickness.
- J. Leave air barrier exposed until tested and inspected and approved by Contracting Officer's Representative.

3.3 FIELD QUALITY CONTROL

- A. Field Inspections and Tests: contractor provided.
 - 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. 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.
- D. Submit inspection and test reports to Contracting Officer's Representative within seven calendar days of completing inspection and test.
- E. Defective Work:
1. Correct deficiencies, make necessary repairs, and retest as required to demonstrate compliance with specified requirements.

3.4 CLEANING

- A. Remove masking materials.
- B. Clean spills and overspray using cleaning agents recommended by manufacturers of affected construction.

3.5 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 31 13
ASPHALT SHINGLES

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies organic felt and fiberglass asphalt shingles over Asphalt-saturated organic felt and/or self-adhering polymer modified bituminous sheets underlayment nailed to roof plywood panels or existing wood board decking.

1.2 RELATED WORK

- A. Color of shingles: AS indicated in part 2.1 SHINGLES and on the Drawings.
- B. Counterflashing and flashing of roof projections: Section 07 60 00, FLASHING AND SHEET METAL.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Samples: Shingles, each type, color and texture.
- C. Sustainable Construction Submittal:
 - 1. Solar Reflectance Index (SEI) for asphalt shingles.
- D. Manufacturer's Literature and Data:
 - 1. Shingles, description of each type
 - 2. Installation instructions
 - 3. Warranty

1.4 DELIVERY AND STORAGE

- A. Deliver materials in manufacturer's unopened bundles or containers with the manufacturer's brand and name clearly marked thereon.
- B. Shingle bundle wrapping shall bear the label of Underwriters Laboratories, Inc.
- C. Store shingles in accordance with manufacturer's printed instructions. Store roll goods on end in an upright position.
- D. Keep materials dry, covered completely, and protected from the weather.

1.5 WARRANTY

- A. Construction Warranty: FAR Clause 52.246-21, "Warranty of Construction."
- B. Manufacturers Warranty: Warrant asphalt shingles against material and manufacturing defects.

1. Material Warranty Period: 25 years
2. Wind-speed Warranty Period: Resist wind speeds up to 120 mph for 15 years.
3. Algae-Resistance Warranty Period: No discoloration for 15 years.

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. American Society for Testing and Materials (ASTM):
 - D226/D226M-17.....Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
 - D1970/D1970M-21 ... Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep roof Underlayment for Ice Dam Protection.
 - D2178/D2178M-15a(2021)..Asphalt Glass Felt used in Roofing and Waterproofing
 - D3018/D3018M-22.....Class A Asphalt Shingles Surfaced with Mineral Granules
 - F1667/F1667M-21a.....Driven Fasteners: Nails, Spikes, and Staples
- C. Underwriter's Laboratories Inc. (UL):
 - UL790-04.....Fire Tests of Roof Covering

PART 2 - PRODUCTS

2.1 SHINGLES

- A. Basis of Design for Building #1001: Match existing adjacent
- B. Basis of Design for Building #3001: Match Existing Adjacent
- C. Class A: (Fire resistive), per UL790. ASTM D3018, Type I and ASTM 3462, square butt for a maximum exposure of 125 mm (5 inches), head lap minimum 50 mm (2 inches), wind resistant, self-sealing. Minimum weight: 10.3 Kg/sqm (210 lbs/100sft).

2.2 ROOFING NAILS

- A. ASTM F1667; Type I, Style 20, galvanized steel, deformed shanks, with heads 9.5 mm to 11 mm (3/8-inch to 7/16-inch) diameter.
- B. Use nails 32 mm (1-1/4 inches) long for shingles and 19 mm (3/4-inch long) for felt.

2.3 ROOFING FELT

- A. Fiberglass Felt: ASTM D2178.
- B. Organic Felt: ASTM D226, TYPE 1.

2.4 ROOF TOP VENTILATION

- A. Ridge Vents, administration building: Manufacturer's standard ridge vent for use under asphalt shingles.
 - 1. Provide ridge vents with internal filters, internal baffles, or external baffles, for weather protection.
 - 2. Free Area: Minimum 25400 square mm per m (12 square inches per foot).
- B. Soffit-less Vents, maintenance building: Basis-of-design Owens Corning VentSure InFlow Vent.
 - 1. Provide vents with internal filters, internal baffles, or external baffles, for weather protection.
 - 2. Free Area: Minimum 21200 square mm per m (10 square inches per foot).

PART 3 EXECUTION

3.1 PREPARATION

- A. Roof surfaces shall be sound, reasonably smooth, and free from defects which would interfere with roofing installation.
- B. Roof accessories, vent pipes and other projections through the roof must be in place and roof flashing installed or ready for installation before laying shingles.

3.2 LAYING

- A. Lay felt under shingles over entire roof.
- B. Install asphalt felt underlayment, lapping a minimum of 100 mm (four inches) at ends, 50 mm (2 inches) at head and 300 mm (12 inches) over ridge. Extend felt 13 mm (1/2-inch) beyond edges of roof. Nail felt 125 mm (five inches) on centers along laps.
- C. At eaves, install strip of 41 Kg (90 pound) mineral surface roll roofing not less than 460 mm (18 inches) wide and starter course of roof shingles with tabs reversed. Both shall overhang lower edge of roof 13 mm (1/2-inch).
- D. Lay shingles with maximum exposure of 125 mm (5 inches). Nail shingles in accordance with manufacturer's published directions.

3.3 METAL DRIP EDGES

- A. At rakes, install metal drip edges made of stainless steel specified under Section 07 60 00, FLASHING AND SHEET METAL. Apply the metal drip edge directly over the underlayment along the rakes.

- B. Secure metal drip edges with compatible nails spaced not more than 250 mm (10 inches) on center along the inner edges.

3.4 FLASHINGS

Provide metal flashings specified under Section 07 60 00, FLASHING AND SHEET METAL at the intersections of roofs, adjoining walls, or projections through the deck such as chimneys and vent stacks. Give careful attention to the installation of all flashings.

3.5 RIDGE

- A. Bend each shingle lengthwise down center to provide equal exposure on each side of ridge. Beginning at one end of ridge, apply shingles with maximum 125 mm (5 inches) exposure.
- B. Secure each shingle with one nail on each side, 210 mm (8-1/2 inches) back from exposed end and one inch up from edge.

3.6 VALLEY FLASHING

- A. Install metal valley flashing shown and as specified under Section 07 60 00, FLASHING AND SHEET METAL.
- B. Secure valley flashing in accordance with shingle manufacturer's printed instructions.
- C. Expose flashing in open portion of valley a minimum of 125 mm (5 inches) and lap the shingles over the flashing a minimum of 125 mm (5 inches).

3.7 ROOF ACCESSORIES (NOT USED)

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SECTION 07 60 00
FLASHING AND SHEET METAL

PART 1 - GENERAL

1.1 DESCRIPTION

A. Formed sheet metal work for facebrick wall and roof flashing, roof edge metal, and drainage specialties, are specified in this section. Existing gutter and downspouts system to remain at areas of existing roofing to remain and modified as required adjacent re-roofed and new roofed areas.

1.2 RELATED WORK

- A. Joint Sealants: Section 07 92 00, JOINT SEALANTS.
- B. asphalt shingles: Section 07 51 13 ASPHALT SHINGLES.
- C. through wall flashing: Section 04 20 00 UNIT MASONRY.
- D. Color of factory coated exterior architectural metal : AS indicted on the drawings .

1.3 APPLICABLE PUBLICATIONS

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

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 Architectural Manufacturers Association (AAMA):

AAMA 620 High Performance Organic Coatings on Coil Coated Architectural Aluminum

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AAMA 621

High Performance Organic Coatings on Coil
Coated Architectural Hot Dipped Galvanized
(HDG) and Zinc-Aluminum Coated Steel Substrates

D. American National Standards Institute/Single-Ply Roofing Institute
(ANSI/SPRI):

ANSI/SPRI ES-1-03

Wind Design Standard for Edge Systems Used with
Low Slope Roofing Systems

E. ASTM International (ASTM):

A653/A653M-20

Steel Sheet Zinc-Coated (Galvanized) or Zinc-
Iron Alloy-Coated (Galvannealed) by the Hot-Dip
Process

B32-20

Solder Metal

B209/B209M-21a

Aluminum and Aluminum-Alloy Sheet and Plate

B370-22

Copper Sheet and Strip for Building
Construction

D173/D173M-03(2018)

Bitumen-Saturated Cotton Fabrics Used in
Roofing and Waterproofing

D412-16(2021)

Vulcanized Rubber and Thermoplastic Elastomers-
Tension

D1187/D1187M-97(2018)

Asphalt-Base Emulsions for Use as Protective
Coatings for Metal

D3656/D3656M-13(2021)

Insect Screening and Louver Cloth Woven from
Vinyl-Coated Glass Yarns

D4586/D4586M-07(2018)

Asphalt Roof Cement, Asbestos Free

F. FM Approvals: RoofNav Approved Roofing Assemblies and Products:

1-49-09

Loss Prevention Data Sheet: Perimeter Flashing

G. International Code Commission (ICC):

International Building Code, Current Edition

H. National Association of Architectural Metal Manufacturers (NAAMM):

AMP 500-06

Metal Finishes Manual

I. Sheet Metal and Air Conditioning Contractors National Association

(SMACNA): Architectural Sheet Metal Manual 2012

1.4 PERFORMANCE REQUIREMENTS

4. Wind Zone 3: 2.20 to 4.98 kPa (46 to 104 lbf/sq. ft.): 9.96-kPa
(208-lbf/sq. ft.) perimeter uplift force, 14.94-kPa (312-lbf/sq.
ft.) corner uplift force, and 4.98-kPa (104-lbf/sq. ft.) outward
force.

- B. Wind Design Standard: Fabricate and install roof-edge flashings tested per ANSI/SPRI ES-1 to resist design pressure indicated on Drawings.

1.5 SUSTAINABILITY REQUIREMENTS

- A. Materials in this section may contribute towards contract compliance with sustainability requirements. See Section 01 81 11, SUSTAINABLE DESIGN REQUIRMENTS, for project local/regional materials, recycled content requirements.

1.6 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. Gutter and Conductors.
- C. Manufacturer's Literature and Data: For all specified items, including:
 - 1. Two-piece counterflashing.
 - 2. Thru wall flashing.
 - 3. Non-reinforced, elastomeric sheeting.
 - 4. Copper clad stainless steel.
- D. Certificates: Indicating compliance with specified finishing requirements, from applicator and contractor.

1.7 PRE-INSTALLATION CONFERENCE

- A. Convene a meeting on site, after submittals are received and approved but before any work, to review drawings and specifications, submittals, schedule, manufacturer instructions, site logistics and pertinent matters of coordination, temporary protection, governing regulations, tests and inspections; participants to include PM and all parties whose work is affected or related to the work of this section.

PART 2 - PRODUCTS

2.1 FLASHING AND SHEET METAL MATERIALS

- A. Stainless Steel: ASTM A167, Type 302B, dead soft temper.
- B. Aluminum Sheet: ASTM B209, Alloy 3003-H14 //except alloy used for color anodized aluminum to be as required to produce specified color. Alloy required to produce specified color must have the same structural properties as Alloy 3003-H14.
- C. Galvanized Sheet: ASTM A653.

D. Non-reinforced, Elastomeric Sheeting: Elastomeric substances reduced to thermoplastic state and extruded into continuous homogenous sheet (0.056 inch) thick.

1. Tensile Strength: Minimum 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.
2. 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: Sheathing paper, weighing minimum 141 g m² (3 lbs/100 sf).

C. Bituminous Paint: ASTM D1187, Type I.

D. Fasteners:

1. Use copper, copper alloy, bronze, brass, or stainless steel for copper and copper clad stainless steel, and 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.

E. Sealant: As specified in Section 07 92 00, JOINT SEALANTS for exterior locations.

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. Copper: 30g (10 oz) minimum 0.33 mm (0.013 inch thick).
2. Stainless steel: 0.25 mm (0.010 inch) thick.

3. Copper clad stainless steel: 0.25 mm (0.010 inch) thick.

4. Galvanized steel: 0.5 mm (0.021 inch) thick.

C. Exposed Locations:

1. Copper: 0.4 Kg (16 oz).

2. Stainless steel: 0.4 mm (0.015 inch).

3. Copper clad 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. Lock and solder copper, stainless steel and copper clad stainless steel joints, except expansion and contraction joints.

2. Jointing of copper over 0.5 Kg (20 oz) weight or stainless steel over 0.45 mm (0.018 inch) thick to be done by lapping, riveting and soldering.

3. Provide joints conforming to following requirements:

a. Finish flat-lock joints not less than 19 mm (3/4 inch) wide.

b. Finish lap joints subject to stress not less than 25 mm (one inch) wide; soldered and riveted.

c. Finish unsoldered lap joints not less than 100 mm (4 inches) wide.

4. Make flat and lap joints in direction of flow.

5. Edges of bituminous coated copper, non-reinforced elastomeric sheeting and polyethylene coated copper to 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.

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.
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.

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. Turn up edges of flashings concealed in masonry joints and opposite drain side 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 must meet requirements of IBC, current edition.

G. Metal Options:

1. Where options are permitted for different metals use only one metal throughout.
2. Stainless steel may be used in concealed locations for fasteners of other metals exposed to view.

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.

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. Use copper, stainless steel, or copper clad 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.
- E. Windowsill Flashing and Lintel Flashing:
 1. Use copper, stainless steel, copper clad stainless steel plane flat sheet, or non-reinforced elastomeric sheeting, bituminous coated copper, copper covered paper, or polyethylene coated copper.

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 Kg (20 oz) copper, 0.5 mm (0.018 inch) thick stainless steel, or 0.5 mm (0.018 inch) thick copper clad stainless steel.
2. Where shown on drawings as combined counter flashing under threshold, sill plate, door sill, or where subject to foot traffic, use 0.6 Kg (24 ounce) copper, 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 COUNTERFLASHING (CAP FLASHING OR HOODS) (NOT USED)

2.8 HANGING GUTTERS

A. Fabricate gutters of not less than the following:

1. 0.8 mm (0.032 inch) thick aluminum.

B. Fabricate hanging gutters in sections not less than 2400 mm (8 feet) long, except at ends of runs where shorter lengths are required.

C. Provide building side of gutter not less than 38 mm (1 1/2 inches) higher than exterior side.

D. Gutter Bead: Stiffen outer edge of gutter by folding edge over approximately 19 mm (3/4 inch) toward roof and down approximately 19 mm (3/4 inch) unless shown otherwise.

E. Gutter Spacers:

1. Fabricate of same material and thickness as gutter.
2. Fabricate 25 mm (one inch) wide strap and fasten to gutters not over 900 mm (36 inches) on center.
3. Turn back edge up 25 mm (one inch) and lap front edge over gutter bead.
4. Rivet and solder to gutter except rivet and seal to aluminum.

F. Outlet Tubes:

1. Form outlet tubes to connect gutters to conductors of same metal and thickness as gutters extend into the conductor 75 mm (3 inch).
Flange upper end of outlet tube 13 mm (1/2 inch).

2. Lock and solder longitudinal seam except use sealant instead of solder with aluminum.
3. Seal aluminum tube to gutter and rivet to gutter.
4. Fabricate basket strainers of same material as gutters.

G. Gutter Brackets:

1. Fabricate of same metal as gutter. Use the following:
 - a. 6 by 25 mm (1/4 by 1 inch aluminum).
2. Fabricate to gutter profile.
3. Drill two 5 mm (3/16 inch) diameter holes in anchor leg for countersunk flat head screws.

2.9 CONDUCTORS (DOWNSPOUTS)

- A. Fabricate conductors of same metal and thickness as gutters 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 instead 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 (1 inch) minimum width. Form to support conductors 25 mm (one inch) from wall surface in accordance with Architectural Sheet Metal Manual Plate 34, Design C for rectangular shapes and E for round shapes.

2.10 REGLETS (NOT USED)

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. Anchor sheet metal flashing and trim and other components of the work securely in place with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants and other miscellaneous items as required, to complete flashing and trim assemblies.
 3. Apply Sealant as specified in Section 07 92 00, JOINT SEALANTS.

4. Apply sheet metal and other flashing material to surfaces which are smooth, sound, clean, dry and free from defects that might affect the application.
5. 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.
6. 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.
7. 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.
8. Confine direct nailing of sheet metal to strips 300 mm (12 inch) or less wide. Nail flashing along one edge only. Space nails not over 100 mm (4 inches) on center unless specified otherwise.
9. 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.
10. Coordinate with roofing work for the installation of metal base flashings and other metal items having roof flanges for anchorage and watertight installation.
11. Nail continuous cleats on 75 mm (3 inch) on centers in two rows in a staggered position.
12. Nail individual cleats with two nails and bend end tab over nail heads. Lock other end of cleat into hemmed edge.
13. Install flashings in conjunction with other trades so that flashings are inserted in other materials and joined together to provide a watertight installation.
14. 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.

15. 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.
16. Paint aluminum in contact with or built into mortar, concrete, plaster, or other masonry materials with a coat of bituminous paint.
17. Paint aluminum in contact with absorptive materials that may become repeatedly wet with two coats of bituminous paint or two coats of aluminum paint.

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 a 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.
- 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. Windowsill 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.

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) (NOT USED)

3.5 REGLETS (NOT USED)

3.6 HANGING GUTTERS

- A. Hang gutters with high points equidistant from downspouts. Slope at not less than 1:200 (1/16 inch per foot).
- B. Lap joints, except for expansion joints, at least 25 mm (one inch) in the direction of flow. Rivet and seal or solder lapped joints.
- C. Support gutters in brackets spaced not more than 600 mm (24 inch) on centers, brackets attached to facial or wood nailer by at least two screws or nails.
 - 1. For copper or copper clad stainless-steel gutters use brass or bronze brackets.
 - 2. For stainless steel gutters use stainless steel brackets.
 - 3. For aluminum gutters use aluminum brackets or stainless-steel brackets.

4. Use brass or stainless-steel screws.
- D. Secure brackets to gutters in such a manner as to allow free movement of gutter due to expansion and contraction.
 1. Secure loose end of cover plate to gutter section on other side of expansion joint by a loose-locked slip joint.
- F. Outlet Tubes: Set bracket strainers loosely into gutter outlet tubes.

- - - E N D - - -

**SECTION 07 72 33
ROOF ACCESSORIES**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work Included: Provide factory-fabricated roof hatch for mechanical access in attics.

1.2 RELATED WORK

- A. Color and texture of finish: Factory finish shall be mill finish aluminum.
- B. Sealant material and installation: Section 07 92 00, JOINT SEALANTS.
- C. General insulation: Section 07 21 13, THERMAL INSULATION.

1.3 QUALITY CONTROL

- A. All roof accessories to be the products of manufacturers regularly engaged in producing the kinds of products specified.
- B. Each accessory type to be the same and be made by the same manufacturer.
- C. Assemble each accessory to the greatest extent possible before delivery to the site.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Shop Drawings: Indicate each item specified showing design, details of construction, installation and fastenings.
- D. Manufacturer's Literature and Data: Provide for each item specified.

1.5 PRE-INSTALLATION CONFERENCE

- A. Convene a meeting on site, after submittals are received and approved but before any work, to review drawings and specifications, submittals, schedule, manufacturer instructions, site logistics and pertinent matters of coordination, temporary protection, governing regulations, tests and inspections; participants to include PM and all parties whose work is effected or related to the work of this section.

1.6 APPLICABLE PUBLICATIONS

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

SPEC WRITER NOTES:

- B. American Architectural Manufacturers Association (AAMA):
2605-11 High Performance Organic Coatings on
Architectural Extrusions and Panels
- C. American Society for Testing and Material (ASTM):
A653/A653M-20 Steel Sheet, Zinc-Coated (Galvanized) or Zinc-
Iron Alloy-Coated (Galvannealed) By the Hot-Dip
Process
B209/B209M-21a Aluminum and Aluminum Alloy-Sheet and Plate
B221-21 Aluminum-Alloy Extruded Bars, Rods, Wire,
Profiles, and Tubes
- D. National Association of Architectural Metal Manufacturers (NAAMM):
AMP 500 Series Metal Finishes Manual
MGB 531 Metal Bar Grating Manual

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. BASIS-OF-DESIGN MANUFACTURER: Type S-50TB Roof Hatch by The BILCO
Company, P.O. Box 1203, New Haven, CT 06505, 1-800-366-6530, Web:
www.BILCO.com.

2.2 MATERIALS

- A. Aluminum, Extruded: ASTM B221M (B221).
B. Aluminum Sheet: ASTM B209M (B209).
C. Recycled Content of Metal Products: Postconsumer recycled content plus
one-half of preconsumer recycled content not less than 30 percent.

2.3 ROOF HATCH (SCUTTLE)

- A. Furnish and install where indicated on plans OSHA compliant metal roof
hatch Type S-50TB, size width: 37" (914mm) x length: 30" (762mm).
Length denotes hinge side. The roof hatch shall be single leaf. The
roof hatch shall be pre-assembled from the manufacturer.
- B. Performance Characteristics
1. Cover and curb shall be thermally broken to prevent heat transfer
between interior and exterior/attic surfaces.
 2. Cover shall be reinforced to support a minimum live load of 40 psf
(195kg/m²) with a maximum deflection of 1/150th of the span or 20
psf (97kg/m²) wind uplift.
 3. Operation of the cover shall be smooth and easy with controlled
operation throughout the entire arc of opening and closing.
 4. Operation of the cover shall not be affected by temperature.

5. Entire hatch shall be weather tight with fully welded corner joints on cover and curb.
- C. Cover: Shall be 11 gauge (2.3mm) aluminum with a 5" (127mm) beaded flange with formed reinforcing members. Interior and exterior surfaces shall be thermally broken to minimize heat transfer and to resist condensation. Cover shall have a heavy extruded EPDM rubber gasket bonded to the cover interior to assure a continuous seal when compressed to the top surface of the curb.
- D. Cover insulation: Shall be 3" (75mm) thick polyisocyanurate with an R-value = 20.3 (U=0.279 W/m²K), fully covered and protected by an 18 gauge (1mm) aluminum liner.
- E. Curb: Shall be 12" (305mm) in height and of 11 gauge (2.3mm) aluminum. Interior and exterior surfaces shall be thermally broken to minimize heat transfer and to resist condensation. The curb shall be formed with a 5-1/2" (140mm) flange with 7/16" (11mm) holes provided for securing to the roof deck. The curb shall be equipped with an integral metal cap flashing of the same gauge and material as the curb, fully welded at the corners, that features the Bil-Clip® flashing system, including stamped tabs, 6" (153mm) on center, to be bent inward to hold single ply roofing membrane securely in place.
- F. Curb insulation: Shall be 3" (75mm) thick polyisocyanurate with an R-value = 20.3 (U=0.279 W/m²K).
- G. Lifting mechanisms: Manufacturer shall provide compression spring operators enclosed in telescopic tubes to provide, smooth, easy, and controlled cover operation throughout the entire arc of opening and closing. The upper tube shall be the outer tube to prevent accumulation of moisture, grit, and debris inside the lower tube assembly. The lower tube shall interlock with a flanged support shoe welded to the curb assembly.
- H. Hardware:
1. Heavy stainless steel pintle hinges shall be provided
 2. Cover shall be equipped with a spring latch with interior and exterior turn handles
 3. Roof hatch shall be equipped with interior and exterior padlock hasps.
 4. The latch strike shall be a stamped component bolted to the curb assembly.

5. Cover shall automatically lock in the open position with a rigid hold open arm equipped with a 1" (25mm) diameter red vinyl grip handle to permit easy release for closing.
6. All hardware shall be zinc plated and chromate sealed. [For installation in highly corrosive environments or when prolonged exposure to hot water or steam is anticipated, specify Type 316 stainless steel hardware].
7. Cover hardware shall be bolted into heavy gauge channel reinforcing welded to the underside of the cover and concealed within the insulation space.

I. Finishes: Factory finish shall be mill finish aluminum.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and openings for compliance with requirements for installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install roof hatch where indicated on drawings.
- B. Secure with fasteners in accordance with manufacture's printed installation instructions and approved shop drawings unless shown otherwise.
- C. Coordinate to install insulation where shown; see Section 07 21 13, THERMAL INSULATION.
- D. Comply with section 07 92 00, JOINT SEALANTS to install sealants where manufactures installation instructions require sealant.
- E. Install products in strict accordance with manufacturer's instructions and approved submittals. Locate units' level, plumb, and in proper alignment with adjacent work.
 1. Test units for proper function and adjust until proper operation is achieved.
 2. Repair finishes damaged during installation.
 3. Restore finishes so no evidence remains of corrective work.

3.3 ADJUSTING AND CLEANING

- A. Adjust roof hatch hardware to operate freely and so that cover will operate without binding, close tightly at perimeter, and latch securely.

Black Hills National Cemetery
/Renovate and Expand Administration and Maintenance Buildings
20901 Pleasant Valley Drive
Sturgis, SD 57785

NCA Project #884CM3015
10/31/22
BID DOCUMENTS

- B. Clean exposed surfaces using methods acceptable to the manufacturer which will not damage finish.

3.4 PROTECTION

- A. Protect roof accessories from damage during installation and after completion of the work from subsequent construction.

- - - E N D - - -

SECTION 07 84 00
FIRESTOPPING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Tested and listed firestopping systems, combination of materials, or devices to form an effective barrier against the spread of flame, smoke and gases, and maintain the integrity of fire resistance rated walls, partitions, floors, and ceiling-floor assemblies, including through-penetrations and construction joints and gaps.
 - 1. Through-penetrations include the annular space around pipes, tubes, conduit, wires, cables and vents.
 - 2. Gaps requiring firestopping include gaps between the top of the fire-rated walls and the roof or floor deck above and at the intersection of shaft assemblies and adjoining fire resistance rated assemblies.
- B. Closure of openings in walls against penetration of gases or smoke in smoke partitions.

1.2 RELATED WORK

- A. Sealants and application: Section 07 92 00, JOINT SEALANTS.
- D. Fire and smoke damper assemblies in ductwork: Section 23 31 00, HVAC DUCTS AND CASINGS Section 23 37 00, AIR OUTLETS AND INLETS.

1.3 SUSTAINABILITY REQUIREMENTS

- A. Materials in this section may contribute towards contract compliance with sustainability requirements. See Section 01 81 11, SUSTAINABLE DESIGN REQUIRMENTS, for project local/regional materials, low-emitting materials, requirements.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Submit detail drawings including manufacturer's descriptive data, typical details conforming to UL Fire Resistance or other details certified by another nationally recognized testing laboratory, installation instructions or UL listing details for a firestopping assembly instead of fire-test data or report. For those firestop applications for which no UL tested system is available through a manufacturer, submit a manufacturer's engineering judgment, derived from similar UL system designs or other tests, for review and approval

prior to installation. Submittal must indicate the firestopping material to be provided for each type of application; when more than a total of 5 penetrations and/or construction joints are to receive firestopping, provide drawings that indicate location, "F", "T" and "L" ratings, and type of application.

- C. Submit certificates attesting that firestopping material complies with the specified requirements. For all intumescent firestop materials used in through penetration systems, manufacturer must provide certification from UL of passing the "Aging and Environmental Exposure Testing" portion of UL 1479.
- D. Submit manufacturer's representative certification stating that firestopping work has been inspected and found to be applied according to the manufacturer's recommendations and the specified requirements. Manufacturer's representative must be a direct employee of the manufacturer (not a distributor or an agent) and be qualified to perform the specified inspections and certify the firestopping installation.

1.5 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.

1.6 WARRANTY

- A. Firestopping work subject to the terms of the Article "Warranty of Construction", FAR clause 52.246-21, except extend the warranty period to five years.

1.7 QUALITY ASSURANCE

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

1.8 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by the basic designation only. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
- B. American Society for Testing and Materials (ASTM):
E84-22 Surface Burning Characteristics of Building Materials

| | |
|----------------|---|
| E814-13a(2017) | Fire Tests of Penetration Firestop Systems |
| E2174-20a | On-Site Inspection of Installed Fire Stops |
| E2393-20a | On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers |

C. FM Global (FM):

| | |
|--------------|-----------------------------------|
| Annual Issue | Approval Guide Building Materials |
|--------------|-----------------------------------|

D. Underwriters Laboratories, Inc. (UL):

| | |
|--------------|---|
| Annual Issue | Building Materials Directory |
| Annual Issue | Fire Resistance Directory |
| 1479 | Fire Tests of Through-Penetration Firestops |

E. Warnock Hersey (WH):

| | |
|--------------|------------------------|
| Annual Issue | Certification Listings |
|--------------|------------------------|

1.9 SEQUENCING

- A. Coordinate the specified work with other trades.
- B. Apply firestopping materials, at penetrations of pipes and ducts, prior to insulating, unless insulation meets requirements specified for firestopping.
- C. Apply firestopping materials at building joints and construction gaps, prior to completion of enclosing walls or assemblies.
- D. Locate and install cast-in-place firestop devices in place before concrete placement. Install pipe, conduit or cable bundles through cast-in-place device after concrete placement but before area is concealed or made inaccessible.
- E. Inspect and receive approval for firestop material prior to final completion and enclosing of any assemblies that may conceal installed firestop.

PART 2 - PRODUCTS

2.1 FIRESTOP SYSTEMS

- A. Use 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.
- B. Through-penetration firestop systems and firestop devices tested in accordance with ASTM E814 or UL 1479 using the "F" or "T" rating must maintain the same rating and integrity as the fire barrier being sealed. "T" ratings are not required for penetrations smaller than or

equal to 100 mm (4 in) nominal pipe or 0.01 m² (16 sq. in.) in overall cross-sectional area.

- C. Products requiring heat activation that seal an opening by its intumescence must exhibit a demonstrated ability to function as designed to maintain the fire barrier.
- D. Provide firestop sealants used for firestopping or smoke sealing with the following properties:
 - 1. Contain no flammable or toxic solvents.
 - 2. Have 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 used in exposed areas, firestop sealant can be sanded and finished with similar surface treatments as used on the surrounding wall or floor surface.
- E. Provide firestopping system or devices used for penetrations by glass pipe, plastic pipe or conduits, unenclosed cables, or other non-metallic materials with following properties:
 - 1. Classified for use with the 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.
 - 3. Intumescent products which would expand to seal the opening and act as fire, smoke, toxic fumes, and water sealant.
- F. Provide products with maximum flame spread of 25 and smoke development of 50 when tested in accordance with ASTM E84.
- G. Provide products FM, UL, or WH rated or tested by an approved laboratory in accordance with ASTM E814.
- H. Materials must be asbestos free.

2.2 SMOKE STOPPING IN SMOKE PARTITIONS

- A. Use silicone sealant in smoke partitions as specified in Section 07 92 00, JOINT SEALANTS.
- B. Use mineral fiber filler and bond breaker behind sealant.
- C. Sealants must have a maximum flame spread of 25 and smoke developed of 50 when tested in accordance with 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.

3.2 PREPARATION

- A. Remove dirt, grease, oil, 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 150 mm (6 inches) on either 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.

3.3 INSTALLATION

- A. Do not begin 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 INSPECTIONS

- A. Manufacturer's technical representative to inspect all firestopping in accordance with ASTM standards for firestop inspection, and document inspection results; ASTM E2174 and E2393.

3.5 CLEAN-UP AND ACCEPTANCE OF WORK

- A. As work on each floor is completed, remove materials, litter, and debris.
- B. Do not move materials and equipment to the next-scheduled work area until completed work is inspected and accepted by the PM; PM inspection does not supersede requirement for inspection by manufacturer's representative or requirements of local jurisdiction.
- C. Clean up spills of liquid type materials.

- - - E N D - - -

SECTION 07 92 00
JOINT SEALANTS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Section covers all sealant and caulking materials and their application, wherever required for complete installation of building materials or systems.

1.2 RELATED WORK

- A. Sealing of site work concrete paving: Section 32 05 23, CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS.
- B. Masonry control and expansion joint: Section 04 20 00, UNIT MASONRY.
- C. Sealing joints in cast stone: Section 04 72 00, CAST STONE MASONRY.
- D. Firestopping penetrations: Section 07 84 00, FIRESTOPPING.
- F. Glazing: Section 08 80 00, GLAZING.
- G. Sound rated gypsum partitions/sound sealants: Section 09 29 00, GYPSUM BOARD.
- H. Mechanical Work: Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING
Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

1.3 QUALITY CONTROL

- A. Installer Qualifications: An experienced installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance.
- B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.
- C. Product Testing: Obtain test results from a qualified testing agency based on testing current sealant formulations within a 12-month period.
 - 1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021.
 - 2. Test elastomeric joint sealants for compliance with requirements specified by reference to ASTM C920, and where applicable, to other standard test methods.
 - 4. Determine sealants will not stain joint substrates according to ASTM C1248.

- D. Preconstruction Field-Adhesion Testing: Before installing elastomeric sealants, field test their adhesion to joint substrates in accordance with sealant manufacturer's recommendations:
1. Locate test joints where indicated or, if not indicated, as directed by Contracting Officer.
 2. Conduct field tests for each application indicated below:
 - a. Each type of elastomeric sealant and joint substrate indicated.
 - b. Each type of non-elastomeric sealant and joint substrate indicated.
 3. Notify PM seven days in advance of dates and times when test joints will be erected.
- E. Meet VOC requirements of pertinent CARB and/or SCAQMD Rule for sealants VOC (4 percent by weight VOC or less in less than 16 ounce package or less than 250 g/L in larger package). All non-porous sealant primers must be below 250g/L and primers for porous substrates less than 775 g/L.
- F. Mockups: Before installing joint sealants, apply elastomeric sealants as follows to verify selections made under sample submittals and to demonstrate aesthetic effects and qualities of materials and execution:
1. Joints in mockups of assemblies specified in other sections, that are indicated to receive elastomeric joint sealants, which are specified by reference to this section.

1.4 SUSTAINABILITY REQUIREMENTS

- A. Materials in this section may contribute towards contract compliance with sustainability requirements

1.5 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's installation instructions for each product used.
- C. Cured samples of exposed sealants for each color where required to match adjacent material.
- D. Manufacturer's Literature and Data:
 1. Caulking compound.
 2. Primers.
 3. Sealing compound, each type, including compatibility when different sealants are in contact with each other.

1.6 PRE-INSTALLATION CONFERENCE

- A. Convene a meeting on site, after submittals are received and approved but before any work, to review drawings and specifications, submittals, schedule, manufacturer instructions, site logistics and pertinent matters of coordination, temporary protection, governing regulations, tests and inspections; participants to include PM and all parties whose work is affected or related to the work of this section.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations:
 1. Do not proceed with installation of joint sealants under following conditions:
 - a. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 4.4 °C (40 °F).
 - b. When joint substrates are wet.
- B. Joint-Width Conditions: 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: Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

1.8 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 less than 5° C (40° F) or exceeding 32° C (90° F).

1.9 DEFINITIONS

- A. Definitions of terms in accordance with ASTM C717 and as specified.
- B. Back-up Rod: A type of sealant backing.
- C. Bond Breakers: A type of sealant backing.
- D. Filler: A sealant backing used behind a back-up rod.

1.10 WARRANTY

- A. Warranty exterior sealing against leaks, adhesion, and cohesive failure, and subject to terms of "Warranty of Construction", FAR clause

52.246-21, except that warranty period to be extended to five (5) years.

- B. General Warranty: Special warranty specified in this Article will not deprive Government of other rights Government may have under other provisions of Contract Documents and are in addition to, and run concurrent with, other warranties made by Contractor under requirements of Contract Documents.

1.11 APPLICABLE PUBLICATIONS

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

- B. American Society for Testing and Materials (ASTM):

| | |
|----------------|---|
| C612-14(2019) | Mineral Fiber Block and Board Thermal Insulation |
| C717-19 | Standard Terminology of Building Seals and Sealants |
| C734-15(2019) | Low Temperature Flexibility of Latex Sealants after Artificial Weathering |
| C834-17 | Latex Sealants |
| C919-22 | Use of Sealants in Acoustical Applications |
| C920-18 | Elastomeric Joint Sealants |
| C1021-08(2019) | Laboratories Engaged in Testing of Building Sealants |
| C1193-16 | Use of Joint Sealants |
| C1248-22 | Staining of Porous Substrate by Joint Sealants |
| C1330-18 | Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants |
| D217-21a | Cone Penetration of Lubricating Grease |
| D1056-20 | Flexible Cellular Materials—Sponge or Expanded Rubber |
| E84-22 | Surface Burning Characteristics of Building Materials |

- C. California Air Resources Board (CARB)

- D. South Coast Air Quality Management District (SCAQMD)

- E. Sealant, Waterproofing and Restoration Institute (SWRI):
The Professionals' Guide

PART 2 - PRODUCTS

2.1 SEALANTS

A. S-1:

1. ASTM C920, polyurethane.
2. Type M.
3. Class 25.
4. Grade NS.
5. Shore A hardness of 20-40.

B. S-2:

1. ASTM C920, polyurethane.
2. Type M.
3. Class 25.
4. Grade P.
5. Shore A hardness of 25-40.

C. S-3:

1. ASTM C920, polyurethane.
2. Type S.
3. Class 25, joint movement range of plus or minus 50 percent.
4. Grade NS.
5. Shore A hardness of 15-25.
6. Minimum elongation of 700 percent.

D. S-4:

1. ASTM C920 polyurethane.
2. Type S.
3. Class 25.
4. Grade NS.
5. Shore A hardness of 25-40.

E. S-5:

1. ASTM C920, polyurethane.
2. Type S.
3. Class 25.
4. Grade P.
5. Shore hardness of 15-45.

F. S-6:

1. ASTM C920, silicone, neutral cure.
2. Type S.
3. Class: Joint movement range of plus 100 percent to minus 50 percent.

4. Grade NS.

5. Shore A hardness of 15-20.

G. S-7:

1. ASTM C920, silicone, neutral cure.

2. Type S.

3. Class 25.

4. Grade NS.

5. Shore A hardness of 25-30.

6. Structural glazing application.

H. S-8:

1. ASTM C920, silicone, acetoxy cure.

2. Type S.

3. Class 25.

4. Grade NS.

5. Shore A hardness of 25-30.

6. Structural glazing application.

I. S-9:

1. ASTM C920 silicone.

2. Type S.

3. Class 25.

4. Grade NS.

5. Shore A hardness of 25-30.

6. Non-yellowing, mildew resistant.

J. S-10:

1. ASTM C920, coal tar extended fuel resistance polyurethane.

2. Type M/S.

3. Class 25.

4. Grade P/NS.

5. Shore A hardness of 15-20.

K. S-11:

1. ASTM C920 polyurethane.

2. Type M/S.

3. Class 25.

4. Grade P/NS.

5. Shore A hardness of 35 to 50.

L. S-12:

1. ASTM C920, polyurethane.

2. Type M/S.
3. Class 25, joint movement range of plus or minus 50 percent.
4. Grade P/NS.
5. Shore A hardness of 25 to 50.

2.2 CAULKING COMPOUND

- A. C-1: ASTM C834, acrylic latex.
- B. C-2: Polymer-based acoustical sealant conforming to ASTM C919 must have a flame spread of 25 or less and a smoke developed rating of 50 or less when tested in accordance with ASTM E84. Acoustical sealant must have a consistency of 250 to 310 when tested in accordance with ASTM D217, and must remain flexible and adhesive after 500 hours of accelerated weathering as specified in ASTM C734, and must be non-staining.

2.3 COLOR

- A. Match color of mortar joints at exposed masonry.
- B. Match color of adjacent concrete at unpainted concrete.
- C. Provide light gray or aluminum, unless specified otherwise, for other locations.
- D. Provide light gray or white caulking, unless specified otherwise.

2.4 JOINT SEALANT BACKING

- A. General: Provide sealant backings of material and type that are non-staining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C1330, of type indicated below and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
 1. Type C: Closed-cell material with a surface skin.
- C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 32° C (minus 26° F). Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and otherwise contribute to optimum sealant performance.
- D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint

where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.5 FILLER

- A. Mineral fiber board: ASTM C612, Type IVA.
- B. Thickness same as joint width.
- C. Depth to fill void completely behind back-up rod.

2.6 PRIMER

- A. As recommended by manufacturer of caulking or sealant material.
- B. Stain free type.

2.7 CLEANERS-NON POUROUS SURFACES

- A. Chemical cleaners acceptable to manufacturer of sealants and sealant backing material, free of oily residues and other substances capable of staining or harming joint substrates and adjacent non-porous surfaces and formulated to promote adhesion of sealant and substrates.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Inspect substrate surface for bond breaker contamination and unsound materials at adherent faces of sealant.
- B. Coordinate for repair and resolution of unsound substrate materials.
- C. Inspect for uniform joint widths and that dimensions are within tolerance established by sealant manufacturer.

3.2 PREPARATIONS

- A. Prepare joints in accordance with manufacturer's instructions and as specified only when installers are ready to initiate sealant application as soon as practicable after preparation and before subsequent surface deterioration.
- B. Clean surfaces of joint to receive caulking or sealants leaving joint dry to the touch, free from frost, moisture, grease, oil, wax, lacquer paint, or other foreign matter that would tend to destroy or impair adhesion.
 - 1. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants.
 - 2. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air. Porous joint surfaces include the following:

- a. Concrete.
 - b. Masonry.
 - c. Unglazed surfaces of ceramic tile.
3. Remove laitance and form-release agents from concrete.
 4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
 - a. Metal.
 - b. Glass.
 - c. Porcelain enamel.
 - d. Glazed surfaces of ceramic tile.
- C. Do not cut or damage joint edges.
- D. Apply masking tape to face of surfaces adjacent to joints before applying primers, caulking, or sealing compounds.
 1. Do not leave gaps between ends of sealant backings.
 2. Do not stretch, twist, puncture, or tear sealant backings.
 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- E. Apply primer to sides of joints wherever required by compound manufacturer's printed instructions.
 1. Apply primer prior to installation of back-up rod or bond breaker tape.
 2. Use brush or other approved means that will reach all parts of joints.
- F. Take all necessary steps to prevent three sided adhesion of sealants.

3.3 BACKING INSTALLATION

- A. Install back-up material, to form joints enclosed on three sides as required for specified depth of sealant.
- B. Where deep joints occur, install filler to fill space behind the back-up rod and position the rod at proper depth.
- C. Cut fillers installed by others to proper depth for installation of back-up rod and sealants.
- D. Install back-up rod, without puncturing the material, to a uniform depth, within plus or minus 3 mm (1/8 inch) for sealant depths specified.

- E. Where space for back-up rod does not exist, install bond breaker tape strip at bottom (or back) of joint so sealant bonds only to two opposing surfaces.
- F. Take all necessary steps to prevent three-sided adhesion of sealants.

3.4 SEALANT DEPTHS AND GEOMETRY

- A. At widths up to 6 mm (1/4 inch), sealant depth equal to width.
- B. At widths over 6 mm (1/4 inch), sealant depth 1/2 of width up to 13 mm (1/2 inch) maximum depth at center of joint with sealant thickness at center of joint approximately 1/2 of depth at adhesion surface.

3.5 INSTALLATION

- A. General:
 - 1. Comply with manufacturer's written installation instructions for products and applications indicated.
- B. For application of sealants, follow requirements of ASTM C1193 unless specified otherwise.
- C. Where gypsum board partitions are of sound rated, fire rated, or smoke barrier construction, follow requirements of ASTM C919 only to seal all cut-outs and intersections with the adjoining construction unless specified otherwise.
 - 1. Apply a 6 mm (1/4 inch) minimum bead of sealant each side of runners (tracks), including those used at partition intersections with dissimilar wall construction.
 - 2. Coordinate with application of gypsum board to install sealant immediately prior to application of gypsum board.
 - 3. Partition intersections: Seal edges of face layer of gypsum board abutting intersecting partitions, before taping and finishing or application of veneer plaster-joint reinforcing.
 - 4. Openings: Apply a 6 mm (1/4 inch) bead of sealant around all cut-outs to seal openings of electrical boxes, ducts, pipes and similar penetrations. To seal electrical boxes, seal sides and backs.
 - 5. Control Joints: Before control joints are installed, apply sealant in back of control joint to reduce flanking path for sound through control joint.

3.6 CLEANING

- A. Fresh compound accidentally smeared on adjoining surfaces: Scrape off immediately and rub clean with a solvent as recommended by the caulking or sealant manufacturer.

- B. After filling and finishing joints, remove masking tape.
- C. Leave adjacent surfaces in a clean and unstained condition.

3.7 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.8 LOCATIONS

- A. Exterior Building Joints, Horizontal and Vertical:
 - 1. Metal to Metal: Type S-6, S-7.
 - 2. Metal to Masonry or Cast Stone: Type S-1.
 - 3. Masonry to Masonry or Cast Stone: Type S-1.
 - 6. Threshold Setting Bed: Type S-1, S-3, S-4.
 - 7. Masonry Expansion and Control Joints: Type S-6.
 - 8. Wood to Masonry: Type S-1.
- B. Sanitary Joints:
 - 1. Walls to Plumbing Fixtures: Type S-9.
 - 2. Counter Tops to Walls: Type S-9.
 - 3. Pipe Penetrations: Type S-9.
- C. Horizontal Traffic Joints:
 - 1. Concrete Paving, Unit Pavers: Type S-11 or S-12.
- D. Interior Caulking:
 - 1. Typical Narrow Joint 6 mm, (1/4 inch) or less at Walls and Adjacent Components: Types C-1, C-2 and C-3.
 - 2. Perimeter of Doors, Windows, Access Panels which Adjoin Concrete or Masonry Surfaces: Types C-1, C-2 and C-3.
 - 3. Joints at Masonry Walls and Columns, Piers, Concrete Walls or Exterior Walls: Types C-1, C-2 and C-3.
 - 4. Exposed Isolation Joints at Top of Full Height Walls: Types C-1, C-2 and C-3.
 - 5. Exposed Acoustical Joint at Sound Rated Partitions: Type C-2.
 - 6. Concealed Acoustic Sealant Type: S-4, C-1, C-2 and C-3.

- - - E N D - - -

**SECTION 08 11 13
HOLLOW METAL DOORS AND FRAMES**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies steel doors, steel frames and related components.
- B. Terms relating to steel doors and frames as defined in ANSI/SDI A250.7 and as specified.

1.2 RELATED WORK

- A. Door Hardware: Section 08 71 00, DOOR HARDWARE.
- B. Electric Door Control, electrical connections including conduit and wiring for door control and operators. Section 26,

1.3 TESTING

- A. Perform testing with an independent testing laboratory.

1.4 SUSTAINABILITY REQUIREMENTS

- A. Materials in this section may contribute towards contract compliance with sustainability requirements. See Section 01 81 11, SUSTAINABLE DESIGN REQUIRMENTS, for project local/regional materials, recycled content, requirements.
- B. Biobased Material: For products designated by the USDA's BioPreferred® program, provide products that meet or exceed USDA recommendations for biobased content, subject to the products compliance with performance requirements in this Section. For more information regarding the product categories covered by the BioPreferred® program, visit <http://www.biopreferred.gov>.

1.5 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturers Literature and Data:
 - 1. Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced grade standard.
 - 2. Fire rated doors and frames, showing conformance with NFPA 80 and Underwriters Laboratory, Inc., or Intertek Testing Services or Factory Mutual fire rating requirements .
- C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and identifying location of different finishes, if any.

- D. Schedule: Provide a schedule prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on drawings; coordinate with final door hardware schedule.

1.6 SHIPMENT

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

1.7 STORAGE AND HANDLING

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

1.8 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by the basic designation only. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
- B. American Society for Testing and Materials (ASTM):
- | | |
|------------------|--|
| A653/A653M-20 | Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process |
| A1008/A1008M-21a | Steel, sheet, Cold-Rolled, Carbon, Structural, High Strength Low Alloy and High Strength Low Alloy with Improved Formability, Solution Hardened, and Bake Hardened |
| C665-17 | Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing |
| E136-19a | Behavior of Materials in a Vertical Tube Furnace at 750 degrees C |
- C. Builders Hardware Manufacturers Association (BHMA):
- | | |
|-----------------------|---|
| ANSI/BHMA A156.115-06 | American National Standard for Hardware Preparation in Steel Doors and Steel Frames |
|-----------------------|---|
- D. FM Global:
Approval Guide
- E. Intertek Testing Services (ITS):
Certifications Listings Latest Edition
- F. National Fire Protection Association (NFPA):

80-10 Fire Doors and Fire Windows
105-13 Standard for the Installation of Smoke Door
Assemblies and Other Opening Protectives.

G. Steel Door Institute (SDI):

ANSI/SDI A250.6-03(R09) Recommended Practice for Hardware Reinforcing
on Standard Steel Doors and Frames
ANSI/SDI A250.7-1997 Nomenclature for Standard Steel Doors and Steel
Frames
ANSI/SDI A250.8-03(R08) Recommended Specifications for Standard Steel
Doors and Frames
ANSI/SDI A250.11-2012 Recommended Erection Instructions for Steel
Frames

H. Underwriters Laboratories, Inc. (UL):

Fire Resistance Directory

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Metallic-Coated Steel Sheet: ASTM A653, Commercial Steel (CS), Type B.
- B. Sheet Steel: ASTM A1008, cold-rolled for panels (face sheets) of doors.
- C. Anchors, Fastenings and Accessories: Fastenings anchors, clips connecting members and sleeves from zinc coated steel.
- D. Prime Paint: Paint that meets or exceeds the requirements of A250.8.
- E. Grout: Portland cement grout of maximum 4-inch slump for hand troweling; thinner pumpable grout is prohibited.
- F. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat; provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
- G. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.

2.2 FABRICATION GENERAL

- A. General:
 - 1. Follow ANSI A250.8 for fabrication of steel doors, except as specified otherwise. Doors to receive hardware specified in Section

08 71 00, DOOR HARDWARE. Tolerances must comply to SDI A250.8.

Thickness, 44 mm (1-3/4 inches), unless otherwise shown.

2. Close top edge of exterior doors flush and seal to prevent water intrusion.
3. When vertical steel stiffeners are used for core construction, fill spaces between stiffeners with mineral fiber insulation.

B. Smoke Doors and Frames:

1. Close top and vertical edges flush.
2. Provide seamless vertical edges.
3. Provide clearance at head, jamb and sill as specified in NFPA 80.

C. Fire Rated Doors and Frames (Labeled):

1. Conform to NFPA 80 when tested by Underwriters Laboratories, Inc., Inchcape Testing Services, or Factory Mutual for the class of door or door opening shown.
2. Permanently attach metal fire rated labels to doors, with raised or incised markings of approving laboratory.

2.3 CLASSIFICATION AND PERFORMANCE

A. Standard Duty Doors: ANSI/SDI A250.8, Level 1, physical performance Level C, Model 2, of size(s) and design(s) indicated and core construction as required by the manufacturer.

1. Provide where indicated.

B. Heavy Duty Doors: ANSI/SDI A250.8, Level 2, physical performance Level B, Model 2, with core construction as required by the manufacturer for interior doors and for exterior doors, of size(s) and design(s) indicated.

1. Where vertical stiffener cores are required, the space between the stiffeners to be filled with mineral board insulation.
2. Provide Level 2 where indicated.

2.4 METAL FRAMES

A. General: SDI Level 2, formed frames to sizes and shapes indicated.

1. Frames for Labeled Fire Rated Doors:

- a. Comply with NFPA 80; tested by Underwriters Laboratories, Inc., Intertek Testing Services, or Factory Mutual.
- b. Fire rated labels of approving laboratory permanently attached to frames as evidence of conformance with these requirements.

Provide labels of metal or engraved stamp, with raised or incised markings.

2. Type: Continuously weld frame faces at corner joints. Mechanically interlock or continuously weld stops and rabbets, grind welds smooth.

B. Reinforcement and Covers:

1. ANSI/SDI A250.8 for, minimum thickness of steel reinforcement welded to back of frames.
2. Provide mortar guards securely fastened to back of hardware reinforcements.
3. Comply with applicable requirements in ANSI/SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.

C. Anchors: Provide anchors to secure the frame to adjoining construction; steel anchors, zinc-coated or painted with rust-inhibitive paint, not lighter than 1.2 mm thick (18 gage).

1. Wall Anchors: Provide at least three anchors for each jamb. For frames which are more than 2285 mm (7.5 feet) in height, provide one additional anchor for each jamb for each additional 760 mm (2.5 feet) or fraction thereof.
 - a. Masonry: Provide anchors of corrugated or perforated steel straps or 5 mm (3/16 inch) diameter steel wire; adjustable or T-shaped.
 - b. Stud partitions: Weld or otherwise securely fasten anchors to backs of frames. Design anchors to be fastened to wood studs with nails, to closed steel studs with sheet metal screws, and to open steel studs by wiring or welding .
2. Floor Anchors: Provide floor anchors drilled for 10 mm (3/8 inch) anchor bolts at bottom of each jamb member. Where floor fill occurs, terminate bottom of frames at the indicated finished floor levels and support by adjustable extension clips resting on and anchored to the structural slabs.

2.5 TRANSOM PANELS (NOT USED)

2.6 LOUVERS (NOT USED)

2.7 HARDWARE PREPARATION

- A. Provide minimum hardware reinforcing gages as specified in SDI A250.6.
- B. Drill and tap doors and frames to receive finish hardware.

- C. Prepare doors and frames for hardware in accordance with the applicable requirements of SDI A250.8 and SDI A250.6; for additional requirements refer to ANSI/BHMA A156.115.
- D. Drill and tap for surface-applied hardware at the project site.
- E. Build additional reinforcing for surface-applied hardware into the door at the factory.
- F. Punch door frames, except for frames that will have weatherstripping or gasketing, to receive a minimum of two rubber or vinyl door silencers on lock side of single doors and one silencer for each leaf at heads of double doors; set lock strikes out to provide clearance for silencers.

2.8 SHOP PAINTING

- A. ANSI/SDI A250.8.

2.9 CUSTOM PRE-FINISHED DOORS AND FRAMES AT COMMITTAL SHELTER (NOT USED)

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Plumb, align and brace frames securely until permanent anchors are set, in accordance with SDI A250.11.
 - 1. Use triangular bracing near each corner on both sides of frames with temporary wood spreaders at midpoint.
 - 2. Use wood spreaders at bottom of frame if the shipping spreader is removed.
 - 3. Protect frame from accidental abuse.
 - 4. Where construction will permit concealment, leave the shipping spreaders in place after installation, otherwise remove the spreaders after the frames are set and anchored.
 - 5. Remove wood spreaders and braces only after the walls are built and jamb anchors are secured.
- B. Floor Anchors:
 - 1. Anchor the bottom of door frames to floor with two 6 mm (1/4 inch) diameter expansion bolts.
 - 2. Power actuated drive pins may be used to secure frame anchors to concrete floors.
- C. Jamb Anchors:
 - 1. Anchors in Masonry Walls: Embed anchors in mortar. Fill space between frame and masonry wall with grout or mortar as walls are built.

2. Solidly pack mineral-fiber insulation inside frames in stud partitions.
 3. Secure anchors to sides of studs with two fasteners through anchor tabs. Use steel drill screws to steel studs.
 4. Frames set in prepared openings of masonry or concrete: Expansion bolt to wall with 6 mm (1/4 inch) expansion bolts through spacers. Where sub-frames or rough bucks are used, 6 mm (1/4 inch) expansion bolts on 600 mm (24 inch) centers or power activated drive pins 600 mm (24 inches) on centers. Secure two-piece frames to sub-frame or rough buck with machine screws on both faces.
- D. Install anchors for labeled fire rated doors to provide rating as required.
- E. Hang doors in accordance with clearances specified in SDI/DOOR A250.8.
- F. Install fire doors and frames, including hardware, in accordance with NFPA 80.
- G. Install fire rated smoke doors and frames in accordance with NFPA 80 and NFPA 105.

3.2 INSTALLATION OF HARDWARE

- A. Install hardware as specified in this Section and Section 08 71 00, DOOR HARDWARE.
- B. After erection and glazing, clean and adjust hardware.

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**SECTION 08 14 00
INTERIOR WOOD DOORS**

PART 1 - GENERAL

1.1 DESCRIPTION

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

1.2 RELATED WORK

- A. Metal door frames: Section 08 11 13, HOLLOW METAL DOORS AND FRAMES.
- B. Overhead doors including loading docks: Section 08 33 00, COILING DOORS AND GRILLES.
- C. Door hardware including hardware location (height): Section 08 71 00, DOOR HARDWARE.
- D. Installation of doors and hardware: Section 08 11 13, HOLLOW METAL DOORS AND FRAMES, Section 08 14 00, INTERIOR WOOD DOORS, or Section 08 71 00, DOOR HARDWARE.
- E. Finish: AS indicated on drawings to match existing wood doors in the Administration Building..

1.3 SUSTAINABILITY REQUIREMENTS

- A. Materials in this section may contribute towards contract compliance with sustainability requirements. See Section 01 81 11, SUSTAINABLE DESIGN REQUIREMENTS, for project local/regional materials, recycled content, certified wood requirements.
- B. Biobased Material: For products designated by the USDA's BioPreferred® program, provide products that meet or exceed USDA recommendations for biobased content, subject to the products compliance with performance requirements in this Section. For more information regarding the product categories covered by the BioPreferred® program, visit <http://www.biopreferred.gov>.

1.4 SUBMITTALS

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

C. Shop Drawings:

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

D. Manufacturer's Literature and Data:

1. Labeled fire rated doors showing conformance with NFPA 80.

E. Laboratory Test Reports:

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

1.5 WARRANTY

A. Doors are subject to terms of Article titled "Warranty of Construction", FAR clause 52.246-21, except that warranty to be as follows:

1. For interior doors, manufacturer's warranty for lifetime of original installation.

1.6 DELIVERY AND STORAGE

- A. Factory seal doors and accessories in cardboard packages; keep packaging intact during delivery and storage.
- B. Label package for door opening where used.
- C. Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- D. Store doors flat on level raised platforms in clean, dry, well-ventilated area protected from sunlight and weather; cover but allow for air circulation.

1.7 APPLICABLE PUBLICATIONS

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

B. Window and Door Manufacturers Association (WDMA):

| | |
|---|--|
| I.S.1A-11 | Architectural Wood Flush Doors |
| I.S.4-09 | Water-Repellent Preservative Non-Pressure Treatment for Millwork |
| I.S.6A-11 | Architectural Wood Stile and Rail Doors |
| T.M.5-90 (2009) | Split Resistance Test Method |
| T.M.7-08 | Cycle-Slam Test Method |
| T.M.8-08 | Hinge Loading Test Method |
| T.M.10-08 | Screwholding Test Method |
| C. National Fire Protection Association (NFPA): | |
| 80-13 | Protection of Buildings from Exterior Fire |
| 252-12 | Fire Tests of Door Assemblies |

PART 2 - PRODUCTS

2.1 FLUSH DOORS

A. General:

1. Meet requirements of WDMA I.S.1-A, solid core.
2. Adhesive: Type II.
3. Thickness: 45 mm (1-3/4 inches) unless otherwise shown or specified.
4. Give exposed wood parts of exterior doors a water-repellent preservative treatment in accordance with WDMA I.S.4.

B. Face Veneer:

1. In accordance with WDMA I.S.1-A.
2. One species throughout the project unless scheduled or otherwise shown.
3. For Transparent Finishes: Premium Grade, rotary cut, red oak .
 - a. Grade: Custom (Grade A).
 - b. Match face veneers for doors for uniform effect of color and grain at joints.
 - c. Provide door edges of same species as door face veneer, except maple may be used for stile face veneer on birch doors.
 - d. In existing buildings, where doors are required to have transparent finish, use wood species and grade of face veneers to match adjacent existing doors.

C. Wood for stops, louvers, muntins and moldings of flush doors required to have transparent finish:

1. Solid Wood of same species as face veneer, except maple may be used on birch doors.

D. Fire Rated Wood Doors:

1. Fire Performance Rating:
 - a. "C" Label: 3/4 hour.
2. Labels:
 - a. Conform to the requirements of NFPA 252 and carry an identifying label, from a qualified testing and inspection agency, for class of door or opening shown designating fire performance rating.
 - b. Metal labels with raised or incised markings.
3. Performance Criteria for Stiles of doors utilizing standard mortise leaf hinges:
 - a. Hinge Loading: WDMA T.M.8. Average of 10 test samples for Extra Heavy-Duty doors.
 - b. Direct Screw Withdrawal: WDMA T.M.10 for Extra Heavy-Duty doors. Average of 10 test samples using a steel, fully threaded #12 wood screw.
 - c. Cycle Slam: 1,000,000 cycles with no loose hinge screws or other visible signs of failure when tested in accordance with WDMA T.M.7.
4. Additional Hardware Reinforcement:
 - a. Provide fire rated doors with hardware reinforcement blocking.
 - b. Size of lock blocks as required to secure hardware specified.
 - c. Top, bottom, and intermediate rail blocks must measure not less than 125 mm (five inches) by full core width.
 - d. Reinforcement blocking in compliance with manufacturer's labeling requirements.
 - e. Mineral material similar to core is not acceptable.
5. Other Core Components: Manufacturer's standard as allowed by the labeling requirements.

2.2 STILE AND RAIL DOORS (NOT USED)

2.3 PREFITTING

- A. Flush doors may be factory machined to receive hardware, bevels, undercuts, cutouts, accessories, and fitting for frame.
- B. Factory fitting to conform to specification for shop and field fitting, including factory application of sealer to edge and routings.

2.3 FACTORY FINISHING (NOT USED)

2.4 IDENTIFICATION MARK

- A. Provide on top edge of door.

- B. Provide as a stamp, brand, or other indelible mark, giving manufacturer's name, door's trade name, construction of door, code date of manufacture and quality.
- C. Include one of the following additional requirements:
 - 1. An identification mark or a separate certification including name of inspection organization.
 - 2. Identification of standards for door, including glue type.
 - 3. Identification of veneer and quality certification.
 - 4. Identification of preservative treatment for stile and rail doors.

2.5 BIOBASED CONTENT

Interior Wood Door Products shall comply with following standards for biobased materials:

| Material Type | Percent by Weight |
|--|------------------------------|
| Lumber | 25 percent biobased material |
| Composite Panels- Structural Interior Panels | 89 percent biobased material |

The minimum-content standards are based on the weight (not the volume) of the material in the insulating core only.

PART 3 - EXECUTION

3.1 DOOR PREPARATION

- A. Factory Preparation: Do not violate the qualified testing and inspection agency label requirements for fire rated doors.
- B. Clearances between Doors and Frames and Floors:
 - 1. Maximum 3 mm (1/8 inch) clearance at the jambs, heads, and meeting stiles, and a 19 mm (3/4 inch) clearance at bottom, except as otherwise specified.
 - 2. Maximum clearance at bottom of sound rated doors, light-proofed doors, doors to operating rooms, and doors designated to be fitted with mechanical seal: 10 mm (3/8 inch).
- C. Rout doors for hardware using templates and location heights specified in Section, 08 71 00 DOOR HARDWARE.
- D. Fit doors to frame, bevel lock edge of doors 3 mm (1/8 inch) for each 50 mm (two inches) of door thickness .
- E. Immediately after fitting and cutting of doors for hardware, seal cut edges of doors with two coats of water-resistant sealer.

- F. Finish surfaces, including both faces, top and bottom and edges of the doors smooth to touch.
- G. Apply a steel astragal on the opposite side of active door on pairs of fire rated doors.
- H. Apply a steel astragal to meeting style of active leaf of pair of doors or double egress smoke doors.

3.2 INSTALLATION

- A. Hardware: See Section 08 71 00, DOOR HARDWARE.
- B. Installation Instructions: Install doors to comply with manufacturer's written instructions and the referenced quality standard, and as indicated.
 - 1. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.
- C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 DOOR PROTECTION

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

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**SECTION 08 31 13
ACCESS DOORS AND FRAMES**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Section specifies interior access doors or panels. This includes a wood access door to the attic on the building 1001 exterior wall.

1.2 RELATED WORK

- A. Lock Cylinders: Section 08 71 00, DOOR HARDWARE.
- B. Exterior access door: Section 06 10 00 ROUGH CARPENTRY & 06 20 00 FINISH CARPENTRY.
- C. Access doors in acoustical ceilings: Section 09 51 00, ACOUSTICAL CEILINGS.
- D. Locations of access doors for duct work cleanouts: Section 23 31 00, HVAC DUCTS AND CASINGS Section 23 37 00, AIR OUTLETS AND INLETS.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Shop Drawings: Indicate each type of access door, showing construction, location and installation details.
- C. Manufacturer's Literature and Data: Access doors, each type.

1.4 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by the basic designation only. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
- B. American Welding Society (AWS):
D1.3/D1.3M (2008) Structural Welding Code Sheet Steel
- C. The National Association of Architectural Metal Manufacturers (NAAMM):
AMP 500 Series Metal Finishes Manual
- D. National Fire Protection Association (NFPA):
80-13 Fire Doors and Windows
- E. Underwriters Laboratories, Inc. (UL):
Fire Resistance Directory

PART 2 - PRODUCTS

2.1 FABRICATION, GENERAL

- A. Fabricate components to be straight, square, flat and in same plane where required.
 - 1. Slightly round exposed edges and without burrs, snags, and sharp edges.
 - 2. Make exposed welds continuous and ground smooth.
 - 3. Weld in accordance with AWS D1.3.
- B. Provide number of locks and non-continuous hinges as required to maintain alignment of panel with frame. For fire rated doors, use hinges and locks as required by fire test.
- C. Provide anchors or make provisions in frame for anchoring to adjacent construction. Provide size, number, and location of anchors on four sides to secure access door in opening. Provide anchors as required by fire test.

2.2 ACCESS DOORS, FIRE RATED

- A. Meet requirements for "B" label 1-1/2 hours with maximum temperature rise of 120 degree C (250 degrees F).
- B. Comply with NFPA 80 and have Underwriters Laboratories Inc., or other nationally recognized laboratory label for Class B opening.
- C. Door Panel: Form of minimum 0.9 mm (0.0359 inch) thick steel or stainless steel sheet, insulated sandwich type construction.
- D. Frame: Form of minimum 1.5 mm (0.0598 inch) thick steel sheet of depth and configuration to suit material and type of construction where installed. Provide frame flange at perimeter where installed in concrete masonry or gypsum board openings.
 - 1. Weld exposed joints in flange and grind smooth.
 - 2. Provide frame flange at perimeter where installed in gypsum board.
- E. Automatic Closing Device: Provide automatic closing device for door.
- F. Hinge: Continuous steel hinge with stainless steel pin.
- G. Lock:
 - 1. Self-latching, with provision for fitting flush a standard screw-in type lock cylinder. Lock cylinder specified in Section 08 71 00, DOOR HARDWARE.
 - 2. Provide latch release device operable from inside of door. Mortise case in door.

2.3 ACCESS DOORS, FLUSH PANEL

A. Door Panel:

1. Form of minimum 1.9 mm (0.0747 inch) thick steel or 1.5 mm (0.0598 inch) thick stainless steel sheet.
2. Reinforce to maintain flat surface.

B. Frame:

1. Form of minimum 1.5 mm (0.0598 inch) thick steel or stainless steel sheet of depth and configuration to suit material and type of construction where installed.
2. Provide surface mounted units having frame flange at perimeter where installed in concrete, masonry, or gypsum board construction.
3. Weld exposed joints in flange and grind smooth.

C. Hinge:

1. Concealed spring hinge to allow panel to open 175 degrees.
2. Provide removable hinge pin to allow removal of panel from frame.

D. Lock:

1. Self-latching device with cylinder lock; match facility keying system.

2.4 ACCESS DOOR, RECESSED PANEL (NOT USED)

A. Door Panel:

1. Form of minimum 1.2 mm (0.0478 inch) thick steel or stainless steel sheet to form a 25 mm (one inch) deep recessed pan to accommodate the installation of acoustical units or other materials where shown in walls and ceiling.
2. Reinforce as required to prevent sagging.

B. Frame:

1. Form of minimum 1.5 mm (0.0598 inch) thick steel sheet of depth and configuration to suit installation in suspension system of ceiling or wall framing.
2. Extend sides of frame to protect edge of acoustical units when panel is in open position.
3. Provide shims, bushings, clips and other devices necessary for installation.

C. Hinge: Continuous steel hinge with stainless steel pin or concealed hinge.

D. Lock:

1. Self-latching device with cylinder lock; match facility keying system.
2. Provide sleeve of plastic or stainless-steel grommet to protect hole made in acoustical unit for screwdriver access to lock.

2.5 FINISH

- A. Provide in accordance with NAAMM AMP 500 series on exposed surfaces.
- B. Steel Surfaces: Baked-on prime coat over a protective phosphate coating.
- C. Stainless Steel: No. 4 for exposed surfaces.

2.6 SIZE

- A. Provide minimum 600 mm (24 inches) square door unless otherwise shown .

PART 3 - EXECUTION

3.1 LOCATION

- A. Provide access panels or doors wherever any valves, traps, dampers, cleanouts, and other control items of mechanical, electrical and conveyor work are concealed in wall or partition or are above ceiling of gypsum board or plaster.
- B. Use fire rated doors in fire rated partitions and ceilings.
- C. Use flush panels in partitions and gypsum board or plaster ceilings, except lay-in acoustical panel ceilings or upward access acoustical tile ceilings.

3.2 INSTALLATION, GENERAL

- A. Install access doors in openings to have sides vertical in wall installations, and parallel to ceiling suspension grid or side walls when installed in ceiling.
- B. Set frames so that edge of frames without flanges will finish flush with surrounding finish surfaces.
- C. Set frames with flanges to overlap opening and so that face will be uniformly spaced from the finish surface.
- D. Set recessed panel access doors recessed so that face of surrounding materials will finish on the same plane when finish in door is installed.

3.3 ANCHORAGE

- A. Secure frames to adjacent construction using anchors attached to frames or by use of bolts or screws through the frame members.

- B. Provide type, size and number of anchoring devices suitable for the material surrounding the opening, maintain alignment, and resist displacement during normal use of access door.
- C. Anchors for fire rated access doors must meet requirements of applicable fire test.

3.4 ADJUSTMENT

- A. Adjust hardware so that door panel will open freely.
- B. Adjust door when closed so door panel is centered in the frame.

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SECTION 08 52 13
ALUMINUM-CLAD WOOD CASEMENT WINDOWS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Aluminum-clad or vinyl clad wood casement windows to match existing at the Administration Building 1001.

1.2 RELATED SECTIONS

- A. Section 06 16 13 - Insulating Sheathing Systems: Water-resistant barrier.
- B. Section 06 10 00-Rough Carpentry- Window framing
- C. 06 20 00 Finish Carpentry- Window trim
- D. Section 07920 (07 92 00) - Joint Sealants: Sealants and caulking.
- E. Section 09 90 00 Painting- Window trim finish

1.3 REFERENCES

- A. American Architectural Manufacturers Association (AAMA):
 - 1. AAMA 502 - Voluntary Specification for Field Testing of Windows and Sliding Doors.
 - 2. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.
 - 3. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
 - 4. AAMA 612 Voluntary Specification, Performance Requirements, and Test Procedures for Combined Coatings of Anodic Oxide and Transparent Organic Coatings on Architectural Aluminum.
- B. American Society for Testing and Materials (ASTM):
 - 1. ASTM B 117 - Operating Salt Spray (Fog) Apparatus.
 - 2. ASTM C 1036 - Flat Glass.
 - 3. ASTM C 1048 - Heat-Treated Flat Glass - Kind HS, Kind FT Coated and Uncoated Glass.
 - 4. ASTM D 1149 - Rubber Deterioration - Surface Ozone Cracking in a Chamber.
 - 5. ASTM D 2803 - Filiform Corrosion Resistance of Organic Coatings on Metal.
 - 6. ASTM D 3656 - Insect Screening and Louver Cloth Woven from Vinyl-Coated Glass Yarns.
 - 7. ASTM D 4060 - Abrasion Resistance of Organic Coatings by the Taber Abraser.
 - 8. ASTM E 283 - Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors Under Specified Pressure Difference Across the Specimen.
 - 9. ASTM E 330 - Structural Performance of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference.
 - 10. ASTM E 547 - Water Penetration of Exterior Windows, Curtain Walls and Doors by Cyclic Static Air Pressure Differential.
 - 11. ASTM E 1105 - Standard Test Method for Field Determination of Water Penetration of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
 - 12. ASTM G 85 - Modified Salt Spray (Fog) Testing.

Black Hills National Cemetery
Renovate and Expand Administration and Maintenance Buildings
20901 Pleasant Valley Drive
Sturgis, SD 57785

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BID DOCUMENTS

- C. Screen Manufacturers Association (SMA):
 - 1. SMA 1201 - Specifications for Insect Screens for Windows, Sliding Doors and Swinging Doors.

- D. Window and Door Manufacturers Association (WDMA):
 - 1. AAMA/WDMA/CSA 101/I.S.2/A440 - North American Fenestration Standard/Specification for windows, doors, and skylights
 - 2. WDMA I.S.4 - Industry Specification for Preservative Treatment for Millwork.

1.4 PERFORMANCE REQUIREMENTS

- A. Windows shall be Hallmark certified to a rating of [C] [AP]-[R] [CW]-PG[_____] specifications in accordance with ANSI/AAMA/WDMA 101/I.S.2/A440-08 or ANSI/AAMA/WDMA 101/I.S.2/A440-11.

- B. Window Unit Air Leakage, ASTM E 283, 1.57 psf (25 mph): 0.05 cfm per square foot of frame or less.

- C. Window Unit Water Penetration: No water penetration through window unit when tested in accordance with ASTM E 547, under static pressure of 7.5 psf (52 mph) after 4 cycles of 5 minutes each, with water being applied at a rate of 5 gallons per hour per square foot.

Black Hills National Cemetery
Renovate and Expand Administration and Maintenance Buildings
20901 Pleasant Valley Drive
Sturgis, SD 57785

NCA Project #884CM3015
10/31/22
BID DOCUMENTS

1.5 SUBMITTALS

- A. Comply with Division 1 requirements.
- B. Product Data: Submit manufacturer's product data, including installation instructions.
- C. Shop Drawings: Submit manufacturer's shop drawings, indicating dimensions, construction, component connections and locations, anchorage methods and locations, hardware locations, and installation details. Samples: Submit color of exterior and interior finish. Warranty: Submit manufacturer's standard warranty.

1.6 QUALITY ASSURANCE A.Mockup:

- 1. Provide sample installation as part of Masonry wall mockup to determine acceptability of window installation methods.
- 2. Approved mockup shall represent minimum quality required for the Work.
- 3. Approved mockup shall remain as part of the in place Work with approval of the COR.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to site undamaged in manufacturer's or sales branch's original, unopened containers and packaging, with labels clearly identifying manufacturer and product name. Include installation instructions.
- B. Storage: Store materials in an upright position, off ground, under cover, and protected from weather, direct sunlight, and construction activities.
- C. Handling: Protect materials and finish during handling and installation to prevent damage.

PART 2 PRODUCTS

2.1 MANUFACTURER

- A. Basis of Design (BOD): Clad wood casement window, factory assembled as manufactured by Pella Corporation, 102 Main Street, Pella, Iowa 50219. Toll Free (800) 54-PELLA. Phone (641) 621-1000. Website www.pellaADM.com.
- B. Also Approved: Factory assembled clad wood casement units as manufactured by Kolbe & Kolbe Millwork Co., Inc., Menawa, Wisconsin. Greg Larson (612) 224-5276 Greg.larson@kolbegallerytc.com.

2.2 ALUMINUM-CLAD WOOD [CASEMENT] [AND] [AWNING] WINDOWS

- A. Aluminum-Clad Wood Casement Windows: Factory-assembled aluminum-clad wood windows with outward-opening sash installed in frame and fixed unit.

- B. Frame:
 - 1. Select woods, water-repellent, preservative-treated in accordance with WDMA I.S.-4.
 - 2. Interior Exposed Surfaces: Clear Pine with no visible fastener holes.
 - 3. Exterior Surfaces: Clad with extruded aluminum.
 - 4. Overall Frame Depth: 5 inches (127 mm).

- C. Sash:
 - 1. Select woods, water-repellent, preservative-treated in accordance with WDMA I.S.-4.
 - 2. Interior Exposed Surfaces: Clear Pine with no visible fastener holes.
 - 3. Exterior Surfaces: Clad with extruded aluminum butt-jointed at all corners of the sash with through-stile construction.
 - 4. Sash Profile: Exterior profile is [ogee] [putty glaze], interior profile is ogee.
 - 5. Corners: Mortised and tenoned, glued and secured with metal fasteners.
 - 6. Sash Thickness: 1-13/16 inches (46 mm).
 - 7. Sash Face to Glass Reveal: 0.63 inches (16 mm) to reflect historic window proportions.

- D. Weather Stripping:
 - 1. Dual weather stripping.
 - 2. Continuous, flexible, Santoprene material in dual-durometer design.
 - 3. Units shall have welded corners, compressed between frame and sash for positive seal on all 4 sides.
 - 4. Secondary PVC leaf-type weather strip between sash and frame for positive seals on all 4 sides.

2.3 GLAZING

- A. Glazing:
 - 1. Float Glass: ASTM C 1036, Quality 1.
 - a. Tempered Glass: ASTM C 1048.

2. Type: Silicone-glazed 11/16-inch dual-seal, tempered insulating glass, clear multi-layer Low-E coated with argon.

2.4 OPTIONS

- A. Insect Screens: Standard.
 1. Compliance: ASTM D 3656 and SMA 1201.
 2. Screen Cloth: Vinyl-coated fiberglass, 18/16 mesh.
 3. Set in aluminum frame fitted to inside of window.
 4. Complete with necessary hardware.
 5. Screen Frame Finish: Baked enamel Brown.

2.5 HARDWARE

- A. Operator:
 1. Steel worm-gear operator with hardened gears.
 2. Operator Base: Zinc die cast with painted finish.
 3. Operator Linkage, Hinge Slide, and Hinge Arms: Stainless steel.
 4. Exposed Fasteners: Stainless steel.
 5. External Hardware Salt Spray Exposure, ASTM B 117: Exceed 1,000 hours.
- B. Crank Handle Type and Finish
 2. Integrated Traditional Folding Crank: Baked enamel, brown.
- C. Locking System: Sure Lock System.
 1. Single handle locking system.
 2. Operate positive-acting arms that reach out and pull sash into locked position.
 3. Casement Windows: One installed on sash 29 inches and smaller in frame height, 2 unison operating locks installed on sash over 29 inches in frame height.
 4. Lock handle finish matches crank handle finish

2.6 TOLERANCES

- A. Windows shall accommodate the following opening tolerances:
 1. Vertical Dimensions Between High and Low Points: Plus 1/4 inch, minus 0 inch.
 2. Width Dimensions: Plus 1/4 inch, minus 0 inch.
 3. Building Columns or Masonry Openings: Plus or minus 1/4 inch from plumb.

2.7 FINISH

- A. Exterior Finish System:
 1. Exterior aluminum surfaces shall be finished with the following multi-stage system:
 - a. Clean and etch aluminum surface of oxides.
 - b. Pre-treat with conversion coating.
 - c. Topcoat with baked-on polyester enamel.
 2. Color: Brown to match existing adjacent.
 3. Performance Requirements: Exterior aluminum finishes shall meet or exceed all performance requirements of AAMA 2604 and the following performance requirements of AAMA 2605:
 - a. Dry Film Hardness: Eagle Turquoise Pencil, H minimum.
 - b. Film Adhesion: 1 mm crosshatch, dry, wet, boiling water.

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- c. Impact Resistance: 1/10-inch distortion, no film removal.
- d. Chemical Resistance: 10 percent Muriatic acid, 15 minutes. Mortar pat test, 24 hours.
- e. Detergent Resistance: 3 percent at 100 degrees F, 72 hours.
- f. Corrosion Resistance: ASTM G85-A5, 2000 hours. Humidity, 3,000 hours. Salt spray exceeds 3,000 hours.

B. Interior Finish: Unfinished, ready for site finishing.

2.8 INSTALLATION ACCESSORIES

A. Flashing/Sealant Tape:

- 1. Aluminum-foil-backed butyl window and door flashing tape.
- 2. Maximum Total Thickness: 0.013 inch.
- 3. UV resistant.
- 4. Verify sealant compatibility with sealant manufacturer.

B. Interior Insulating-Foam Sealant: Low-expansion, low-pressure polyurethane insulating window and door foam sealant.

C. Exterior Perimeter Sealant: High quality, multi-purpose sealant as specified in the joint's sealant section.

2.9 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine areas to receive windows. Notify Architect of conditions that would adversely affect installation or subsequent use. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Install windows in accordance with manufacturer's instructions and approved shop drawings.

B. Install windows to be weather-tight and freely operating.

C. Maintain alignment with adjacent work.

D. Secure assembly to framed openings, plumb and square, without distortion.

E. Integrate window system installation with exterior water-resistant barrier using flashing/sealant tape. Apply and integrate flashing/sealant tape with water-resistant barrier using watershed principles in accordance with window manufacturer's instructions.

F. Place interior seal around window perimeter to maintain continuity of building thermal and air barrier using [backer rod and sealant] [insulating-foam sealant].

G. Seal window to exterior wall cladding with sealant and related backing materials at perimeter of assembly.

H. Leave windows closed and locked.

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3.3 FIELD QUALITY CONTROL (NOT USED)

3.4 CLEANING

- A. Clean window frames and glass in accordance with Division 1 requirements.
- B. Do not use harsh cleaning materials or methods that would damage finish.
- C. Remove labels and visible markings.

3.5 PROTECTION

- A. Protect installed windows to ensure that, except for normal weathering, windows will be without damage or deterioration at time of substantial completion.

END OF SECTION

SECTION 08 52 13.02
FIBERGLASS DOUBLE HUNG WINDOWS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Double Hung operating windows complete with hardware, glazing, weatherstripping, screens jamb extensions and standard anchorages, trim, attachments, and accessories at the Maintenance Building .

1.02 RELATED SECTIONS

- Section 01 33 23 - Shop Drawings, Product Data, and Samples..
- Section 01 42 19 - Reference Standards.
- Section 06 10 00 - Rough Carpentry.
- Section 06 16 13 - Finish Carpentry.
- Section 07 92 00 - Joint Sealants.
- Section 08 80 00 - Glazing.
- Section 09 90 00 - Painting.

1.03 REFERENCES

- A. American Society for Testing and Materials (ASTM):
1. ASTM E283-19' - Standard Test Method for Rate of Air Leakage through Exterior Windows, Curtain Walls, and Doors.
 2. ASTM E330-14' (2021) - Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
 3. ASTM E547-00' (2016) - Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Cyclic Static Air Pressure Differential.
 4. ASTM E1425-14' or AAMA 1801-97 - Certification of Acoustical Performance.
 5. ASTM F588-17' (Windows).
 6. ASTM E1996-20' - Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors and Storm Shutters Impacted by Windborne Debris in Hurricanes.
 7. ASTM E1886-19' - Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors and Storm Shutters Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials.
 8. ASTM E2190-19' - Standard Specification for Insulating Glass Unit Performance and Evaluation.
- B. American Architectural Manufacturers Association/Window and Door Manufacturers Association (AAMA/WDMA), American National Standards Institute/Window and Door Manufacturers Association (ANSI/WDMA), Canadian Standards Association (CSA).

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1. AAMA/WDMA/CSA 101/I.S.2/A440-05', 101/I.S.2/A440-08' - Standard / Specification for Windows, Doors, and Skylights.
 2. WDMA I.S. 4-07'A Water Repellant Preservative Treatment for Millwork.
- C. National Fenestration Rating Council (NFRC)
1. NFRC 100-2004' & 2010' - Determining Fenestration U-Factor.
 2. NFRC 100-2004' & 2010' - Test Procedure for Thermal Transmittance of Fenestration.
 3. NFRC 200-2004' & 2010' - Determining Fenestration SHGC & Tv.
 4. ASTM E1423-06' - Determining Thermal Transmittance of Fenestration Systems.
 5. NFRC 500-2010' - Determining Fenestration Product Condensation Resistance.
- D. WDMA Hallmark Program
1. WDMA Hallmark Program Procedural Guide C.S.-1.
- E. Consumer Product Safety Commission (CPSC)
1. CPSC 16 CFR 1201 - Safety Glazing Standards.
 2. ANSI Z-97.1 - Safety Glazing Standards for Tempered Glass.

1.04 SYSTEM DESCRIPTION

- A. Design and Performance Requirements
1. Applications of windows include:
 - a. Light commercial application.
 2. Air, water, structural, and forced entry resistance shall be at levels which meet the specified design pressure as per AAMA/WDMA/CSA 101/I.S.2/A440-05', 101/I.S.2/A440-08'.
 3. Unique, non-listed unit's performance, when not tested, may be addressed by a manufacturer's Statement of Qualification.
 4. Mullion design can be adequate for specified design pressure.
- B. Energy Ratings
- All units tested are one-lite, residential, LoE²-270, argon filled. Values are certified per NFRC, and units are labeled per state requirements.
1. Unique, non-listed units may have U & SHGC determined by NFRC procedures and listed on a manufacturer's Statement of Qualification.

1.05 SUBMITTALS

- A. Shop Drawings: Submit shop drawings in accordance with Section 01330 Submittal Procedures or Section 01 33 23 - Shop Drawings, Product Data, and Samples.
- B. Product Data: Submit catalog data in accordance with Section 01330 Submittal Procedures or Section 01 33 23 - Shop Drawings, Product Data, and Samples.

**SECTION 08 52 13.02
FIBERGLASS DOUBLE HUNG WINDOWS**

- C. Samples: Submit corner section in accordance with Section 01330 Submittal Procedures or Section 01 33 23 - Shop Drawings, Product Data, and Samples.
Include glazing system, quality of construction, specified finish, and color.
- D. Installation Instructions.
- E. Quality Control Submittals: Certificates: Submit performance test results reported by independent laboratory or manufacturer's Statement of Qualification indicating compliance with specified performance and design requirements.

1.06 QUALITY ASSURANCE

- A. Insulating Glass - two certification programs: IGCC and IGMAC. Possible IGMA Certification (harmonized IGMAC & SIGMA).
- B. NFRC Certification Program for Energy Rating of Fenestration.
- C. Mockup: Provide sample installation for field testing unit performance requirements for approval.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Deliver in original packaging, store in an upright position off the ground in a clean, dry area. Protect from weather and construction activities.
- B. Prime or seal wood surfaces, including surfaces to be concealed by wall construction if more than 30 days will expire between delivery and installation.

1.08 WARRANTY

- A. Glass: See Kolbe & Kolbe Glass Warranty for details and exclusions.
 - B. Pre-finishing: See Kolbe & Kolbe Finish Warranty for details and exclusions.
 - C. Product Defects: See Kolbe & Kolbe Product Warranty for details and exclusions.
 - D. International: See Kolbe & Kolbe International Warranty for details and exclusions.
- These warranties are available on our website at <http://www.kolbewindows.com>.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

For Individual and Muller Window Units Only:

- A. Basis of Design (BOD): Double Hung, factory assembled, vertical sliding window units as manufactured by Kolbe & Kolbe Millwork Co., Inc., Manawa, Wisconsin. Contact Greg Larson (612) 224-5276 Greg.larson@kolbegallerytc.com.
- B. Also approved: Marvin Essential Double Hung factory assembled, manufactured by Marvin Windows, Warroad, MN.:
- C. Also approved: Double Hung, factory assembled, vertical sliding window units as manufactured by Pella Corporation, 102

Main Street, Pella, Iowa 50219. Toll Free (800) 54-PELLA.
Phone (641) 621-1000. Website www.pellaADM.com.

D.

2.02 MATERIALS

- A. Frame: Constructed of multi-chambered fiberglass and UV stable polymer extrusions. The interior of the windows can be either wood/fiberglass which consists of pine interior stops and mull casings on mull units or All fiberglass, which consists of uPVC interior stops and mull casings on mull units. Frames have integrated heavy vinyl nailing fins at head, side jambs, and sill. Drip cap for installation is cut to fit and shipped loose.
1. Jamb thickness: 5/8 inch (16mm)
 2. Basic jamb width: 2-1/2 inch (64mm).
 3. Standard overall jamb with extensions applied: 4-9/16 inch (116mm)
 4. Exterior: All frame parts are .087 inch (2.2mm) thick.
 5. Corner Construction: Welded mitered corners
- B. Sash: Constructed of multi-chambered fiberglass and UV stable polymer extrusions. The interior of the windows can be either wood/fiberglass which consists of pine glazing beads or All fiberglass, which consists of uPVC glazing beads]. Water repellent, preservative treated glazing beads in accordance with WDMA I.S. 4-07'A.
1. Thickness: 1-3/4 inch (44.5 mm)
 2. Sash Width/Face Dimension: 1-7/8 inch (47.6mm).
 3. Exterior: Sash parts are .087 inch (2.2mm) thick.
 4. Corner construction: Welded mitered corners
 5. Interior glazed.
- C. Surface Finish:
1. Exterior Finish - Fiberglass with uPVC polymer exterior.
 - a. Standard Integral Colors: Cloud and Sahara
 - b. Acrylic Film Colors: Bronze and Midnight. Exterior acrylic films on frame and sash components. The film has a 100% polyvinylidene fluoride PVDF laminate top layer. The base layer consists of solar shield technology (SST) to further decrease heat build-up in the film and underlying components.
 2. Interior Finish - All Fiberglass
 - a. Standard integral colors: Cloud and Sahara
 - b. Fiberglass with a uPVC polymer interior.
- D. Hardware: All hardware is painted zinc.
1. Lock - 1 cam lock on units less than 30" in unit width and 2 locks for units greater than 30" in unit width.
 2. Tilt Latches - 2 tilt latches for both top and bottom operating sash.
 3. On Studio (sash set) Fixed Units and Transoms: Retainer clips are used on the head, sill, and sides of the unit.
- E. Weatherstripping: On all units, including Transoms.
1. Frame/Sill - weather stripped on the sill riser and slope sill.
 2. Sash: 2 rows of sash weather strip on all stiles. 2 rows of bulb seal on both the top rail and bottom rail.
- F. Screens: Sent loose as standard on all units.

SECTION 08 52 13.02 FIBERGLASS DOUBLE HUNG WINDOWS

1. Screen cloth: fiberglass is standard.
 2. Screen Channels: .024 inch (0.6mm) thick roll formed aluminum.
 3. Attachment: Spring clips with pulls.
 4. Corner Construction and Finish Color: Screen channels Sand.
- G. Jamb Extensions: Provide factory installed jamb extensions up to 9 inches (229 mm) for wall thickness indicated or required.
1. Finish: match interior frame finish. fiberglass units: PDL system utilizes a permanently adhered aluminum grille bar to the interior and a permanently adhered aluminum grille bar to the exterior glass.
 1. Material: Muntin is constructed of .050 inch (1mm) thick 6063 extruded aluminum alloy [7/8 inch (22mm) wide] [2-1/4 inch (57mm) wide].
 2. Pattern: rectangular.
 3. Spacer bar between the glass. Finish: Standard Champagne.
- J. Accessories & Trim: Casings are only available as cut-to-fit kits for field application.
1. Casings
 - a. 2-inch (51mm) Brickmould

2.03 GLAZING

A. Glass:

1. Triple Glazed: Standard one lite IG is 15/16" (23.8mm) with LoE²-270 on surface #2 and LoE-180 on surface #5, argon filled.]
2. All glass is select quality complying with FS-DD-G-451D.
3. IG complies with IGCC and ASTM E2190-08'.

B. Glazing Methods:

1. Units are dry glazed utilizing the EPDM full perimeter gasket. C. Glass Options:
 1. [LoE³ 340 - Glare Control] [LoE³-366]. [ThermaPlus LoE² glass has a [LoE²-270] [LoE³-366] option on surface 2 and a LoE hard coat on surface 4 plus permanent coating (interior pane)].
 2. gray lite.
 3. Tempered or laminated glass.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verification of conditions: Before installation, verify that openings are plumb and square and of proper dimension. Report frame defects or unsuitable conditions to the General Contractor before proceeding.
- B. Acceptance: Beginning of installation means acceptance of existing conditions.

3.02 INSTALLATION

SECTION 08 52 13.02 FIBERGLASS DOUBLE HUNG WINDOWS

- A. Install windows according to manufacturer's installation instructions, reviewed shop drawings .
- B. Install sealant and related flashing materials at perimeter of assembly in accordance with Section 07 92 00 - *Joint Sealants*.
- C. Install accessory items as required.

3.03 ADJUSTING AND CLEANING

- A. Adjust operable sash to work freely with hardware functioning properly. Re-adjust at completion of the project if directed.
- B. Remove visible labels.
- C. Leave windows in a job clean condition.

3.04 PROTECTION

- A. Cover windows during spray painting or other construction operations (such as muriatic acid washing after completion of masonry) that might cause damage.

END OF SECTION

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, INTERIOR WOOD DOOR and Section 08 11 13, HOLLOW METAL DOORS AND FRAMES.
- C. Finishes: Section 09 06 00, SCHEDULE FOR FINISHES.
- D. Painting: Section 09 91 00, PAINTING.
- E. Card Readers: Section 28 13 11, PHYSICAL ACCESS CONTROL SYSTEMS.
- F. Electrical: Division 26, ELECTRICAL.

1.3 GENERAL

- A. All hardware must comply with UFAS, (Uniform Federal Accessible Standards) unless specified otherwise.
- B. Provide rated door hardware assemblies where required by most current version of the International Building Code (IBC).
- C. Hardware for Labeled Fire Doors and Exit Doors: Conform to requirements of NFPA 80 for labeled fire doors and to NFPA 101 for exit doors, as well as to other requirements specified. Provide hardware listed by UL, except where heavier materials, large size, or better grades are specified herein under paragraph HARDWARE SETS. Instead 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. Make hardware for application on metal and wood doors and frames 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 to be of the same manufacturer, if possible, except as otherwise specified:
 - 1. Mortise locksets.
 - 2. Hinges for hollow metal and wood doors.
 - 3. Surface applied overhead door closers.
 - 4. Exit devices.

1.4 SUSTAINABILITY REQUIREMENTS

- A. Materials in this section may contribute towards contract compliance with sustainability requirements. See Section 01 81 11, SUSTAINABLE DESIGN REQUIRMENTS, for project, local/regional materials, low-emitting materials, and recycled content requirements.

1.5 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- B. Hardware Schedule: Prepare and submit hardware schedule in the following form:

| Hardware Item | Quantity | Size | Reference Publication Type No. | Finish | Mfr. Name and Catalog No. | Key Control Symbols | UL Mark (if fire rated and listed) | ANSI/BHMA Finish Designation |
|---------------|----------|------|--------------------------------|--------|---------------------------|---------------------|------------------------------------|------------------------------|
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

- C. Samples and Manufacturers' Literature:
 - 1. Samples: All hardware items (proposed for the project) that have not been previously approved by Builders Hardware Manufacturers Association must 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 must be accompanied by copies of reports as referenced. The testing must have been conducted 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.

1.6 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 must identify items by Project

Specification number and manufacturer's catalog number. These items will 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.

1.7 INSTRUCTIONS

- A. Hardware Set Symbols on Drawings: Except for protective plates, door stops, mutes, thresholds and the like specified herein, hardware requirements for each door are indicated on drawings by symbols. Symbols for hardware sets consist of letters "HW" followed by a number. Each number designates a set of hardware items applicable to a door type.
- B. Keying: Key cylinders into existing Key System. Provide removable core cylinders that are removable only with a special key or tool without disassembly of knob or lockset. Provide pin type cylinders. Keying information will be furnished at a later date by the COR.

1.8 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by the basic designation only. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
- B. American National Standards Institute/Builders Hardware Manufacturers Association (ANSI/BHMA):
 - A156.1-13 Butts and Hinges
 - A156.2-11 Bored and Pre-assembled Locks and Latches
 - A156.3-01 Exit Devices
 - A156.4-08 Door Controls (Closers)
 - A156.5-10 Auxiliary Locks and Associated Products
 - A156.6-10 Architectural Door Trim
 - A156.8-10 Door Controls-Overhead Stops and Holders
 - A156.13-12 Mortise Locks and Latches
 - A156.15-11 Release Devices-Closer Holder, Electromagnetic and Electromechanical
 - A156.16-02 American National Standard for Auxiliary Hardware
 - A156.18-12 Materials and Finishes
 - A156.21-09 Thresholds

- A156.22-12 Door Gasketing and Edge Seal Systems
- A156.23-10 Electromagnetic Locks
- A156.24-12 Delayed Egress Locking Systems
- A156.26-12 Continuous Hinges
- A156.31-01 Electric Strikes and Frame Mounted Actuators

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

- F883-09 Padlocks

D. Builders Hardware Manufacturers Association (BHMA):

Certified Products Directory 2014

E. National Fire Protection Association (NFPA):

- 80-13 Fire Doors and Fire Windows
- 101-12 Life Safety Code

F. Underwriters Laboratories, Inc. (UL):

Building Materials Directory

PART 2 - PRODUCTS

2.1 BUTT HINGES

A. ANSI A156.1. Provide the following types of butt hinges for the types of doors listed, except where otherwise specified:

1. Exterior Doors: Type A2112 for doors 900 mm (3 feet) wide or less and Type A2111 for doors over 900 mm (3 feet) wide. Provide hinges for exterior doors with non-removable pins.
2. Interior Doors: Type 8112 for doors 900 mm (3 feet) wide or less and Type A8111 for doors over 900 mm (3 feet) wide.

B. 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. Continuous, Gear-Type Hinges: Extruded-aluminum, pin-less, geared hinge leaves; joined by a continuous extruded-aluminum channel cap; with concealed, self-lubricating thrust bearings.

B. ANSI/BHMA A156.26, Grade 1-600.

1. Listed under Category N in BHMA's "Certified Product Directory."

2.3 DOOR CLOSING DEVICES

A. Provide closing devices of one manufacturer.

2.4 OVERHEAD CLOSERS - NOT USED

2.5 DOOR STOPS

A. Conform to ANSI A156.16.

- B. Provide door stops wherever an opened door or any item of hardware thereon would strike a wall, column, equipment or other parts of building construction. For concrete, masonry or quarry tile construction, use lead expansion shields for mounting door stops.
- C. Where cylindrical locks with turn pieces or pushbuttons occur, equip wall bumpers Type L02251 (rubber pads having concave face) to receive turn piece or button.
- D. Substitute floor stops Type L02141 or L02161 as appropriate, when wall bumpers would not provide an effective door stop.
- E. Where drywall partitions occur, use floor stops, Type L02141 or L02161.
- F. Provide stop Type L02011 or L02181, as applicable for exterior doors.
- G. Provide appropriate roller bumper for each set of doors (except where closet doors occur) where two doors would interfere with each other in swinging.
- H. Provide appropriate door mounted stop on doors in individual toilets where floor or wall mounted stops cannot be used.

2.6 FLOOR DOOR HOLDERS

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

2.7 LOCKS AND LATCHES

- A. Conform to ANSI A156.2. Locks and latches for doors 45 mm (1-3/4 inch) thick or over must have beveled fronts. Lock cylinders must have not less than six pins or seven pins. Cylinders for all locksets to be removable core type. Cylinder to 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. Lever or lockset must not require disassembly to remove core from lockset. All locksets or latches on double doors with fire label to have latch bolt with 19 mm (3/4 inch) throw. Provide temporary keying device or construction core of allow opening and closing during construction and prior to the installation of final cores.
- B. In addition, locks and latches must comply with following requirements:
 - 1. Mortise Lock and Latch Sets: Conform to ANSI/BHMA A156.13; Series 1000, minimum Grade 2. Locks and latchsets to be furnished with curved lip strike and wrought box. Lock function F02 to be furnished with emergency tools/keys for emergency entrance. 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 must meet ADA (Americans with Disabilities Act) requirements. Cylindrical locksets to be series 4000 Grade I. Knobs for series 4000 lock and latch sets to have 57 mm (2-1/4 inch) diameters. Where two turn pieces are specified for lock F76, turn piece on inside knob must lock and unlock inside knob, and turn piece on outside knob must 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 specified under hardware sets must conform to ANSI A156.5.

2.8 ELECTROMAGNETIC LOCKS

- A. ANSI/BHMA A156.23; electrically powered, of strength and configuration indicated; with electromagnet attached to frame and armature plate attached to door. Listed under Category E in BHMA's "Certified Product Directory."
 1. Type: Full exterior or full interior, as required by application indicated.
 2. Strength Ranking: 1500 lbf - 1000 lbf.

2.9 ELECTRIC STRIKES

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

2.10 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 | 10 each different key way |
| Master-keyed sets | 6 keys each |
| Grand Master sets | 6 keys each |
| Great Grand Master set | 5 keys |
| Control key | 1 key |

2.11 KICK-MOP PLATES

- A. Conform to ANSI Standard A156.6.
- B. Provide protective plates as specified below:
 - 1. Kick-mop plates and armor plates to be metal, Type J100 series, color as required.
 - 2. Provide kick-mop plates for both sides of each new door, except where noted as not required. Kick-mop plates to be 200 mm (8 inches) high. On push side of doors where jamb stop extends to floor, make combination kick-mop plates 38 mm (1-1/2 inches) less than width of door, except pairs of metal doors to have plates 25 mm (1 inch) less than width of each door. Extend all other combination kick-mop plates to within 6 mm (1/4 inch) of each edge of doors. Kick mop plates to butt astragals. For jamb stop requirements, see specification sections pertaining to door frames.
 - 3. Kick-mop plates are not required on following door sides:
 - a. Exterior side of exterior doors.
 - b. Closet side of closet doors.
 - c. Storage side of doors to or from storage spaces; and
 - d. Both sides of aluminum entrance doors.

2.12 EXIT DEVICES

- A. Conform to ANSI Standard A156.3, 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 to have lever handles similar to locksets, unless otherwise specified.
- B. Exit devices for fire doors must comply with Underwriters Laboratories, Inc., requirements for Fire Exit Hardware. Submit proof of compliance.

2.13 FLUSH BOLTS (LEVER EXTENSION)

- A. Conform to ANSI A156.16, Type L24081 unless otherwise specified. Furnish proper dustproof strikes conforming to ANSI A156.16, for flush bolts required on lower part of doors. Modify flush bolts to fit stiles of aluminum doors on double-acting doors.
- B. Face plates for cylindrical strikes to be rectangular and not less than 25 mm by 63 mm (1 inch by 2-1/2 inches).
- C. Friction-fit cylindrical dustproof strikes with circular face plate may be used only where metal thresholds occur.

2.14 DOOR PULLS WITH PLATES

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

2.15 PUSH PLATES

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

2.16 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), rounded top and bottom edges. 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. Mount pulls in down direction.

2.17 THRESHOLDS

- A. Conform to ANSI A156.21, mill finish extruded aluminum, except as otherwise specified. In existing construction, install thresholds in a bed of sealant with 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. At exterior doors and any interior doors exposed to moisture, provide threshold with non-slip abrasive finish.

2.18 WEATHERSTRIPS (FOR EXTERIOR DOORS)

- A. Conform to ANSI A156.22. Air leakage must not to exceed 0.50 CFM per foot of crack length (0.000774m³/s/m).

2.19 PADLOCKS FOR VARIOUS DOORS, GATES AND HATCHES

- A. ASTM F883, size 50 mm (2 inch) wide chain; furnish extended shackles as required by job conditions. Provide padlocks, with key cylinders, for each door in following areas as noted.
- B. Key padlocks as follows:
 - 1. Chain Link Fence Gates.
 - 2. Roof Access and Scuttles: Engineer's set.

2.20 FINISHES

- A. Exposed surfaces of hardware to have ANSI A156.18 finishes as specified below. Provide finishes on all hinges, pivots, closers, thresholds, etc. as specified below under "Miscellaneous Finishes." For field painting (final coat) of ferrous hardware, see Section 09 91 00, PAINTING.
- B. 626 or 630: 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 at rated doors or 626.
 - 3. Door Closers: Factory applied paint finish. Dull or Satin Aluminum color.
 - 4. Thresholds: Mill finish aluminum.
 - 5. Other primed steel hardware: 652.
- D. Hardware Finishes for Existing Buildings: Match finishes of hardware in (similar) existing spaces except where otherwise specified.

2.21 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. Visit the site, verify location of existing hardware and submit locations to COR for approval.
- B. Hardware Heights from Finished Floor:
 - 1. Exit devices centerline of strike (where applicable): 1000 mm (40-5/16 inches).
 - 2. Locksets and latch sets centerline of strike: 1000 mm (40-5/16 inches).
 - 3. Deadlocks centerline of strike: 1200 mm (48 inches).
 - 4. Centerline of door pulls: 1000 mm (40 inches).
 - 5. Push plates and push-pull: 1250 mm (50 inches) to top of plate.

6. Push-pull latch: 1000 mm (40-5/16 inches) to centerline of strike.
7. Centerline of deadlock strike: 840 mm (33 inches) when used with push-pull latch.
8. Locate other hardware at standard commercial heights.
9. Locate push and pull plates to prevent conflict with other hardware.

3.2 INSTALLATION

- A. Equip and mount closer devices, including those with hold-open features, to provide maximum door opening permitted by building construction or equipment. Closers to be mounted regular arm. Where closers are mounted on doors, mount with sex nuts and bolts; foot fastened to frame with machine screws.
- B. Substitute parallel arm or top jamb mounting for regular arm mounting where the following conditions occur:
 1. Where door swing, in fully open position, would be limited to less than 90 degrees due to partition construction and closer location.
 2. Where door to room opens outward into corridor.
 3. Where exterior doors open outward.
- C. Hinge Size Requirements:

| Door Thickness | Door Width | Hinge Height |
|--|---|-----------------------|
| 45 mm (1-3/4 inch) | 900 mm (3 feet) and less | 113 mm (4-1/2 inches) |
| 45 mm (1-3/4 inch) | Over 900 mm (3 feet) but not more than 1200 mm (4 feet) | 125 mm (5 inches) |
| 35 mm (1-3/8 inch) (hollow core wood doors) | Not over 1200 mm (4 feet) | 113 mm (4-1/2 inches) |

- D. Provide hinge leaves sufficiently wide to allow doors to swing clear of door frame trim.
- E. Where new hinges are specified for new doors in existing frames or existing doors in new frames, provide sizes of new hinges matching sizes of existing hinges; or, contractor may reuse existing hinges provided hinges are restored to satisfactory operating condition as approved by COR. Existing hinges cannot 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.
- F. Hinges Required Per Door:

| | |
|--|---------|
| Doors over 1500 mm (5 ft) high and not over 2280 mm (7 ft 6 in) high | 3 butts |
|--|---------|

- G. Fastenings: Suitable size and type to suit 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 must be of nonferrous metal.
- H. After locks have been installed; show in presence of COR that keys operate their respective locks in accordance with keying requirements. (Send keys, Master Key level and above by Registered Mail to the Cemetery Director along with the bitting list. Also send a copy of the invoice to the COR for the records.) Installation of locks which do not meet specified keying requirements will 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 HARDWARE SETS

- A. Following sets of hardware correspond to hardware symbols shown on drawings. Where hardware set for a single door is specified for a pair of doors; equip each leaf of such pair of doors with set noted. Only those hardware sets that are shown on drawings will be required. Disregard hardware sets listed in specifications but not shown on drawings.
- B. Manufacturer's Abbreviations:
- 1.MK - McKinney
 - 2.PE - Pemko
 - 3.RU - Corbin Russwin
 - 4.OT - Other
 - 5.HS - HES

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- 6.RO - Rockwood
- 7.RF - Rixson
- 8. SU - Securitron

C. Hardware Sets - Administration Building

Hardware Sets - Administration Building 1001

Set: HW 2

Doors: 2, B02, B03, B08

| | | | |
|---------------------------------|---|-------|----|
| 1 Continuous Hinge (A31031G) | CFM__SL-HD1 | | PE |
| 1 Storeroom Lock (F07) | ML2057 NSA LC | 626 | RU |
| 1 Cylinder | Verify & match existing - MK | 626 | OT |
| 1 Electric Strike (E09321) | 1006CS (includes 2005M3) | 630 | HS |
| 1 Surface Closer(C02011/C02021) | DC8200/DC8210 | 689 | RU |
| 1 Wall Stop (L02101) | 403 | US26D | RO |
| 3 Silencer (L03011) | 608-RKW | | RO |
| 1 Alarm Contact | By Security contractor | | OT |
| 1 CARD Reader | By security contractor | | OT |
| 1 Power supply | Regulated, filtered, 12 or 24V, Amperage as required | | SU |

Notes: Door is normally closed and locked. Exterior access by presenting a valid credential to reader, momentarily releasing electric strike for entry. Free egress at all times.

Set: HW 2.1

Doors:11

| | | | |
|------------------------------|------------------------------|-----|----|
| 1 Continuous Hinge (A31031G) | CFM__SL-HD1 | | PE |
| 1 Storeroom Lock (F07) | ML2057 NSA LC | 626 | RU |
| 1 Cylinder | Verify & match existing - MK | 626 | OT |
| 1 Electric Strike (E09321) | 1006CS (includes 2005M3) | 630 | HS |
| 1 Surface Closer (C02021-HD) | DC8210 A11 | 689 | RU |
| 1 Threshold (J12190/J32190) | 273x3AFG | | PE |
| 1 Gasketing (R0Y164) | 2893AV | | PE |
| 2 Gasketing (R0Y164) | 2903AV | | PE |

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| | | | |
|------------------------|---|-------|----|
| 1 Rain Guard (R0Y976) | 346C | | PE |
| 1 Door Bottom (R0Y436) | 216AFG | | PE |
| 1 Alarm Contact | By security contractor | | OT |
| 1 Card Reader | By security contractor | | OT |
| 1 Power Supply | Regulated, Filtered, 12 or 24V, Amperage as required | | SU |
| 1 Latch Protector | 321 | US32D | RO |

Set: HW 2.2

Doors: Not Used

| | | | |
|-------------------------------|------------------------------|-------|----|
| 2 Continuous Hinge (A31031G) | CFM__SL-HD1 | | PE |
| 2 Manual Bolt (L04251/L04261) | 555/557 | US26D | RO |
| 1 Dust Proof Strike (L04021) | 570 | US26D | RO |
| 1 Storeroom Lock (F07) | ML2057 NSA LC | 626 | RU |
| 1 Cylinder | Verify & match existing - MK | 626 | OT |
| 2 Wall Stop (L02101) | 403 | US26D | RO |
| 2 Silencer (L03011) | 608-RKW | | RO |

Set: HW 3

Doors: 1A

| | | | |
|------------------------------|---|-------|------|
| 1 Continuous Hinge (A31031G) | CFM__SL-HD1 | | PE |
| 1 Storeroom Lock (F07) | ML2057 NSA LC | 626 | RU |
| 1 Cylinder | Verify & match existing - MK | 626 | OT |
| 1 Electric Strike (E09321) | 1006CS | 630 | HS ↗ |
| 1 Surface Closer (C02021-HD) | DC8210 A11 | 689 | RU |
| 1 Wall Stop (L02101) | 403 | US26D | RO |
| 1 Threshold (J12130/J32130) | 271A | | PE |
| 1 Gasketing (R0Y154) | S88D | | PE |
| 1 Sweep (R0Y416) | 315CN | | PE |
| 1 Alarm Contact | By security contractor | | OT |
| 1 Card Reader | By security contractor | | OT |
| 1 Power Supply | Regulated, Filtered, 12 or 24V, Amperage as required | | SU ↗ |

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Notes: Verify existing conditions to receive new hardware.

Door is normally closed and locked.

Exterior access by presenting a valid credential to reader, momentarily releasing electric strike for entry.

Free egress at all times.

Set: HW 7

Doors 6,7

| | | | |
|----------------------------------|------------------------------|-------|----|
| 1 Continuous Hinge (A31031G) | CFM__SL-HD1 | | PE |
| 1 Storeroom Lock (F07) | ML2057 NSA LC | 626 | RU |
| 1 Cylinder | Verify & match existing - MK | 626 | OT |
| 1 Surface Closer (C02011/C02021) | DC8200/DC8210 | 689 | RU |
| 1 Kick Plate (J102) | K1050 12" CSK BEV | US32D | RO |
| 1 Wall Stop (L02101) | 403 | US26D | RO |
| 3 Silencer (L03011) | 608-RKW | | RO |

Set: HW 11

Doors: 3, 4

| | | | |
|-------------------------------|------------------------------|-------|----|
| 3 Hinge, Full Mortise (A8112) | TA2714 | US26D | MK |
| 1 Entrance Lock (F04) | ML2054 NSA LC | 626 | RU |
| 1 Cylinder | Verify & match existing - MK | 626 | OT |
| 1 Wall Stop (L02101) | 403 | US26D | RO |
| 3 Silencer (L03011) | 608-RKW | | RO |

Set: HW 11.1

Doors: 12

| | | | |
|-------------------------------|------------|-------|----|
| 3 Hinge, Full Mortise (A8112) | TA2714 | US26D | MK |
| 1 Passage Latch (F01) | ML2010 NSA | 626 | RU |
| 1 Surf Overhead Stop (C01541) | 9ADJ-_36 | 652 | RF |
| 1 Gasketing (R0Y154) | S88D | | PE |

Set: HW 12

Doors: Not Used

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| | | | |
|-------------------------------|------------------------------|-------|----|
| 3 Hinge, Full Mortise (A8112) | TA2714 NRP | US26D | MK |
| 1 Storeroom Lock (F07) | ML2057 NSA LC | 626 | RU |
| 1 Cylinder | Verify & match existing - MK | 626 | OT |
| 1 Wall Stop (L02101) | 403 | US26D | RO |
| 3 Silencer (L03011) | 608-RKW | | RO |

Set: HW 13

Doors: 5

| | | | |
|-------------------------------------|-------------------|-------|----|
| 3 Hinge, Full Mortise (A8112) | TA2714 | US26D | MK |
| 1 Privacy Lock (F19, ADA Thumbturn) | ML2030 NSA M34 | 626 | RU |
| 1 Kick Plate (J102) | K1050 12" CSK BEV | US32D | RO |
| 1 Mop Plate (J102) | K1050 8" CSK BEV | US32D | RO |
| 1 Wall Stop (L02101) | 403 | US26D | RO |
| 3 Silencer (L03011) | 608-RKW | | RO |

D. Hardware Sets - Maintenance Building

Hardware Sets- Maintenance Building 3001, 3002 and Vehicle Storage Bldg. 3003

Set: HW 0

Doors: 14

| | | | |
|-----------------|----------------------|--|----|
| 1 Cased Opening | No hardware required | | OT |
|-----------------|----------------------|--|----|

Set: HW 2.1A

Doors: 10, 13, 7A, 9

| | | | |
|------------------------------|------------------------------|-----|----|
| 1 Continuous Hinge (A31031G) | CFM__SL-HD1 | | PE |
| 1 Storeroom Lock (F07) | ML2057 NSA LC | 626 | RU |
| 1 Cylinder | Verify & match existing - MK | 626 | OT |
| 1 Surface Closer (C02021-HD) | DC8210 A11 | 689 | RU |
| 1 Threshold (J12190/J32190) | 273x3AFG | | PE |
| 1 Gasketing (R0Y164) | 2893AV | | PE |
| 2 Gasketing (R0Y164) | 2903AV | | PE |
| 1 Rain Guard (R0Y976) | 346C | | PE |
| 1 Door Bottom (R0Y436) | 216AFG | | PE |

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| | | | |
|-----------------------|---------------------------------|----|----|
| 1 Latch Protector 321 | US32D RO | | |
| 1 Alarm Contact | By security contractor | | OT |
| 1 Card Reader | By security contractor | | OT |
| 1 Power Supply | Regulated, Filtered, 12 or 24V, | SU | ⚡ |
| | Amperage as required | | |

Notes: Door is normally closed and locked.

Exterior access by presenting a valid credential to reader, momentarily releasing electric strike for entry.

Free egress at all times.

Set: HW 2.1B

Doors: 2-1, 2-2, 3-1

Upgrade to doors at Maintenance Building 2 and Vehicle Storage Building

| | | | |
|-----------------|---------------------------------|----|----|
| 1 Alarm Contact | By security contractor | | OT |
| 1 Card Reader | By security contractor | | OT |
| 1 Power Supply | Regulated, Filtered, 12 or 24V, | SU | ⚡ |
| | Amperage as required | | |

Notes: Door is normally closed and locked.

Exterior access by presenting a valid credential to reader, momentarily releasing electric strike for entry.

Free egress at all times.

Set: HW 4

Doors: 18

| | | | |
|----------------------------------|------------------------------|-------|------|
| 1 Continuous Hinge (A31031G) | CFM__SL-HD1 | | PE |
| 1 Storeroom Lock (F07) | ML2057 NSA LC | 626 | RU |
| 1 Cylinder | Verify & match existing - MK | 626 | OT |
| 1 Electric Strike (E09321) | 4500C | 630 | HS ⚡ |
| 1 Surface Closer (C02011/C02021) | DC8200/DC8210 | 689 | RU |
| 1 Kick Plate (J102) | K1050 12" CSK BEV | US32D | RO |
| 1 Wall Stop (L02101) | 403 | US26D | RO |
| 1 Gasketing (R0Y154) | S88D | | PE |

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| | | |
|-----------------|---|------|
| 1 Alarm Contact | By security contractor | OT |
| 1 Card Reader | By security contractor | OT |
| 1 Power Supply | Regulated, Filtered, 12 or 24V, Amperage as reqd | SU ↗ |

Notes: Door is normally closed and locked.

Exterior access by presenting a valid credential to reader, momentarily releasing electric strike for entry.

Free egress at all times.

Set: HW 7

Doors: 19

| | | | |
|----------------------------------|------------------------------|-------|----|
| 1 Continuous Hinge (A31031G) | CFM__SL-HD1 | | PE |
| 1 Storeroom Lock (F07) | ML2057 NSA LC | 626 | RU |
| 1 Cylinder | Verify & match existing - MK | 626 | OT |
| 1 Surface Closer (C02011/C02021) | DC8200/DC8210 | 689 | RU |
| 1 Kick Plate (J102) | K1050 12" CSK BEV | US32D | RO |
| 1 Wall Stop (L02101) | 403 | US26D | RO |
| 3 Silencer (L03011) | 608-RKW | | RO |

Set: HW 11

Doors: 17B, 2, 4

| | | | |
|-------------------------------|------------------------------|-------|----|
| 3 Hinge, Full Mortise (A8112) | TA2714 | US26D | MK |
| 1 Entrance Lock (F04) | ML2054 NSA LC | 626 | RU |
| 1 Cylinder | Verify & match existing - MK | 626 | OT |
| 1 Wall Stop (L02101) | 403 | US26D | RO |
| 3 Silencer (L03011) | 608-RKW | | RO |

Set: HW 11.1

Doors: 7B

| | | | |
|-------------------------------|------------|-------|----|
| 3 Hinge, Full Mortise (A8112) | TA2714 | US26D | MK |
| 1 Passage Latch (F01) | ML2010 NSA | 626 | RU |
| 1 Surf Overhead Stop (C01541) | 9ADJ-_36 | 652 | RF |
| 1 Gasketing (R0Y154) | S88D | | PE |

Set: HW 15.1

Doors: 3

| | | | |
|---|-------------------|-------|----|
| 3 Hinge, Full Mort Hvy Wt (A8111)T4A3786 | | US26D | MK |
| 1 Push Plate (J301) | 70C-RKW | US32D | RO |
| 1 Pull Plate (J405) | 111x70C | US32D | RO |
| 1 Surface Closer (C02011/C02021)DC8200/DC8210 | | 689 | RU |
| 1 Kick Plate (J102) | K1050 12" CSK BEV | US32D | RO |
| 1 Mop Plate (J103) | K1050 8" CSK BEV | US32D | RO |
| 1 Wall Stop (L02101) | 403 | US26D | RO |
| 1 Gasketing (R0Y154) | S88D | | PE |

Set: HW 15.2

Doors: 16, 8

| | | | |
|---|--------------------|-------|----|
| 3 Hinge, Full Mort Hvy Wt (A8111)T4A3786 | | US26D | MK |
| 1 Push Plate (J301) | 70C-RKW | US32D | RO |
| 1 Pull Plate (J405) | 111x70C | US32D | RO |
| 1 Surf Overhead Stop (C01541) 9ADJ-_36 | | 652 | RF |
| 1 Surface Closer (C02011/C02021)DC8200/DC8210 | | 689 | RU |
| 1 Drop Plate | 754F2_ as required | 689 | RU |
| 1 Kick Plate (J102) | K1050 12" CSK BEV | US32D | RO |
| 1 Mop Plate (J103) | K1050 8" CSK BEV | US32D | RO |
| 1 Wall Stop (L02101) | 403 | US26D | RO |
| 1 Gasketing (R0Y154) | S88D | | PE |

Set: HW 19

Doors: 17A

| | | | |
|--------------------------------------|------------------------------|-------|----|
| 3 Hinge, Full Mortise (A8112) TA2714 | | US26D | MK |
| 1 Storeroom Lock (F07) | ML2057 NSA LC | 626 | RU |
| 1 Cylinder | Verify & match existing - MK | 626 | OT |
| 1 Wall Stop (L02101) | 403 | US26D | RO |
| 1 Threshold (J12130/J32130) | 271A | | PE |
| 1 Gasketing (R0Y154) | S88D | | PE |
| 1 Sweep (R0Y416) | 315CN | | PE |

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- - - E N D - - -

SECTION 08 80 00
GLAZING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies glass, related glazing materials and accessories. Glazing products specified apply to factory or field glazed items. For window glazing types, see sections for Fiberglass Double Hung Windows and Aluminum Clad Casement Windows.

1.2 RELATED WORK

- A. Factory glazed by manufacturer in following units:
1. Section 08 11 13, HOLLOW METAL DOORS AND FRAMES, and Section 08 14 00, INTERIOR WOOD DOORS.
 2. Mirrors: Section 10 28 00, TOILET, BATH, AND LAUNDRY ACCESSORIES.
 3. Section 0852 13.02 FIBERGLASS DOUBLE HUNG, Section 08 52 13 ALUMINUM CLAD WOOD CASEMENT WINDOWS.

1.3 LABELS

- A. Temporary Labels:
1. Provide temporary label on each light of glass identifying manufacturer or brand and glass type, quality and nominal thickness. Identify coated side of glass units.
 2. Label in accordance with NFRC (National Fenestration Rating Council) label requirements.
 3. Temporary labels must remain intact until glass is approved by COR.
- B. Permanent Labels:
1. Locate in corner for each pane.
 2. Label in accordance with SGCC (Safety Glass Certification Council) label requirements.
 - a. Tempered glass.
 - b. Laminated glass.

1.4 PERFORMANCE REQUIREMENTS

- A. General: Design glazing system consistent with guidance and practices presented in the GANA Glazing Manual, GANA Laminated Glazing Manual, and GANA Sealant Manual, as applicable to project. Installed glazing must withstand applied loads, thermal stresses, thermal movements, building movements, permitted tolerances, and combinations of these conditions without failure, including loss or glass breakage attributable to defective manufacture, fabrication, or installation;

failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; unsafe engagement of the framing system; deflections beyond specified limits; or other defects in construction.

B. Glazing Unit Design: Design glass, including engineering analysis meeting requirements of authorities having jurisdiction. Thicknesses listed are minimum. Coordinate thicknesses with framing system manufacturers.

1. Design glass in accordance with ASTM E1300, and for conditions beyond the scope of ASTM E1300, by a properly substantiated structural analysis.

2. Design Wind Pressures: As indicated on Drawings in accordance with applicable code.

3. Wind Design Data: As indicated on Drawings in accordance with applicable code.

4. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than the structural capacity of the glazing unit, the threshold at which frame engagement is no longer safely assured, 1/100 times the short-side length, or 0.75 inch (19 mm), whichever is less.

D. Building Enclosure Vapor Retarder and Air Barrier:

1. Utilize the inner pane of multiple panes sealed units for the continuity of the air barrier and vapor retarder seal.

2. Maintain a continuous air barrier and vapor retarder throughout the glazed assembly from glass pane to heel bead of glazing sealant.

1.5 SUSTAINABILITY REQUIREMENTS

A. Materials in this section may contribute towards contract compliance with sustainability requirements. See Section 01 81 11, SUSTAINABLE DESIGN REQUIREMENTS, for project local/regional materials, low-emitting materials, or recycled content requirements.

1.6 SUBMITTALS

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

B. Manufacturer's Certificates:

1. Provide certificate stating that fire-protective and fire-resistive glazing units meet code requirements for fire-resistance-rated assembly and applicable safety glazing requirements.

2. Certify solar heat gain coefficient when value is specified.
 3. Certify "R" value when value is specified.
- C. Warranty: Submit sample warranty, conforming to "Warranty" Article in this Section.
- D. Manufacturer's Literature and Data:
1. Glass, each kind required.
 2. Insulating glass units.
 3. Glazing accessories, each type.
- E. Samples:
1. Size: 300 mm by 300 mm (12 by 12 inches).
 2. All glazing types specified for the project.
- F. Preconstruction Adhesion and Compatibility Test Report: Submit glazing sealant manufacturer's test report indicating glazing sealants were tested for adhesion to glass and glazing channel substrates and for compatibility with glass and other glazing materials.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Schedule delivery to coincide with glazing schedules so minimum handling of crates is required. Do not open crates except as required for inspection for shipping damage.
- B. Storage: Store cases according to printed instructions on case, in areas least subject to traffic or falling objects. Keep storage area clean and dry.
- C. Handling: Unpack cases following printed instructions on case. Stack individual windows on edge leaned slightly against upright supports with separators between each.

1.8 PROJECT CONDITIONS

- A. Field Measurements: Field measure openings before ordering tempered glass products. Be responsible for proper fit of field measured products.

1.9 WARRANTY

- A. Warranty: Conform to terms of "Warranty" Article, FAR clause 52.246-21, except extend warranty period for the following:
1. Insulating glass units to remain sealed and free of obstruction of vision by dust, moisture, or film on interior surfaces of glass for 10 years.

2. Laminated glass units to remain visibly clear without edge separation, delamination affecting vision, and blemishes for 5 years.
3. Coated glass units to remain visibly clear without peeling, cracking, or discoloration for 10 years.

1.10 APPLICABLE PUBLICATIONS

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

B. American Society of Civil Engineers/Structural Engineering Institute (ASCE):

ASCE/SEI 7-2010 Minimum Design Loads for Buildings and Other Structures

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

C542-05(2017) Lock-Strip Gaskets

C716-06(2020) Installing Lock-Strip Gaskets and Infill Glazing Materials

C864-05(2019) Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers

C920-18 Elastomeric Joint Sealants

C1036-21 Flat Glass

C1048-18 Heat-Treated Flat Glass-Kind HS, Kind FT Coated and Uncoated Glass

C1172-19 Laminated Architectural Flat Glass

E1300-16 Determining Load Resistance of Glass in Buildings

E1886-19 Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials

E1996-20 Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes

E2190-19 Insulating Glass Unit

D. Glass Association of North America (GANA):

Glazing Manual (2009)

Laminated Glazing Manual (2009)

Sealant Manual (2009)

Protective Glazing Manual (2011)

E. International Code Council (ICC):

International Building Code (IBC), adopted
edition applicable to project

F. National Fenestration Rating Council (NFRC)

G. Safety Glazing Certification Council (SGCC):

Certified Products Directory (Issued Semi-
Annually)

H. Sealant, Waterproofing, and Restoration Institute (SWRI):

Product Validation Program

PART 2 - PRODUCT

2.1 GLASS PRODUCTS

A. Provide minimum thickness stated and as additionally required to meet performance requirements.

1. Provide minimum 6 mm (1/4 inch) thick glass units unless otherwise indicated.

B. Obtain glass units from single source from single manufacturer for each glass type.

C. Clear Annealed Float Glass: ASTM C1036, Type I, Class 1, Quality q3.

D. Low-emissivity-coated glass: ASTM C1036, Type I, Class 2, Quality q3.

2.2 HEAT-TREATED GLASS

A. Clear Heat-Strengthened Float Glass: ASTM C1048, Kind HS, Condition A, Type I, Class 1, Quality q3.

B. Clear Tempered Float Glass: ASTM C1048, Kind FT, Condition A, Type I, Class 1, Quality q3.

2.3 INSULATING GLASS UNITS

A. Provide factory fabricated, hermetically sealed glass unit consisting of two panes of glass separated by a dehydrated air space and comply with ASTM E2190.

B. Assemble units using glass types specified.

2.4 GLAZING ACCESSORIES

A. As required to supplement the accessories provided with the items to be glazed and to provide a complete installation. Provide accessories approved by manufacturer for application and compatible with related

materials. Provide ferrous metal accessories exposed in the finished work, with a finish that will not corrode or stain while in service.

B. Setting Blocks: ASTM C864:

1. Channel shape; having 6 mm (1/4 inch) internal depth.
2. Shore A hardness of 80 to 90 Durometer.
3. Block lengths: 50 mm (two inches) except 100 to 150 mm (four to six inches) for insulating glass.
4. Block width: Approximately 1.6 mm (1/16 inch) less than the full width of the rabbet.
5. Block thickness: Minimum 4.8 mm (3/16 inch). Thickness sized for rabbet depth as required.

C. Spacers: ASTM C864:

1. Channel shape having a 6 mm (1/4 inch) internal depth.
2. Flanges not less 2.4 mm (3/32 inch) thick and web 3 mm (1/8 inch) thick.
3. Lengths: One to 25 to 76 mm (one to three inches).
4. Shore a hardness of 40 to 50 Durometer.

D. Sealing Tapes:

1. Semi-solid polymeric based material exhibiting pressure-sensitive adhesion and withstanding exposure to sunlight, moisture, heat, cold, and aging.
2. Shape, size and degree of softness and strength suitable for use in glazing application to prevent water infiltration.

E. Glazing Gaskets: ASTM C864:

1. Firm dense wedge shape for locking in sash.
2. Soft, closed cell with locking key for sash key.
3. Flanges may terminate above the glazing-beads or terminate flush with top of beads.

F. Lock-Strip Glazing Gaskets: ASTM C542, shape, size, and mounting as indicated.

G. Glazing Sealants: ASTM C920, silicone neutral cure:

1. Type S.
2. Class 25 or 50 as recommended by manufacturer for application.
3. Grade NS.
4. Shore A hardness of 25 to 30 Durometer.
5. SWRI validated.

I. Color - Glazing Compounds, Gaskets, and Sealants:

1. Match color of the finished aluminum and be non-staining, when in contact with aluminum.
2. Provide black, gray, or neutral color, when in contact with other exposed and prefinished materials (unpainted).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions:
 1. Examine openings for glass and glazing units; determine they are proper size; plumb; square; and level before installation is started.
 2. Verify that glazing openings conform with details, dimensions and tolerances indicated on manufacturer's approved shop drawings.
- B. Do not proceed with installation until above conditions have been verified or corrected, at no additional cost to government.
- C. Verify that wash down of adjacent masonry is completed prior to erection of glass and glazing units to prevent damage to glass and glazing units by cleaning materials.

3.2 PREPARATION

- A. For sealant glazing, prepare glazing surfaces in accordance with GANA Sealant Manual.
- B. Determine glazing unit size and edge clearances by measuring the actual unit to receive the glazing.
- C. Shop-fabricate and cut glass with smooth, straight edges of full size required by openings to provide GANA recommended edge clearances.
- D. Verify that components used are compatible.
- E. Clean and dry glazing surfaces.
- F. Prime surfaces scheduled to receive sealants, as determined by preconstruction sealant-substrate testing.

3.3 INSTALLATION - GENERAL

- A. Install in accordance with GANA Glazing Manual and GANA Sealant Manual unless specified otherwise.
- B. Glaze in accordance with recommendations of glazing and framing manufacturers, and as required to meet performance requirements specified in other applicable sections of specifications.
- C. Set glazing without bending, twisting, or forcing of units.
- D. Do not allow glass to rest on or contact any framing member.

- E. Glaze doors and operable sash, in a securely fixed or closed and locked position, until sealant, glazing compound, or putty has thoroughly set.
- F. Tempered Glass: Install with roller distortions in horizontal position unless otherwise directed.
- G. Insulating Glass Units:
 - 1. Glaze in compliance with glass manufacturer's written instructions.
 - 2. When glazing gaskets are used, provide in sufficient size and depth to cover glass seal or metal channel frame completely.
 - 3. Do not use putty or glazing compounds.
 - 4. Do not grind, nip, cut, or otherwise alter edges and corners of fused glass units after shipping from factory.
 - 5. Install with tape or gunnable sealant in wood sash.

3.4 INSTALLATION - DRY METHOD (TAPE AND GASKET SPLINE GLAZING)

- A. Cut glazing tape to length; install on glazing pane. Seal corners by butting and sealing junctions with butyl sealant.
- B. Place setting blocks at 1/4 points with edge block no more than 150 mm (6 inches) from corners.
- C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure to attain full contact.
- D. Install removable stops without displacing glazing spline. Exert pressure for full continuous contact.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Trim protruding tape edge.

3.5 INSTALLATION - WET/DRY METHOD (PREFORMED TAPE AND SEALANT)

- A. Cut glazing tape to length and set against permanent stops, 5 mm (3/16 inch) below sight line. Seal corners by butting tape and dabbing with butyl sealant.
- B. Apply heel bead of butyl sealant along intersection of permanent stop with frame ensuring full perimeter seal between glass and frame to complete the continuity of the air and vapor seal.
- C. Place setting blocks at 1/4 points with edge block no more than 150 mm (6 inches) from corners.
- D. Rest glazing on setting blocks and push against tape and heel bead of sealant with sufficient pressure to achieve full contact at perimeter of pane or glass unit.

- E. Install removable stops, with spacer strips inserted between glazing and applied stops, 6 mm (1/4 inch) below sight line. Place glazing tape on glazing pane or unit with tape flush with sight line.
- F. Fill gap between glazing and stop with sealant to depth equal to bite of frame on glazing, but not more than 9 mm (3/8 inch) below sight line.
- G. Apply cap bead of sealant along void between the stop and the glazing, to uniform line, flush with sight line. Tool or wipe sealant surface smooth.

3.6 INSTALLATION - WET METHOD (SEALANT AND SEALANT)

- A. Place setting blocks at 1/4 points and install glazing pane or unit.
- B. Install removable stops with glazing centered in space by inserting spacer shims both sides at 600 mm (24 inch) intervals, 6 mm (1/4 inch) below sight line.
- C. Fill gaps between glazing and stops with sealant to depth of bite on glazing, but not more than 9 mm (3/8 inch) below sight line to ensure full contact with glazing and continue the air and vapor seal.
- D. Apply sealant to uniform line, flush with sight line. Tool or wipe sealant surface smooth.

3.7 INSTALLATION - INTERIOR WET/DRY METHOD (TAPE AND SEALANT)

- A. Cut glazing tape to length and install against permanent stops, projecting 1.6 mm (1/16 inch) above sight line.
- B. Place setting blocks at 1/4 points with edge block no more than 150 mm (6 inches) from corners.
- C. Rest glazing on setting blocks and push against tape to ensure full contact at perimeter of pane or unit.
- D. Install removable stops, spacer shims inserted between glazing and applied stops at 600 mm (24 inch) intervals, 6 mm (1/4 inch) below sight line.
- E. Fill gaps between pane and applied stop with sealant to depth equal to bite on glazing, to uniform and level line.
- F. Trim protruding tape edge.

3.8 INSTALLATION - INTERIOR WET METHOD (COMPOUND AND COMPOUND) (NOT USED)

3.9 INSTALLATION - REGLAZING HISTORIC FRAMING (NOT USED)

3.10 REPLACEMENT AND CLEANING

- A. Clean new glass surfaces removing temporary labels, paint spots, and defacement after approval by Resident Engineer.

- B. Replace cracked, broken, and imperfect glass, or glass which has been installed improperly.
- C. Leave glass, putty, and other setting material in clean, whole, and acceptable condition.

3.11 PROTECTION

- A. Protect finished surfaces from damage during erection, and after completion of work. Strippable plastic coatings on colored anodized finish are not acceptable.

3.12 MONOLITHIC GLASS SCHEDULE

- A. Glass Type MG-1: Clear fully tempered float glass.
 - 1. Minimum Thickness: 6 mm.
 - 2. Safety glazing required.

3.13 LAMINATED GLASS SCHEDULE - NOT USED

3.14 INSULATING GLASS SCHEDULE

- A. Glass Type IG-1: Low-E-coated, clear insulating glass.
 - 1. Overall Unit Thickness: 17 mm (11/16 inch).
 - 2. Minimum Thickness of Each Glass Lite: 3 mm (0.12 inch).
 - 3. Outdoor Lite: Annealed float glass and fully tempered float glass at door.
 - 4. Interspace Content: Argon.
 - 5. Indoor Lite: Fully tempered float glass.
 - 6. Low-E Coating: Sputtered on second surface.
 - 7. Visible Light Transmittance: 68 percent minimum.
 - 8. Solar Heat Gain Coefficient: 0.64 maximum.
 - 9. Safety glazing required.

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**SECTION 08 90 00
LOUVERS AND VENTS**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies fixed and operable wall louvers and wall vents.
- B. Color of Finish: Bronze/Dark Bronze except for White Gable Vent on Maintenance building addition and Stainless Steel at Maintenance building existing flammable storage.

1.2 RELATED WORK

- A. Carpentry: Section 06 10 00, ROUGH CARPENTRY.
- B. Attic ventilation and baffles: Section 07 21 13, LOOSE FILL INSULATION.
- C. Roof top ventilation and ridge vents: Section 07 31 13, ASPHALT SHINGLES.

1.3 SUSTAINABILITY REQUIREMENTS

- A. Materials in this section may contribute towards contract compliance with sustainability requirements. See Section 01 81 11, SUSTAINABLE DESIGN REQUIREMENTS, for project, local/regional materials, low-emitting materials, and recycled content.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Shop Drawings: For each type of product.
 - 1. Show material, finish, size of members, operating devices, method of assembly, and installation and anchorage details.
 - 2. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
- C. Manufacturer's Literature and Data: For each type of louver and vent.
 - 1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by the basic designation only. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
- B. Air Movement and Control Association, Inc. (AMCA):

- 500-L-12 Testing Louvers
- C. American Architectural Manufacturers Association (AAMA):
- 2605-05 Performing Organic Coatings on Architectural
Extrusions and Panels
- D. American Society for Testing and Materials (ASTM):
- A167-99 Stainless and Heat-Resisting Chromium-Nickel
Steel Plate, Sheet, and Strip
- A1008/A1008M-12a Steel, Sheet, Carbon, Cold Rolled, Structural,
and High Strength Low-Alloy with Improved
Formability
- B209/B209M-10 Aluminum and Aluminum Alloy, Sheet and Plate
- B221-13 Aluminum and Aluminum Alloy Extruded Bars,
Rods, Wire, Profiles, and Tubes
- E. The Master Painters Institute (MPI):
- Approved Product List - Current Year
- F. National Association of Architectural Metal Manufacturers (NAAMM):
- AMP 500-505 Metal Finishes Manual
- G. National Fire Protection Association (NFPA):
- 90A-12 Installation of Air Conditioning and
Ventilating Systems

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Aluminum, Extruded: ASTM B221.
- B. Stainless Steel: ASTM A167, Type 302B.
- C. Carbon Steel: ASTM A1008.
- D. Aluminum, Plate and Sheet: ASTM B209.
- E. Fasteners: Provide toggle or expansion bolt fasteners for securing louvers and wall vents to adjoining construction, except as otherwise specified or shown, 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.
- F. Inorganic Zinc Primer: MPI No. 19.

2.2 EXTERIOR WALL LOUVERS

A. General:

1. Provide fixed type louvers of size and design shown.
2. Heads, sills and jamb sections formed with caulking slots or designed to retain caulking. Head sections 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 to be mechanically fastened or welded construction with welds dressed smooth and flush.

B. Performance Characteristics:

1. Provide weather louvers with a minimum of 50 percent free area and pass 500 fpm free area velocity at a pressure drop not exceeding 0.1 inch water gage 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 must bear AMCA certified rating seals for Air Performance and Water Penetration ratings.

C. Aluminum Louvers:

1. General: Frames, blades, sills, and mullions (sliding interlocking type); 2 mm (0.081-inch) thick extruded aluminum.
2. Blades to be drainable type and have reinforcing bosses.
3. Louvers, Fixed:
 - a. Make frame sizes 13 mm (1/2-inch) smaller than openings.
 - b. Single louvers frames not to exceed 1700 mm (66 inches) wide.
 - c. When openings exceed 1700 mm (66 inches), provide twin louvers separated by mullion members.

D. Stainless Steel Louvers: Form stainless steel louvers using 1.6 mm (0.063-inch) thick sheet for frames, blades, sills and mullions.

1. Louver to have fixed 45 degree drainable blades with water baffle; make overall frame size 13 mm (1/2-inch) less than opening, unless otherwise shown.
2. Single louver sections not exceed 1700 mm (66 inches) in width; for openings larger than 1700 mm (66 inches) wide, provide multiple sections not larger than 1700 mm (66 inches) wide separated by mullions.

2.3 CLOSURE ANGLES AND CLOSURE PLATES

- A. Fabricate from 2 mm (0.074-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 specified.

2.4 WIRE GUARDS

- A. Provide wire guards on outside of all exterior louvers, except on exhaust air louvers. Aluminum to be used at aluminum construction and Stainless steel to be used Stainless steel construction.
- B. Fabricate frames from 2 mm (0.081-inch) thick extruded or sheet aluminum and 1.5 mm (0.059-inch) thick stainless steel designed to retain wire mesh.
- C. Provide wire mesh woven from minimum 1.6 mm (0.063-inch) diameter aluminum wire and 1.3 mm (0.05-inch) diameter stainless steel wire in 13 mm (1/2-inch) square mesh.
- D. Miter corners and join by concealed corner clips or locks extending about 57 mm (2-1/4 inches) into rails and stiles. Equip wire guards over four feet in height with a mid-rail constructed as specified for frame components.
- E. Fasten frames to outside of louvers with aluminum or stainless steel devices designed to allow removal and replacement without damage to the wire guard or the louver.

2.5 EXTERIOR DOOR LOUVERS - NOT USED

2.6 INTERIOR DOOR LOUVERS - NOT USED

2.7 WALL VENTS

- A. Fabricate exterior wall vents from 4.7 mm (0.187-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 to have aluminum screen frame with aluminum alloy insect screening mounted on back of vent.
- 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 minimum 6 mm (1/4-inch) diameter expansion bolts at jambs.
- D. Demountable gable vent as indicated on drawings.

2.8 AIR INTAKE VENTS

- A. Fabricate exterior louvered wall ventilators for fresh air intake for air conditioning units from extruded aluminum, ASTM B221.

- B. Form with integral horizontal louvers and frame, with drip extending beyond face of wall and integral water stops.
- C. Provide aluminum closures where shown for inside face of dummy vents.
- D. Provide 0.8 mm (0.032-inch) thick aluminum sleeves in cavity walls.

2.9 BRICK VENTS

- A. Vents to be of size shown formed of approximately 3 mm (0.125 inch) thick cast aluminum, or 3 mm (0.125) 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.

2.10 SOFFIT VENTS

- A. Match existing roofing system materials.
- B. Vent strips to be provided at roof edge of administration building.
 - 1. Provide vents with internal filters, internal baffles, or external baffles, for weather protection.
 - 2. Free Area: Minimum 25400 square mm per m (12 square inches per foot).

2.11 FINISH

- A. In accordance with NAAMM Metal Finishes Manual: AMP 500-505.
- B. Aluminum Louvers, Air Intake Vents, Wire Guards:
 - 1. Anodized Finish:
 - a. AA-C22A42 Chemically etched medium matte, with integrally colored anodic coating, Class I Architectural, 0.7 mils thick.
 - c. AA-C22A44 Chemically etched medium matte, with electronically deposited metallic compound, Class I Architectural, 0.7 mils thick may be provided as an option for AA-C22A42 color anodic coating. Dyes will not be accepted.
 - 2. Organic Finish: AAMA 2605 (Fluorocarbon coating).
- C. Stainless Steel: Mechanical finish No. 4 in accordance with NAAMM Metal Finishes Manual.

2.12 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 paint (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 shown; 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. Generally 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.

3.2 CLEANING AND ADJUSTING

- A. After installation, clean exposed prefinished and plated items and items fabricated from stainless steel and aluminum as recommended by the manufacturer and protected from damage until completion of the project.
- B. Clean and adjust movable parts, including hardware, 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

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SECTION 09 05 16
SUBSURFACE PREPARATION FOR FLOOR FINISHES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies subsurface preparation requirements for areas to
- B. Receive the installation of applied and resinous flooring. This section includes removal of existing floor coverings, testing concrete for moisture and pH, remedial floor coating for concrete floor slabs having unsatisfactory moisture or pH conditions, floor leveling and repair as required.

1.2 RELATED WORK

- A. Section 07 92 00, JOINT SEALANTS.
- B. Section 09 65 19, RESILIENT TILE FLOORING // Section 09 67 23.20, RESINOUS EPOXY BASE WITH VINYL CHIP BROADCAST (RES-2) // Section 09 67 23.30, RESINOUS MORTAR (Epoxy Resin Composition) FLOORING // Section 09 67 23.50, RESINOUS (Epoxy Terrazzo) FLOORING (RES-5) // Section 09 67 23 60, RESINOUS (Urethane and Epoxy Mortar) FLOORING // Section 09 68 00, CARPETING.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA and TEST DATA.
- B. Written approval confirming product compatibility with subfloor material manufacturer and the flooring manufacturer
- C. Product Data:
 - 1. Moisture remediation system
 - 2. Underlayment Primer
 - 3. Cementitious Self-Leveling Underlayment
 - 4. Cementitious Trowel-Applied Underlayment (Not suitable for resinous floor finishes)
- D. Test Data:
 - 1. Moisture test and pH results performed by a qualified independent testing agency or warranty holding manufacturer's technical representative.

1.4 DELIVERY AND STORAGE

- A. Deliver materials in containers with labels legible and intact and grade-seals unbroken.

B. Store material to prevent damage or contamination.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in text by basic designation only.
- B. ASTM International (ASTM):
 - D638-22.....Standard Test Method for Tensile Properties of Plastics
 - D4259-18.....Standard Practice for Preparation of Concrete by Abrasion Prior to Coating Application.
 - C109/C109M-21.....Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens
 - D7234-21.....Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers
 - E96/E96M-22.....Standard Test Methods for Water Vapor Transmission of Materials
 - F710-21.....Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring
 - F1869-22.....Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
 - F2170-19a.....Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes
 - C348-21.....Standard Test Method for Flexural Strength of Hydraulic-Cement Mortars
 - C191-21.....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 floor coverings in 16 hours, and resinous flooring in 3-7 days.
- H. Primer: compatible and as recommended by manufacturer for use over intended substrate
- I. System Components: Manufacturer's standard components that are compatible with each other and as follows:
 1. Primer:
 - a. Resin: copolymer
 - b. Formulation Description: single component ready to use.
 - c. Application Method: Squeegee and medium nap roller.
 - d. All puddles shall be removed, and material shall be allowed to dry, 1-2 hours at 70F/21C.
 - e. Number of Coats: (1) one.
 2. Grout Resurfacing Base:
 - a. Formulation Description: Single component, cementitious self-leveling high-early and high-ultimate strength grout.
 - b. Application Method: colloidal mix pump, cam rake, spike roll.
 - 1) Thickness of Coats: Per architectural scope, 1" lifts.
 - 2) Number of Coats: More than one if needed.

- c. Aggregates: for applications greater than 1 inch, require additional 3/8" aggregate to mix.

J.

| Property | Test | Value |
|------------------------------------|-----------------|--|
| Compressive Strength | ASTM C109/C109M | 2,200 psi @ 24 hrs 3,000 psi @ 7 days |
| Initial set time Final Set time | ASTM C191 | 30-45 min. 1 to 1.5 hours |
| Bond Strength | ASTM D7234 | 100% bond to concrete failure |

2.3 CEMENTITIOUS TROWEL-APPLIED UNDERLAYMENT (NOT SUITABLE FOR RESINOUS FLOOR FINISHES)

- A. Underlayment shall be calcium aluminate cement-based, containing Portland cement. Gypsum-based products are unacceptable.
- B. Compressive Strength: Minimum 4000 psi in 28 days
- C. Trowel-applied underlayment shall not contain silica quartz (sand).
- D. Dry Time: Underlayment shall receive the application of floor covering in 15-20 minutes.

PART 3 - EXECUTION

3.1 ENVIRONMENTAL REQUIREMENTS

- A. Maintain ambient temperature of work areas at not less than 16 degree C (60 degrees F), without interruption, for not less than 24 hours before testing and not less than three days after testing.
- B. Maintain higher temperatures for a longer period of time where required by manufacturer's recommendation.
- C. Do not install materials when the temperatures of the substrate or materials are not within 60-85 degrees F/ 16-30 degrees C.

3.2 SURFACE PREPARATION

- A. Existing concrete slabs with existing floor coverings:
 - 1. Conduct visual observation of existing floor covering for adhesion, water damage, alkaline deposits, and other defects.
 - 2. Remove existing floor covering and adhesives. Comply with local, state and federal regulations and the RFCI Recommended Work Practices for Removal of Resilient Floor Coverings, as applicable to the floor covering being removed.
- B. Concrete shall meet the requirements of ASTM F710 and be sound, solid, clean, and free of all oil, grease, dirt, curing compounds, and any

substance that might act as a bond-breaker before application. As required prepare slab by mechanical methods. No chemicals or solvents shall be used.

- C. General: Prepare and clean substrates according to flooring manufacturer's written instructions for substrate indicated.
- D. Prepare concrete substrates per ASTM D4259 as follows:
 - 1. Dry abrasive blasting.
 - 2. Wet abrasive blasting.
 - 3. Vacuum-assisted abrasive blasting.
 - 4. Centrifugal-shot abrasive blasting.
 - 5. Comply with manufacturer's written instructions.
- E. Repair damaged and deteriorated concrete according to flooring manufacturer's written recommendations.
- F. Verify that concrete substrates are dry.
- G. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with application only after substrates have maximum moisture-vapor-emission rate of per flooring manufactures formal and project specific written recommendation.
- H. Perform in situ probe test, ASTM F2170. Proceed with application only after substrates do not exceed a maximum potential equilibrium relative humidity per flooring manufacture's formal and project specific written recommendation.
- I. Provide a written report showing test placement and results.
- J. Prepare joints in accordance with Section 07 92 00, JOINT SEALANTS and material manufacturer's instructions.
- K. Alkalinity: Measure surface pH in accordance with procedures provided in ASTM F710 or as outlined by qualified testing agency or flooring manufacturer's technical representative.
- L. Tolerances: Subsurface shall meet the flatness and levelness tolerance specified on drawings or recommended by the floor finish manufacturer. Tolerance shall also not to exceed 1/4" deviation in 10'. As required, install underlayment to achieve required tolerance.
- M. Other Subsurface: For all other subsurface conditions, such as wood or metal, contact the floor finish or underlayment manufacturer, as appropriate, for proper preparation practices.

3.3 MOISTURE REMEDIATION COATING

- A. Where results of relative humidity testing (ASTM F2170) exceed the requirements of the specified flooring manufacturer, apply remedial coating as specified to correct excessive moisture condition.
- B. Prior to remedial floor coating installation mechanically prepare the concrete surface to provide a concrete surface profile in accordance with ASTM D4259.
- C. Mix and apply moisture remediation coating in accordance with manufacturer's instructions.

3.4 CEMENTITIOUS UNDERLAYMENT

- A. Install cementitious self-leveling underlayment as required to correct surface defects, floor flatness or levelness corrections to meet the tolerance requirements as or detailed on drawings, address non-moving cracks or joints, provide a smooth surface for the installation of floor covering, or meet elevation requirements detailed on drawings.
- B. Mix and apply in accordance with manufacturer's instructions.

3.5 PROTECTION

- A. Prior to the installation of the finish flooring, the surface of the underlayment should be protected from abuse by other trades by the use of plywood, tempered hardwood, or other suitable protection course

3.6 FIELD QUALITY CONTROL

- A. Where specified, field sampling of products shall be conducted by a qualified, independent testing facility.

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SECTION 09 22 16
NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies steel studs 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. Support for wall mounted items: Section 05 50 00, METAL FABRICATIONS.
B. Ceiling suspension systems for acoustical tile or panels : Section 09 51 00, ACOUSTICAL CEILINGS, Section 09 29 00, GYPSUM BOARD.

1.3 TERMINOLOGY

- A. Description of terms to 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 is defined as the underside of the floor or roof construction supported by beams, trusses, or bar joists.
C. Thickness of steel specified is the minimum bare (uncoated) steel thickness.

1.4 SUSTAINABILITY REQUIREMENTS

- A. Materials in this section may contribute towards contract compliance with sustainability requirements. See Section 01 81 11, SUSTAINABLE DESIGN REQUIREMENTS, for project local/regional materials, recycled content, requirements.

1.5 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.

1.6 DELIVERY, IDENTIFICATION, HANDLING AND STORAGE

- A. In accordance with the requirements of ASTM C754.

1.7 APPLICABLE PUBLICATIONS

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

- B. American Society For Testing And Materials (ASTM):

| | |
|---------------|--|
| A123/A123M-17 | Zinc (Hot-dip Galvanized) Coatings on Iron and Steel Products |
| A641/A641M-19 | Zinc-Coated (Galvanized) Carbon Steel Wire |
| A653/A653M-20 | Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process |
| C11-18/b | Terminology Relating to Gypsum and Related Building Materials and Systems |
| C635/C635M-22 | Manufacture, Performance, and Testing of Metal Suspension System for Acoustical Tile and Lay-in Panel Ceilings |
| C645-18 | Non-Structural Steel Framing Members |
| C754-20 | Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products |
| C841-03(2018) | Installation of Interior Lathing and Furring |
| C954-22 | 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 |

PART 2 - PRODUCTS

2.1 STEEL STUDS AND RUNNERS (TRACK)

- A. Framing Members, General: Comply with ASTM C754 for conditions indicated.

1. Deflection Limit:

- a. L/240 unless otherwise noted.
- b. L/360 where Level 5 gypsum board finish is indicated, at tile backing panels, where plaster veneer is indicated, and elsewhere as indicated.

2. Lateral Pressure: 5.0 psf (240 Pa) unless otherwise noted.

- B. Steel Sheet Components: Comply with ASTM C645 requirements for metal, unless otherwise indicated.
- C. Protective Coating: ASTM A653, Z120 (G40) , hot dip galvanized, unless otherwise indicated.
- D. 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.
- E. Doubled studs for openings and studs for supporting concrete backer-board.
- F. Provide studs 3600 mm (12 feet) or less in length in one piece.

2.2 FURRING CHANNELS

- A. Rigid furring channels (hat shape): ASTM C645.

2.3 FASTENERS, CLIPS, AND OTHER METAL ACCESSORIES

- A. Conform to 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 instead of tie wire must have holding power equivalent to that provided by the tie wire for the specific application.
- 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.

2.4 SUSPENDED CEILING SYSTEM FOR GYPSUM BOARD

- A. Conform to ASTM C635 and C754 for materials and sizes.
1. Grid Suspension System for Ceilings - Contractor Option: ASTM C645, direct-hung system composed of main beams and cross-furring members that interlock.
- B. Conform to ASTM A641 for wire hangers.

2.5 COMPONENT FINISH

- A. Provide framing components with Z180 (G60) minimum per ASTM A123.

PART 3 - EXECUTION

3.1 INSTALLATION CRITERIA

- A. Examine substrates to which gypsum board assemblies attach or abut, installed hollow metal frames, cast-in-anchors, and structural framing, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of assemblies specified in this section.

3.2 INSTALLING STUDS

- A. Install studs in accordance with ASTM C754, except as otherwise shown or specified.
- B. Install runners (tracks) at floors, ceilings, and structural walls and columns where gypsum board stud assemblies abut other construction.
1. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where otherwise indicated. Continue framing over frames of doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.
- C. Install steel studs and furring in sizes and at spacing indicated.
- D. Install steel studs so flanges point in the same direction and leading edge or end of each gypsum board panel can be attached to open (unsupported) edges of stud flanges first.

E. Frame door openings to comply with applicable published recommendations of gypsum board manufacturer, unless otherwise indicated. Attach vertical studs at jambs with screws directly to frames or to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.

1. Install two (2) studs at each jamb, unless otherwise indicated.

F. Frame openings other than door openings to comply with details indicated or, if none indicated, as required for door openings. Install framing below sills of openings to match framing required above door heads.

3.3 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.

B. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, counter splaying, or other equally effective means.

C. Where width of ducts and other construction within ceiling plenum produces hanger spacing that interfere with the location of hangers required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads, within performance limits established by referenced standards.

D. Secure wire hangers by looping and wire-tying, directly to structures or to inserts, eyescrews, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause them to deteriorate or otherwise fail.

E. Install suspended steel framing components in sizes and at spacing indicated, but not less than that required by the referenced steel framing installation standard.

1. Wire Hangers: 1219 mm (48 inches) o.c.

2. Carrying Channels (Main Runners): 1219 mm (48 inches) o.c.

3. Furring Channels (Furring Members): 406 mm (16 inches) o.c.

- F. Installation Tolerances: Install steel framing components for suspended ceilings so that cross-furring or grid suspension members are level to within 3 mm (1/8 inch) in 3.66 meters (12 feet) as measured both lengthwise on each member and transversely between parallel members.
- G. Wire-tie or clip furring members to main runners and to other structural supports as indicated.
- H. Grid Suspension System: Attach perimeter wall track or angle where grid suspension system meets vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track

3.4 TOLERANCES

- A. Fastening surface for application of subsequent materials: Not varying 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

A. This section specifies installation and finishing of gypsum board.

1.2 RELATED WORK

A. Installation of steel framing members for walls, partitions, furring, soffits, and ceilings: and Section 09 22 16, NON-STRUCTURAL METAL FRAMING.

B. Thermal Insulation: Section 07 21 13, THERMAL INSULATION.

C. Sealants: Section 07 92 00, JOINT SEALANTS.

1.3 TERMINOLOGY

A. Definitions and description of terms to be in accordance with ASTM C11, C840, and as specified.

1.4 SUSTAINABILITY REQUIREMENTS

A. Materials in this section may contribute towards contract compliance with sustainability requirements. See Section 01 81 11, SUSTAINABLE DESIGN REQUIREMENTS, for project low-emitting materials, recycled content, requirements.

B. Any gypsum wallboard panel products used on this project must have passed testing for moisture and mold-resistance.

1.5 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. Gypsum board, each type.

C. Shop Drawings:

1. Typical gypsum board installation of all assemblies, showing corner details, edge trim details and the like.

D. Samples:

1. Cornerbead.
2. Edge trim.
3. Control joints.

1.6 DELIVERY, IDENTIFICATION, HANDLING AND STORAGE

A. In accordance with the requirements of ASTM C840.

1.7 ENVIRONMENTAL CONDITIONS

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

1.8 APPLICABLE PUBLICATIONS

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

- B. American Society for Testing and Materials (ASTM):

| | |
|---------------------|--|
| C11-18b | Terminology Relating to Gypsum and Related Building Materials and Systems |
| C475/C475M-17(2022) | Joint Compound and Joint Tape for Finishing Gypsum Board |
| C840-20 | Application and Finishing of Gypsum Board |
| C954-22 | 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 |
| C1002-22 | Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs |
| C1047-19 | Accessories for Gypsum Wallboard and Gypsum Veneer Base |
| C1177/C1177M-17 | Glass Mat Gypsum Substrate for Use as Sheathing |
| C1280-18 | Application of Exterior Gypsum Panel Products for Use as Sheathing |
| C1325-22 | Fiber Mat Reinforced Cementitious Backer Unit |
| C1396/C1396M-17 | Gypsum Board |
| C1658/C1658M-19e1 | Glass Mat Gypsum Panels |
| D3273-21 | Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber |

PART 2 - PRODUCTS

2.1 GYPSUM BOARD

- A. Gypsum Board (Typical) - Mold and Moisture-Resistant: ASTM C1396, (Type X,) 16 mm (5/8 inch) thick unless shown otherwise.
- B. Gypsum Backing Board - Mold and Moisture-Resistant: ASTM C1396, 16 mm (5/8 inch) thick.
- C. Cementitious Backing Board: ASTM C1325, use in showers.

- D. Glass-Mat-Faced Interior Panels: ASTM C1177, Type X, 16 mm (5/8 inch) thick and complying to the requirements of ASTM D3273 for Mold and Mildew resistance.
- E. Provide gypsum cores with a minimum of 95 percent post industrial recycled gypsum content. Provide paper facings with 100 percent post-consumer recycled paper content.

2.2 GYPSUM SHEATHING BOARD

- A. Provide panels complying with ASTM C1177 and ASTM C1396, Type X, water-resistant core, 16 mm (5/8 inch) thick.

2.3 ACCESSORIES

- A. ASTM C1047, except form of 0.39 mm (0.015 inch) thick zinc coated steel sheet or rigid PVC plastic.

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. For fire rated construction, type and size same as used in fire rating test.

2.5 FINISHING MATERIALS AND LAMINATING ADHESIVE

- A. ASTM C475 and ASTM C840.
- B. Provide material free of antifreeze, vinyl adhesives, preservatives and biocides, VOC content within limits of stated performance requirements.
- C. Joint Tape: Use cross-laminated, tapered edge, reinforced paper, or fiber glass mesh tape recommended by the manufacturer.

PART 3 - EXECUTION

3.1 GYPSUM BOARD HEIGHTS

- A. Extend gypsum board from floor to heights as follows, unless shown otherwise:
 - 1. Not less than 150 mm (6 inches) above suspended acoustical ceilings.
 - 2. At ceiling of suspended gypsum board ceilings.
 - 3. At existing ceilings.

3.2 INSTALLING GYPSUM BOARD

- A. Install gypsum board in accordance with ASTM C840, except as otherwise specified.
- B. Provide and install moisture and mold-resistant glass-mat-faced interior gypsum wallboard products with moisture-resistant surfaces complying with ASTM C1658 where shown and in high humidity and wet

areas or locations which might be subject to moisture exposure during construction.

1. High humidity and wet areas include, but not limited to, wallboard installed at building perimeter, any wallboard furred to concrete or masonry construction, toilet rooms containing a shower .

C. Ceilings:

1. For single-ply construction, use perpendicular application.
2. For two-ply assemblies:
 - a. Use perpendicular application.
 - b. Apply face ply of gypsum board so that joints of face ply do not occur at joints of base ply with joints over framing members.

D. Install control joints in accordance with ASTM C840.

E. Accessories:

1. Install the following accessories in accordance with ASTM C1047.
 - a. Corner Beads.
 - b. Edge Trim (casing beads).

3.3 INSTALLING GYPSUM SHEATHING

- A. Comply with ASTM C1280; install sheathing vertically, with edges butted tight and ends occurring over firm bearing.
- B. Coordinate sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed exterior wall assembly.
- C. Do not bridge building expansion joints with sheathing; cut and space edges to match spacing of structural support elements.
- D. Seal sheathing joints according to sheathing manufacturer's written recommendations.
 1. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing board joints, and apply and trowel silicone emulsion sealant to embed sealant in entire face of tape.
 2. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered.
 3. Seal other penetrations and openings.

3.4 FINISHING OF GYPSUM BOARD

- A. Finish joints, edges, corners, and fastener heads in accordance with ASTM C840.

- B. Use Level 5 finish for all finished areas open to public view; level 2 finish in utility, maintenance and service areas and level 1 in plenums, attics and other concealed areas.
- C. Follow manufacturer's fire testing reports where fire resistant construction is shown on drawings.

3.5 REPAIRS

- A. After taping and finishing has been completed, and before decoration, repair all damaged and defective work, including non-decorated 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 fire protection equivalent to the fire rated construction.

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SECTION 09 30 00
SPECIALTY MOLDINGS AND TRIM

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Specialty moldings and trim for floor and walls including the following:
 - 1. Stair nosing.
 - 2. Carpet and Resilient Flooring Trims
 - 3. Edge Protection and Transition Profiles for Floors
 - 4. Finishing and edge protection for walls
 - 5. Movement Joints and Cove shaped profiles

1.2 RELATED SECTIONS

- A. Joint Protection: Section 07 92 00, JOINT SEALANTS
- B. Tiling: Section 09 30 00, TILING
- C. Resilient Flooring: Section 09 65 19 - RESILIENT TILE FLOORING.
- D. Modular Carpeting: Section 09 68 00 - TILE CARPETING.

1.3 SUBMITTALS

- A. Submit under provisions of Section 01 30 00 - Administrative Requirements.
- B. Product Data:
 - 1. Manufacturer's data sheets on each product to be used.
 - 2. Preparation instructions and recommendations.
 - 3. Storage and handling requirements and recommendations.
 - 4. Typical installation methods.
- C. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
- D. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square representing actual product, color, and patterns.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with a minimum five years documented experience.
- B. Installer Qualifications: Company specializing in performing Work of this section with minimum two years documented experience with

projects of similar scope and complexity.

- C. Source Limitations: Provide each type of product from a single manufacturing source to ensure uniformity.

1.5 PRE-INSTALLATION CONFERENCE

- A. Convene a conference approximately two weeks before scheduled commencement of the Work. Attendees shall include Architect, Contractor and trades involved. Agenda shall include schedule, responsibilities, critical path items and approvals.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store and handle in strict compliance with manufacturer's written instructions and recommendations.
- B. Protect from damage due to weather, excessive temperature, and construction operations.

1.7 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.8 SEQUENCING

- A. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

PART 2 PRODUCTS

2.1 STAIR NOSING

- A. Commercial Stair Nosing: 2-1/2 inch: Durable nosing protects the edge of the stair from damage.
- B. No Lip Stair Riser: Inside corner transition for resilient floor finishes on stairs.

2.2 CARPET AND RESILIENT FLOORING TRIMS

- A. TS-2: No-Lip Ramp Transition from resilient flooring to carpet tile, or resilient flooring to resilient flooring.
- B. TS-3: Bevel Cap for coving carpet or resilient floors.

2.3 EDGE-PROTECTION AND TRANSITION PROFILES FOR FLOORS

- A. TS-1: Schluter RENO-U Profile with sloped exposed surface, 5/32 inch (4 mm) tall leading edge, integrated trapezoid-perforated anchoring leg, and integrated grout joint spacer.
 - 1. Profile Height: As required to coordinate with tile selection and setting system.

2.4 FINISHING AND EDGE-PROTECTION PROFILES FOR WALLS AND COUNTERTOPS

- A. TR-1: Schluter-QUADEC: Profile with square visible surface, integrated trapezoid-perforated anchoring leg, and integrated grout joint spacer.
 - 1. Corners: Matching inside corners.
 - 2. Corners: Matching outside corners.
 - 3. Corners: Internal connectors.
 - 4. Profile Height: As required to coordinate with tile selection and setting system.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly constructed and prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect in writing of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions, approved submittals and in proper relationship with adjacent construction.

3.4 CLEANING AND PROTECTION

- A. Clean products in accordance with the manufacturer's recommendations.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 09 30 13
TILING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies ceramic, and porcelain tile, and tile backer board.

1.2 RELATED WORK

- A. Sealing of joints where specified: Section 07 92 00, JOINT SEALANTS.
B. Metal and resilient edge strips at joints with new resilient flooring, and carpeting: Section 09 30 00, SPECIALTY MOLDINGS AND TRIMS.

1.3 PERFORMANCE REQUIREMENTS

- A. Grout: Provide materials complying with SCAQMD Rule 1168; petroleum- and plastic-free grout.
B. Finish Flooring: Provide Floor Score certification.

1.4 SUSTAINABILITY REQUIREMENTS

- A. Materials in this section may contribute towards contract compliance with sustainability requirements. See Section 01 81 11, SUSTAINABLE DESIGN REQUIREMENTS, for project low-emitting materials, and recycled content requirements.

1.5 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
B. Samples:
1. Base tile, each type, each color, each size.
2. Porcelain tile, each type, color, patterns and size.
3. Wall (or wainscot) tile, each color, size and pattern.
4. Trim shapes, bullnose cap and cove including bullnose cap and base pieces at internal and external corners of vertical surfaces, each type, color, and size.
C. Product Data:
1. Ceramic and porcelain tile, marked to show each type, size, and shape required.
2. Cementitious backer unit.
3. Dry-set Portland cement mortar and grout.
4. Divider strip.
5. Reinforcing tape.
6. Leveling compound.
7. Latex-Portland cement mortar and grout.

8. Commercial Portland cement grout.
9. Slip resistant tile.
10. Waterproofing isolation membrane.
11. Fasteners.

D. Certification:

1. Master grade, ANSI A137.1.
2. Manufacturer's certificates indicating that the following materials comply with specification requirements:
 - a. Commercial Portland cement grout.
 - b. Cementitious backer unit.
 - c. Dry-set Portland cement mortar and grout.
 - d. Reinforcing tape.
 - e. Latex-Portland cement mortar and grout.
 - f. Leveling compound.

1.6 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.

1.7 APPLICABLE PUBLICATIONS

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

B. American National Standards Institute (ANSI):

| | |
|------------|---|
| A108.1B-13 | Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with dry-Set or latex-Portland Cement Mortar |
| A108.11-10 | Interior Installation of Cementitious Backer Units |
| A108.5-10 | Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar |
| A118.1-12 | Dry-Set Portland Cement Mortar |
| A118.4-12 | Latex-Portland Cement Mortar |
| A118.6-10 | Standard Cement Grouts for Tile Installation |
| A118.7-10 | High Performance Cement Grouts for Tile Installation |

A118.10-08 Load-bearing, Bonded, Waterproof Membranes for
Thin-Set Ceramic Tile and Dimension Stone
Installation

A137.1-12 Ceramic Tile

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

ADJA0185 Steel Welded Wire Fabric, Plain, for Concrete
Reinforcing

C241/C241M-21 Abrasion Resistance of Stone Subjected to Foot
Traffic

C627-18 Evaluating Ceramic Floor Tile Installation
Systems Using the Robinson-Type Floor Tester

C954-22 Steel Drill Screws for the Application of
Gypsum Board on Metal Plaster Base to Steel
Studs from 0.033 in (0.84 mm) to 0.112 in (2.84
mm) in thickness

C979/C979M-16 Pigments for Integrally Colored Concrete

C1002-22 Steel Self-Piercing Tapping Screws for the
Application of Panel Products

C1027-19 Determining "Visible Abrasion Resistance on
Glazed Ceramic Tile"

C1028-07e1 Determining the Static Coefficient of Friction
of Ceramic Tile and Other Like Surfaces by the
Horizontal Dynamometer Pull Meter Method

C1178 /C1178M-18 Coated Glass Mat Water-Resistant Gypsum Backing
Panel

C1325-22 Non-Asbestos Fiber-Mat Reinforced Cementitious
Backer Units

D4397-16 Polyethylene Sheeting for Construction,
Industrial and Agricultural Applications

D. Marble Institute of America (MIA): Design Manual 7.2-2011

E. South Coast Air Quality Management District (SCAQMD):

SCAQMD Rule 1168 (1989/R2005) Adhesive and Sealant Applications

F. Tile Council of North America, Inc. (TCNA):

Handbook for Ceramic, Glass, and Stone Tile Installation

PART 2 - PRODUCTS

2.1 TILE

A. Comply with ANSI A137.1, Standard Grade, except as modified:

1. Inspection procedures listed under the Appendix of ANSI A137.1.
 2. Abrasion Resistance Classification: Tested in accordance with values listed in Table 1, ASTM C1027.
 3. Slip Resistant Tile for Floors - Coefficient of friction, when tested in accordance with ASTM C1028, required for level of performance: Not less than 0.7 (wet condition) for bathing areas.
 4. Factory Blending: For tile with color variations, within the ranges selected during sample submittals blend tile in the factory and package so tile units taken from one package show the same range in colors as those taken from other packages and match approved samples.
- B. Mosaic Tile: Furnish ceramic mosaic tile. Provide tile size as indicated on drawings.
- E. Porcelain Tile: Produce porcelain tile by the dust pressed method made of approximately 50 percent feldspar; the remaining 50 percent to be made up of various high-quality light firing ball clays yielding a tile with a water absorption rate of 0.5 percent or less and a breaking strength of between 390 to 400 pounds.
- F. Trim Shapes:
1. Conform to applicable requirements of adjoining floor and wall tile.
 2. Use trim shapes sizes specified in Section 09 06 00, SCHEDULE FOR FINISHES.

2.2 CEMENTITIOUS BACKER UNITS

- A. Use behind all wall tile.
- B. Comply to ASTM C1325.
- C. Joint materials for Cementitious Backer Units:
1. Reinforcing Tape: Vinyl coated woven glass fiber mesh tape, open weave, 50 mm (2 inches) wide. Tape with pressure sensitive adhesive backing will not be permitted.
 2. Tape Embedding Material: Latex-Portland cement mortar complying with ANSI A108.1.
 3. Joint material, including reinforcing tape, and tape embedding material, must be as specifically recommended by the backer unit manufacturer.

2.3 FASTENERS

- A. Screws for Cementitious Backer Units:
1. Standard screws for gypsum board are not acceptable.

2. Minimum 11 mm (7/16 inch) diameter head, corrosion resistant coated, with washers.

3. ASTM C954 for steel 1 mm (0.033 inch) thick.

4. ASTM C1002 for steel framing less than 0.0329 inch thick.

B. Washers: Galvanized steel, 13 mm (1/2 inch) minimum diameter.

2.5 SETTING MATERIALS OR BOND COATS

A. Conform to TCA Handbook for Ceramic Tile Installation.

B. Portland Cement Mortar: ANSI A108.1B.

C. Latex-Portland Cement Mortar: ANSI A118.4.

1. For wall applications, provide non-sagging, latex-Portland cement mortar complying with ANSI A118.4.

2. Prepackaged Dry-Mortar Mix: Factory-prepared mixture of Portland cement; dry, re-dispersible, ethylene vinyl acetate additive; and other ingredients to which only water needs to be added at Project site.

D. Dry-Set Portland Cement Mortar: ANSI A108.5 and ANSI A118.1; floor installation only.

1. Contractor Option: Latex-Portland cement mortar.

2.6 GROUTING MATERIALS

A. Coloring Pigments:

1. Pure mineral pigments, lime-proof and nonfading, complying with ASTM C979.

2. Addition of coloring pigments to grout must be by the manufacturer; job colored grout is not acceptable.

3. Use is required in Commercial Portland Cement Grout, Dry-Set Grout, and Latex-Portland Cement Grout.

B. Water Cleanable Epoxy Grout: ANSI 118.3, color as specified.

C. Grout Sealer: Grout manufacturer's standard silicone product for sealing grout joints and that does not change color or appearance of grout.

2.7 PATCHING AND LEVELING COMPOUND

A. Portland cement base, polymer-modified, self-leveling compound, manufactured specifically for resurfacing and leveling concrete floors. Products containing gypsum are not acceptable.

2.9 METAL DIVIDER STRIPS

A. Provide terrazzo type divider strips; heavy top type strip with 5 mm (3/16 inch) wide top and 38 mm (1-1/2 inch) long leg.

- C. Embedded leg perforated and deformed for keying to mortar.
- D. Aluminum or brass as specified in Section 09 06 00, SCHEDULE FOR FINISHES.

2.10 WATER

- A. Clean, potable and free from salts and other injurious elements to mortar and grout materials.

2.11 CLEANING COMPOUNDS

- A. Specifically designed for cleaning masonry and concrete and which will not prevent bond of subsequent tile setting materials including patching and leveling compounds and elastomeric waterproofing membrane and coat.
- B. Materials containing acid or caustic material not acceptable.

2.12 FLOOR MORTAR BED REINFORCING

- A. ASTM A185 welded wire fabric without backing, MW3 x MW3 (2 x 2-W0.5 x W0.5).

2.13 WATERPROOF AND CRACK ISOLATION MEMBRANE

- A. Type: Fabric-reinforced, fluid-applied membrane.
- B. Provide manufacturer's standard product that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated; include reinforcement and accessories recommended by manufacturer.

2.14 POLYETHYLENE SHEET

- A. Polyethylene sheet conforming to ASTM D4397.
- B. Nominal thickness: 0.15 mm (six mils).
- C. Use sheet width to minimize joints.

PART 3 - EXECUTION

3.1 ENVIRONMENTAL REQUIREMENTS

- A. Maintain environmental temperature and humidity within all manufacturers' recommendations.

3.2 ALLOWABLE TOLERANCE

- A. Variation in plane of sub-floor, including concrete fills leveling compounds and mortar beds:
 - 1. Not more than 1 in 500 (1/4 inch in 10 feet) from required elevation where Portland cement mortar setting bed is used.
 - 2. Not more than 1 in 1000 (1/8 inch in 10 feet) where dry-set Portland cement, and latex-Portland cement mortar setting beds and chemical-resistant bond coats are used.
- B. Variation in Plane of Wall Surfaces:

1. Not more than 1 in 400 (1/4 inch in eight feet) from required plane where Portland cement mortar setting bed is used.
2. Not more than 1 in 800 (1/8 inch in eight feet) where dry-set or latex-Portland cement mortar or organic adhesive setting materials is used.

3.3 SURFACE PREPARATION

A. Cleaning New Concrete or Masonry:

1. Chip out loose material, clean off all oil, grease dirt, adhesives, curing compounds, and other deterrents to bonding by mechanical method, or by using products specifically designed for cleaning concrete and masonry.
2. Use self-contained power blast cleaning systems to remove curing compounds and steel trowel finish from concrete slabs where ceramic tile will be installed directly on concrete surface with thin-set materials.
3. Steam cleaning or the use of acids and solvents for cleaning will not be permitted.

B. Patching and Leveling:

1. Mix and apply patching and leveling compound in accordance with manufacturer's instructions.
2. Fill holes and cracks and align concrete floors that are out of required plane with patching and leveling compound.
 - a. Thickness of compound as required to bring finish tile system to elevation shown.
 - b. Float finish.
 - c. At substrate expansion, isolation, and other moving joints, allow joint of same width to continue through underlayment.
3. Apply patching and leveling compound to concrete and masonry wall surfaces that are out of required plane.
4. Apply leveling coats of material compatible with wall surface and tile setting material to wall surfaces, other than concrete and masonry that are out of required plane.

C. Mortar Bed for Slopes to Drains:

1. Slope compound to drain where drains are shown.
2. Install mortar bed in depressed slab sloped to drains not less than 1 in 200 (1/16 inch per foot).

3. Allow not less than 50 mm (2 inch) depression at edge of depressed slab.
 4. Screed for slope to drain and float finish.
 5. Cure mortar bed for not less than seven days. Do not use curing compounds or coatings.
- D. Additional preparation of concrete floors for tile set with waterproof and crack isolation membrane to be in accordance with the manufacturer's printed instructions.
- E. Walls:
1. In showers or other wet areas cover studs with polyethylene sheet.
 2. Apply patching and leveling compound to concrete and masonry surfaces that are out of required plane.
 3. Apply leveling coats of material compatible with wall surface and tile setting material to wall surfaces, other than concrete and masonry that are out of required plane.
 4. Apply waterproof membrane in accordance with manufacturer's printed instructions.
- F. Existing Floors and Walls:
1. Remove all foreign material from slab intended for tiling. Prepare surface by grinding, chipping, self-contained power blast cleaning or other suitable mechanical methods to completely expose uncontaminated concrete or masonry surfaces. Follow safety requirements of ANSI A10.20.

3.4 CEMENTITIOUS BACKER UNITS

- A. Remove polyethylene wrapping from cementitious backer units and separate to allow for air circulation. Allow moisture content of backer units to dry down to a maximum of 35 percent before applying joint treatment and tile.
- B. Install in accordance with ANSI A108.11 except as specified otherwise.

3.5 METAL DIVIDER STRIPS

- A. Install metal divider strips in floor joints between ceramic and quarry tile floors and between tile floors and adjacent flooring of other materials where the finish floors are flush unless shown otherwise.
- B. Set divider strip in mortar bed to line and level centered under doors or in openings.

3.6 CERAMIC TILE - GENERAL

- A. Comply with ANSI A108 series of tile installation standards in "Specifications for Installation of Ceramic Tile" applicable to methods of installation.
- B. Comply with TCNA Installation Guidelines:
- C. Installing Mortar Beds for Floors:
 - 1. Install mortar bed to not damage waterproof or crack isolation membrane; 32 mm (1-1/2 inch) minimum thickness.
 - 2. Install floor mortar bed reinforcing centered in mortar fill.
 - 3. Screed finish to level plane or slope to drains where shown, float finish.
 - 4. For thin set systems cure mortar bed not less than seven days; do not use curing compounds or coatings.
 - 5. For tile set with Portland cement, paste over plastic mortar bed coordinate to set tile before mortar bed sets.
- D. Setting Beds or Bond Coats:
 - 1. Where recessed or depressed floor slabs are filled with Portland cement mortar bed, set ceramic mosaic floor tile with latex-Portland cement mortar over cured mortar bed except as specified otherwise, ANSI A108-1B, TCNA System F111 or F112.
 - 2. Set trim shapes in same material specified for setting adjoining tile.
- E. Workmanship:
 - 1. Comply with all ANSI 108, 118, 136, and 137 requirements.
 - 2. Joints:
 - a. Keep all joints in line, straight, level, perpendicular and of even width unless shown otherwise.
 - b. Make joints 2 mm (1/16 inch) wide for glazed wall tile and mosaic tile work.
 - c. Make joints in quarry tile work not less than 6 mm (1/4 inch) nor more than 9 mm (3/8 inch) wide; finish joints flush with surface of tile.
 - d. Make joints in paver tile, porcelain type; maximum 3 mm (1/8 inch) wide.
 - 3. Back Buttering: For installations indicated below, obtain 100 percent mortar coverage by complying with applicable special

requirements for back buttering of tile in referenced ANSI A108 series of tile installation standards:

- a. Tile wall installations in wet areas.
- b. Tile wall installations composed of tiles 200 by 200 mm (8 by 8 inches or larger).

3.7 GROUTING

- A. Grout Type and Location: Refer 09 06 00, SCHEDULE OF FINISHES.
- B. Workmanship:
 1. Install and cure grout in accordance with the applicable standard.
 2. Portland Cement grout: ANSI A108.1.
 3. Epoxy Grout: ANSI A108.1.
 4. Dry-set grout: ANSI A108.1.

3.8 MOVEMENT JOINTS

- A. Prepare tile expansion, isolation, construction and contraction joints for installation of sealant. Refer to Section 07 92 00, JOINT SEALANTS.
- B. TCA details EJ 171.

3.9 CLEANING

- A. Thoroughly sponge and wash tile.
- B. Polish glazed surfaces with clean dry cloths.
- C. Methods and materials used must not damage or impair appearance of tile surfaces.
- D. The use of acid or acid cleaners on glazed tile surfaces is prohibited.
- E. Clean tile as recommended by the manufacturer of the grout and bond coat.
- F. Apply grout sealer.

3.10 PROTECTION

- A. Keep traffic off tile floor, until grout and setting material is firmly set and cured.
- B. Where traffic occurs over tile floor, cover tile floor with not less than 9 mm (3/8 inch) thick plywood, wood particle board, or hardboard securely taped in place. Do not remove protective cover until time for final inspection. Clean tile of any tape, adhesive and stains.

3.11 TESTING FINISH FLOOR

- A. Test floors in accordance with ASTM C627 to show compliance with codes 1 through 10.

3.12 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

- A. Interior Floor Installations, Concrete Subfloor:

1. Ceramic Tile Installation: TCNA F112 and ANSI A108.1B; cement mortar bed (thickset) bonded to concrete.
 - a. Bond Coat for Cured-Bed Method: Modified Dry-set cement mortar.
 - b. Grout: Water cleanable epoxy grout.
 2. Ceramic Tile Installation: TCNA F113; thin-set mortar.
 - a. Bond Coat for Cured-Bed Method: Modified Dry-set Portland cement mortar.
 - b. Grout: Water cleanable epoxy grout .
 3. Ceramic Tile Installation: TCNA F125A; thin-set mortar on waterproof and crack isolation membrane.
 - a. Thin-set Mortar: Modified Dry-set cement mortar.
 - b. Grout: Water cleanable epoxy grout .
- C. Interior Wall Installations, Wood or Metal Studs or Furring:
1. Ceramic Tile Installation: TCNA W244C or TCNA W244F; thin-set mortar on cementitious backer units or fiber-cement backer board over vapor-retarder membrane.
 - a. Thin-set Mortar: Modified Dry-set cement mortar for large and heavy tile.
 - b. Grout: Water cleanable epoxy grout.
- D. Shower Receptor and Wall Installations:
1. Ceramic Tile Installation: TCNA B415; thin-set mortar on waterproof membrane over cementitious backer units over vapor-retarder membrane.
 - a. Thin-set Mortar: Modified Dry-set cement mortar .
 - b. Grout: Water Cleanable Epoxy grout.

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**SECTION 09 65 13
RESILIENT BASE AND ACCESSORIES**

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the installation of resilient base.

1.2 RELATED WORK

- A. Luxury Vinyl Tile Flooring: Section 09 65 16, RESILIENT SHEET FLOORING.
- B. Modular Carpet Tile Flooring: Section 09 68 00, Carpeting.

1.3 SUSTAINABILITY REQUIREMENTS

A. Materials in this section may contribute towards contract compliance with sustainability requirements. See Section 01 81 11, SUSTAINABLE DESIGN REQUIREMENTS, for project low-emitting materials, and recycled content requirements.

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. Base and stair material manufacturer's recommendations for adhesives.
 - 2. Application and installation instructions.
- C. Samples:
 - 1. Base: 150 mm (6 inches) long, each type and color.
 - 2. Resilient Stair Treads: 150 mm (6 inches) long.
 - 3. Rubber Tile Flooring: 300 mm (12 inches) square.
 - 4. Adhesive: Each type.

1.5 DELIVERY

- A. Deliver materials to the site in original sealed packages or containers, clearly marked with the manufacturer's name or brand, type and color, production run number and date of manufacture.
- B. Materials from containers which have been distorted, damaged or opened prior to installation will be rejected.

1.6 STORAGE

A. Follow manufacturer's instruction for storage and protection from damage by handling and construction operations before, during, and after installation.

1.7 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by the basic

designation only. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

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

| | |
|----------------|-----------------------------|
| F1344-21a | Rubber Floor Tile |
| F1861-21 | Resilient Wall Base |
| F2169-15(2020) | Resilient Stair Treads Base |

PART 2 - PRODUCTS

2.1 GENERAL

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

2.2 RESILIENT BASE

- A. ASTM F1861, 3 mm (1/8 inch) thick, 100 mm (4 inches) high, Type TP (Thermoplastic Rubber).
- B. Where carpet occurs, use Style A-straight at carpet locations; Style B-cove other locations.

2.3 RESILIENT TREADS

- A. Conform to ASTM F2169 for surface of treads Class 2 raised pattern and have Group 1 abrasive non-slip strip of same material.
- B. Provide a one-piece nosing/tread/riser or a two piece nosing/tread design with a matching coved riser.
- C. Nosing shape to conform to sub-tread nosing shape.

2.4 RUBBER TILE

- A. ASTM F1344, Class 1, homogenous rubber tile, 600 mm (24 inches) square, minimum 3 mm (1/8 inch) thick.
- B. Color and pattern uniformly distributed throughout tile.
- C. Molded pattern wearing surface base thickness 3 mm (1/8 inch) thick.
- D. Where rubber tile is used provide tiles with a minimum of 90 percent post consumer rubber.

2.5 PRIMER (FOR CONCRETE FLOORS)

A. As recommended by the adhesive and tile manufacturer.

2.6 LEVELING COMPOUND (FOR CONCRETE FLOORS)

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

2.7 ADHESIVES

- A. Use products recommended by the material manufacturer for the conditions of use.
- B. Provide low VOC products that comply with the testing and product requirements of the California Department of Health Services' "Standard

Practice for the Testing of Volatile Organic Emissions from Various
Sources Using Small-Scale Environmental Chambers."

PART 3 - EXECUTION

3.1 PROJECT CONDITIONS

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

3.2 INSTALLATION REQUIREMENTS

- A. The respective manufacturer's instructions for application and installation will be considered for use when approved by the RE/COR.
- B. Submit proposed installation deviation from this specification to the RE/COR indicating the differences in the method of installation.
- C. The RE/COR reserves the right to have test portions of material installation removed to check for non-uniform adhesion and spotty adhesive coverage.
 - 1. Do not use solvents to remove adhesives.
 - 2. Prepare substrate as specified.

3.3 BASE INSTALLATION

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

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

3.6 CLEANING AND PROTECTION

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

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SECTION 09 65 19
RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. This section specifies the installation of luxury vinyl tile, and accessories required for a complete installation.

1.2 RELATED WORK:

- A. Sustainable Design Requirements: Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.
- B. Resilient Base: Section 09 65 13, RESILIENT BASE AND ACCESSORIES.
- C. Subfloor Testing and Preparation: Section 09 05 16, SUBSURFACE PREPARATION FOR FLOOR FINISHES.

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.

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):

- D2047-17.....Test Method for Static Coefficient of Friction
of Polish-Coated Flooring Surfaces as Measured
by the James Machine
- D4078-02 (2021).....Water Emulsion Floor Finish
- E648-19ae1.....Critical Radiant Flux of Floor Covering Systems
Using a Radiant Energy Source
- E662-21ae1.....Specific Optical Density of Smoke Generated by
Solid Materials
- E1155/E1155M-14.....Determining Floor Flatness and Floor Levelness
Numbers
- F510/F510M-20.....Resistance to Abrasion of Resilient Floor
Coverings Using an Abrader with a Grit Feed
Method
- F710-21.....Preparing Concrete Floors to Receive Resilient
Flooring
- F925-13 (2020).....Test Method for Resistance to Chemicals of
Resilient Flooring
- F1700-20.....Solid Vinyl Floor Tile
- F1869-22.....Test Method for Measuring Moisture Vapor
Emission Rate of Concrete Subfloor Using
Anhydrous Calcium Chloride
- F2170-19a.....Test Method for Determining Relative Humidity
in Concrete Floor Slabs Using in Situ Probes

C. Code of Federal Regulation (CFR):

- 40 CFR 59.....Determination of Volatile Matter Content, Water
Content, Density Volume Solids, and Weight
Solids of Surface Coating

D. International Standards and Training Alliance (INSTALL):

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS:

- A. Provide adhesives, underlayment, primers, and polish recommended by resilient floor material manufacturer.
- B. Critical Radiant Flux: 0.45 watts per sq. cm or more, Class I, per ASTM E648.
- C. Smoke Density: Less than 450 per ASTM E662.
- D. Slip Resistance - Not less than 0.5 when tested with ASTM D2047.

2.5 LUXURY VINYL TILE:

- A. ASTM F1700, Class III, Printed Film Vinyl Tile, Type B.
- B. Wear Layer: 32 mils, minimum.
- C. Total Thickness: 2.5 mm, minimum.
- D. Size: AS indicated on drawings

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).

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 // // rubber // // // -colored anodized aluminum // // clear anodized aluminum // 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.

//C. Perform work regarding removal of flooring and adhesive containing asbestos as specified in Section 02 82 13.19, ASBESTOS FLOOR TILE AND MASTIC ABATEMENT. //

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.

SPEC WRITER NOTES:

1. Coordinate any requirements for application of polish/floor finish with the COR.
2. Note that applied finish coatings may affect performance, slip resistant properties and may cause damage to the floor. Coordinate finish coatings with manufacturer.
3. Modify paragraph accordingly.

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

Black Hills National Cemetery
Renovate and Expand Administration and Maintenance Buildings
20901 Pleasant Valley Drive
Sturgis, SD 57785

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carts are used, cover tile with plywood, hardboard, or particle board over paper, secured and maintained until removal is directed by COR.

- E. When protective materials are removed and immediately prior to acceptance, replace damaged tile and mouldings, re-clean resilient materials.

3.5 LOCATION:

- A. Unless otherwise indicated in construction documents, install tile flooring, under areas where casework, laboratory and pharmacy furniture and other equipment occur.
- B. Extend tile flooring for room into adjacent closets and alcoves.

- - - E N D - - -

**SECTION 09 67 23
RESINOUS FLOORING**

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes:
 - 1. High-performance resinous flooring systems.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Installer Certificates for Qualification: Signed by manufacturer stating that installers comply with specified requirements.
- C. Material Certificates: For each resinous flooring component, from manufacturer.
- D. Maintenance Data: For maintenance manuals.
- E. Samples: Submit two 6" X 6" samples of each resinous flooring system applied to a rigid backing. Provide sample which is a true representation of proposed field applied finish. Provide sample color and texture for approval from Owner in writing or approved by General Contractor prior to installation.
- F. Product Schedule: For resinous flooring.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of flooring systems required for this Project.
 - 1. Engage an installer who is approved in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated.
 - 2. Installer Letter of Qualification: Installer to provide letter stating that they have been in business for at least 5 years and listing 5 projects in the last 2 years of similar scope. For each project provide: project name, location, date of installation, contact information, size of project, and manufacturer of materials with system information.
- B. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from single manufacturer. Provide secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from source recommended by manufacturer of primary materials.

- C. Pre-installation Conference: Conduct conference at Project site before work begins.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.5 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 application.
- 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: The Sherwin Williams Company, Cleveland, OH.
- B. Resuflor Deco Quartz BC23, 1/8" nominal thickness.
 - 1. Primer: Resuprime 3579 at 250 sq. ft. per gallon.
 - 2. 1st Receiver Coat: Resuflor 3561 at 140-145 sq. ft. per gallon
 - 3. 1st Broadcast: GP5900F to excess at 0.4 lbs. per sq. ft.
 - 4. 2nd Receiver Coat: Resuflor 3561 at 65-70 sq. ft. per gallon
 - 5. 2nd Broadcast: GP5900F to excess at 0.4 lbs. per sq. ft.
 - 6. Grout Coat: Resuflor 3746 at 100 sq. ft. per gallon.
 - 7. Topcoat: Resuflor 3746 at 200 sq. ft. per gallon.

2.2 MATERIALS

- A. VOC Content of Resinous Flooring: Provide resinous flooring systems, for use inside the weatherproofing system, that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24)].
 - 1. Resinous Flooring: 100 g/L.

2.3 HIGH-PERFORMANCE RESINOUS FLOORING

- A. Resinous Flooring: Abrasion-, impact- and chemical-resistant, high-performance, resin-based, monolithic floor surfacing designed to produce a seamless floor.
- B. System Characteristics:
 - 1. Color and Pattern: As indicated from manufacturers listed above.
 - 2. Slip Resistance: Provide slip resistant finish.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Inspection: Prior to commencing Work, thoroughly examine all underlying and adjoining work, surfaces and conditions upon which Work is in any way dependent for perfect results. Report all conditions which affect Work. No "waiver of responsibility" for incomplete, inadequate or defective underlaying and adjoining work, surfaces and conditions will be considered, unless notice of such unsatisfactory conditions has been filed and agreed to in writing before Work begins. Commencement of Work constitutes acceptance of surfaces.
- B. Surface Preparation: Remove all surface contamination, loose or weakly adherent particles, laitance, grease, oil, curing compounds, paint, dust and debris by blast track method or approved mechanical means (acid etch not allowed). If surface is questionable, try a test patch. Create a minimum surface profile for the system specified in accordance with the methods described in ICRI No. 03732 to achieve profile numbers as follows:
 - 1. Self-leveling mortars, to 3/16" CSP-4 to CSP-6
- C. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.
 - 1. Moisture Testing: Perform tests indicated below.
 - a. Calcium Chloride Test: Perform anhydrous calcium chloride test per ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lbs. of water/1000 sq. ft. in 24 hours. Perform tests so that each test area does not exceed 1000 sq. ft. and perform 3 tests for the first 1000 sq. ft. and one additional test for every additional 1000 sq ft.
 - b. In-Situ Probe Test: Perform relative-humidity test using in-situ probes per ASTM F 2170. Proceed with installation only

after substrates have a maximum 75 percent relative-humidity-level measurement.

3.2 ENVIRONMENTAL CONDITIONS

- A. All applicators and all other personnel in the area of the RF installation shall take all required and necessary safety precautions. All manufacturers' installation instructions shall be implicitly followed.
- B. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written instructions.
- C. Alkalinity and Adhesion Testing: Verify that concrete substrates have pH within acceptable range. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.
- D. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.
- E. Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.
- F. Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written instructions.

3.3 APPLICATIONS

- A. Install resinous floor over properly prepared concrete surface in strict accordance with the manufacturer's directions.
 - 1. Install the primer and/or base coats over thoroughly cleaned and prepared concrete.
 - 2. Install topcoat over flooring after excess aggregate has been removed.
 - 3. Maintain a slab temperature of 60°F to 80°F for 24 hours minimum before applying floor topping, or as instructed by manufacturer.
- B. 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, comply with resinous flooring manufacturer's written instructions.

- C. Sealant: Saw cut resinous floor topping at expansion joints in concrete slab. Fill sawcuts with sealant prior to final seal coat application. Follow manufacturer's written recommendations.
- D. Apply primer over prepared substrate at manufacturer's recommended spreading rate.
- E. Slip Resistant Finish: Provide grit for slip resistance.
- F. Apply topcoats in number indicated for flooring system and at spreading rates recommended in writing by manufacturer.

3.4 COMPLETED WORK

- A. Cleaning: Upon completion of the Work, clean up and remove from the premises surplus materials, tools, appliances, empty cans, cartons and rubbish resulting from the Work. Clean off all spattering and drippings, and all resulting stains.
- B. Protection: Protect Work in accordance with manufacturer's directions from damage and wear during the remainder of the construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.
- C. Contractor shall insure that coating is protected from any traffic until it is fully cured to the satisfaction of the coating manufacturer.

- - - END - - -

SECTION 09 68 00
CARPETING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Section specifies modular carpet, adhesives, and other items required for complete installation.

1.2 RELATED WORK

- A. Carpet Edge Strips: Section 09 30 00, SPECIALTY MOLDINGS AND TRIMS.
- B. Resilient Wall Base: Section 09 65 13, RESILIENT BASE AND ACCESSORIES.

1.3 PERFORMANCE REQUIREMENTS

- A. Static Control: Provide static control to permanently regulate static buildup to less than 3.5 kV when tested at 20 percent relative humidity and 21 degrees C (70 degrees F) in accordance with AATCC 134.
- B. Flammability and Critical Radiant Flux Requirements: Provide carpet with a minimum average critical radiant flux of 0.45 watts per square centimeter when tested in accordance with ASTM E648.
- C. Tuft Bind: Provide tuft bind force required to pull a tuft or loop free from carpet backing with a minimum 40 N (10 pound) average force for loop pile.
- D. Colorfastness to Crocking: Comply dry and wet crocking with AATCC 165 and with a Class 4 minimum rating on the AATCC Color Transference Chart for all colors.
- E. Colorfastness to Light: Comply colorfastness to light with AATCC 16, Test Option E "Water-Cooled Xenon-Arc Lamp, Continuous Light" and with a minimum 4 gray scale rating after 40 hours.
- F. Colorfastness to Water: Comply colorfastness to water with AATCC 107 and with a minimum 4.0 gray scale rating and a minimum 4.0 transfer scale rating.
- G. Delamination Strength: Provide delamination strength for tufted carpet with a secondary back of minimum 440 N/m (2.5 lbs/inch).

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced Installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.

1.5 SUSTAINABILITY REQUIREMENTS

- A. Materials in this section may contribute towards contract compliance with sustainability requirements. See Section 01 81 11, SUSTAINABLE

DESIGN REQUIREMENTS, for project low-emitting materials, and recycled content requirements.

1.6 REGULATORY REQUIREMENTS FOR RECYCLED CONTENT

- A. Products and Materials with Post-Consumer Content and Recovered Materials Content:
1. Contractor is obligated by contract to satisfy Federal mandates for procurement of products and materials meeting recommendations for post-consumer content and recovered materials content; the list of designated product categories with recommendations has been compiled by the EPA - refer to <http://www.epa.gov/wastes/conserves/tools/cpg/products/>.
 2. Materials or products specified by this section may be obligated to satisfy this Federal mandate and Comprehensive Procurement Guidelines program.
 3. The EPA website also provides tools such as a Product Supplier Directory search engine and product resource guides.
- B. Fulfillment of regulatory requirements does not relieve the Contractor of satisfying sustainability requirements stipulated by Section 01 81 11, SUSTAINABLE DESIGN REQUIREMENTS, as it relates to recycled content; additional product and material selections with recycled content may be required, as determined by Contractor's Sustainability Action Plan.

1.7 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Product Data:
1. Manufacturer's catalog data and printed documentation stating physical characteristics, durability, resistance to fading and flame resistance characteristics for each type of carpet material and installation accessory.
 2. Manufacturer's printed installation instructions for the carpet, including preparation of installation substrate, seaming techniques and recommended adhesives and tapes.
 3. Manufacturer's certificate verifying carpet containing recycled materials include percentage of recycled materials as specified.
- C. Samples:

1. Carpet: "Production Quality" samples 300 x 300 mm (12 x 12 inches) of carpets, showing quality, pattern and color specified on drawings, AF600, MATERIAL AND ROOM FINISH SCHEDULE.

D. Shop Drawings: Installers layout plan showing seams and cuts for carpet module.

E. Maintenance Data: Carpet manufacturer's maintenance instructions describing recommended type of cleaning equipment and material, spotting and cleaning methods and cleaning cycles.

1.8 DELIVERY AND STORAGE

A. Deliver carpet in manufacturer's original wrappings and packages clearly labeled with manufacturer's name, brand, name, size, dye lot number and related information.

B. Deliver adhesives in containers clearly labeled with manufacturer's name, brand name, number, installation instructions, safety instructions and flash points.

C. Store in a clean, dry, well-ventilated area, protected from damage and soiling. Maintain storage space at a temperature above 16 degrees C (60 degrees F) for 2 days prior to installation.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Maintain areas in which carpeting is to be installed at a temperature above 16 degrees C (60 degrees F) for 2 days before installation, during installation and for 2 days after installation. Maintain a minimum temperature of 13 degrees C (55 degrees F) thereafter for the duration of the contract. Don not permit traffic or movement of furniture or equipment in carpeted area for 24 hours after installation; complete other work which would damage the carpet prior to installation of carpet.

1.10 WARRANTY

A. Carpet and installation subject to terms of "Warranty of Construction" FAR clause 52.246-21, except that warranty period is extended to two years.

1.11 APPLICABLE PUBLICATIONS

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

B. American National Standards Institute (ANSI)/NSF International (NSF):

NSF/ANSI/140-07 Sustainable Carpet Assessment Standard

C. American Association of Textile Chemists and Colorists (AATCC):

16.1-12 Colorfastness to Light
107-13 Colorfastness to Water
134-11 Electric Static Propensity of Carpets
165-08 Colorfastness to Crocking: Textile Floor
Conerings-AATCC Crockmeter Method

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

D3278-21 Flash Point of Liquids by Small Scale Closed-
Cup Apparatus
D5116-17 Determinations of Organic Emissions from Indoor
Materials/Products
E648-19ae1 Critical Radiant Flux of Floor-Covering Systems
Using a Radiant Heat Energy Source
F1869-22 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

E. The Carpet and Rug Institute (CRI):

Carpet Installation Standard (2011)

PART 2 - PRODUCTS

2.1 CARPET

A. General:

1. Provide product as indicated and selected by Architect.
2. VOC Limits: Use carpet and carpet adhesive that comply with the following limits for VOC content when tested according to ASTM D 5116:
 - a. Carpet, Total VOCs: 0.5 mg/sq.m x hr.
 - b. Carpet, 4-PC (4-Phenylcyclohexene): 0.05 mg/sq.m x hr.
 - c. Carpet, Formaldehyde: 0.05 mg/sq.m x hr.
 - d. Carpet, Styrene: 0.4 mg/sq.m x hr.
 - e. Adhesive, Total VOCs: 10.00 mg/sq.m x hr.
 - f. Adhesive, Formaldehyde: 0.05 mg/sq.m x hr.
 - g. Adhesive, 2-Ethyl-1-Hexanol: 3.00 mg/sq.m x hr.

B. Certification: Gold level of NSF/ANSI 140. CRI's "Green Label Plus" program.

C. Color, Texture, and Pattern: As specified specified on drawings, AF600,
MATERIAL AND ROOM FINISH SCHEDULE.

2.2 ADHESIVE AND CONCRETE PRIMER

A. Water-resistant, mildew resistant, non-staining to suit products and subfloor conditions indicated to comply with flammability requirements for installed carpet as recommended by the carpet manufacturer.

2.3 LEVELING COMPOUND (FOR CONCRETE FLOORS)

- A. Provide Portland cement bases polymer modifier with latex or polyvinyl acetate resin manufactured specifically for resurfacing and leveling concrete floors. Products containing gypsum are not acceptable.
- B. Determine the type of underlayment selected for use by condition to be corrected.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

- A. Comply with manufacturer's recommendations to prepare substrates indicated to receive carpet.
- B. Remove subfloor coatings, including curing compounds and other substances that are incompatible with adhesives.
- C. Broom and vacuum clean subfloors to be covered with carpet. After cleaning, examine subfloor for moisture, alkaline salts, carbonation, or dust.
- D. Moisture Testing: Perform moisture and pH test as recommended by the flooring and adhesive manufacturers. Perform test locations starting on the deepest part of the concrete structure. Proceed with installation only after concrete substrates meet or exceed the manufacturer's requirements. In the absence of specific guidance from the flooring or adhesive manufacturer the following requirements are to be met:
1. Perform moisture vapor emission tests in accordance with ASTM F1869. Proceed with installation only after substrates have a maximum moisture-vapor-emission rate of 1.36 kg of water/92.9 sq. m (3lb of water/1000 sq. ft.) in 24 hours.
 2. Perform concrete internal relative humidity testing using situ probes in accordance with ASTM F2170. Proceed with installation only after concrete reaches maximum 75 percent relative humidity level measurement.
- E. Concrete Subfloor Preparation: Apply concrete slab primer according to manufacturer's directions where recommended by carpet manufacturer.

3.3 MODULAR TILE INSTALLATION

- A. Install modular tiles with permanent adhesive and snugly jointed together. Lay tiles in the same direction with accessibility to the subfloor where required.

3.4 EDGE STRIPS INSTALLATION

- A. Install edge strips over exposed carpet edges adjacent to uncarpeted finish flooring.
- B. Anchor metal strips to floor per manufacturer's recommendations.

3.5 PROTECTION AND CLEANING

- A. Remove waste, fasteners and other cuttings from carpet floors.
- B. Vacuum carpet and provide suitable protection. Do not use polyethylene film.
- C. Do not permit traffic on carpeted surfaces for at least 48 hours after installation. Protect the carpet in accordance with CRI 104.
- D. Do not move furniture or equipment on unprotected carpeted surfaces.
- E. Just before final acceptance of work, remove protection and vacuum carpet clean.

- - - E N D - - -

**SECTION 09 91 00
PAINTING**

PART 1-GENERAL

1.1 DESCRIPTION

- A. Section specifies field painting.
- B. Section specifies prime coats which may be applied in shop under other sections.
- C. Painting includes shellacs, stains, varnishes, and coatings specified.

1.2 RELATED WORK

- A. Shop prime painting of steel and ferrous metals: Division 05 - METALS, Division 08 - OPENINGS, Division 10 - SPECIALTIES, Division 11 - EQUIPMENT, Division 12 - FURNISHINGS, Division 13 - SPECIAL CONSTRUCTION, Division 21 - FIRE SUPPRESSION, Division 22 - PLUMBING, Division 23 - HEATING, VENTILATION AND AIR-CONDITIONING, Division 26 - ELECTRICAL, Division 27 - COMMUNICATIONS, and Division 28 - ELECTRONIC SAFETY AND SECURITY sections.
- B. Contractor Option: Prefinished flush doors with transparent finishes: Section 08 14 00, WOOD DOORS.
- C. Type of Finish, Color, and Gloss Level of Finish Coat: Section 09 06 00, SCHEDULE FOR FINISHES.

1.3 SUSTAINABILITY REQUIREMENTS

- A. Materials in this section may contribute towards contract compliance with sustainability requirements. See Section 01 81 11, SUSTAINABLE DESIGN REQUIREMENTS, for project low-emitting materials, and recycled content requirements.
- B. Biobased Material: For products designated by the USDA's BioPreferred® program, provide products that meet or exceed USDA recommendations for biobased content, subject to the products compliance with performance requirements in this Section. For more information regarding the product categories covered by the BioPreferred® program, visit <http://www.biopreferred.gov>.

1.4 REGULATORY REQUIREMENTS FOR RECYCLED CONTENT

- A. Products and Materials with Post-Consumer Content and Recovered Materials Content:
 - 1. Contractor is obligated by contract to satisfy Federal mandates for procurement of products and materials meeting recommendations for post-consumer content and recovered materials content; the list of

designated product categories with recommendations has been compiled by the EPA - refer to <http://www.epa.gov/wastes/conserves/tools/cpg/products/>.

2. Materials or products specified by this section may be obligated to satisfy this Federal mandate and Comprehensive Procurement Guidelines program.
 3. The EPA website also provides tools such as a Product Supplier Directory search engine and product resource guides.
- B. Fulfillment of regulatory requirements does not relieve the Contractor of satisfying sustainability requirements stipulated by Section 01 81 11, SUSTAINABLE DESIGN REQUIREMENTS, as it relates to recycled content; additional product and material selections with recycled content may be required, as determined by Contractor's Sustainability Action Plan.

1.5 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
 1. Before work is started, or sample panels are prepared, submit manufacturer's literature, the current Master Painters Institute (MPI) "Approved Product List" indicating brand label, product name and product code as of the date of contract award, will be used to determine compliance with the submittal requirements of this specification. The Contractor may choose to use subsequent MPI "Approved Product List", however, only one list may be used for the entire contract and each coating system is to be from a single manufacturer. All coats on a particular substrate must be from a single manufacturer. No variation from the MPI "Approved Product List" where applicable is acceptable.
- C. Samples:
 1. After painters' materials have been approved and before work is started submit samples showing each type of finish and color specified.
 2. Samples to show color: Composition board, 150 by 150 (6 inch by 6 inch).
 3. Panel to show transparent finishes: Wood of same species and grain pattern as wood approved for use, 100 by 250 by 3 mm (4 inch by 10

inch face by 1/4 inch) thick minimum, and where both flat and edge grain will be exposed, 250 mm (10 inches) long by sufficient size, 50 by 50 mm (2 by 2 inch) minimum or actual wood member to show complete finish.

- D. 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.

1.6 DELIVERY AND STORAGE

- A. Deliver materials to site in manufacturer's sealed container marked to show following:
1. Name of manufacturer.
 2. Product type.
 3. Batch number.
 4. Instructions for use.
 5. Safety precautions.
- B. In addition to manufacturer's label, provide a label legibly printed as following:
1. Federal Specification Number, where applicable, and name of material.
 2. Surface upon which material is to be applied.
 3. If paint or other coating, state coat types; prime, body or finish.
- C. Maintain space for storage, and handling of painting materials and equipment in a neat and orderly condition to prevent spontaneous combustion from occurring or igniting adjacent items.
- D. Store materials at site at least 24 hours before using, at a temperature between 18 and 30 degrees C (65 and 85 degrees F).

1.7 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by the basic designation only. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
- B. American Conference of Governmental Industrial Hygienists (ACGIH):

ACGIH TLV-BKLT-2009 Threshold Limit Values (TLV) for Chemical
Substances and Physical Agents and Biological
Exposure Indices (BEIs)
ACGIH TLV-DOC-2009 Documentation of Threshold Limit Values and
Biological Exposure Indices, (Seventh Edition)

C. Master Painters Institute (MPI):

No. 4-13 Interior/ Exterior Latex Block Filler
No. 5-13 Exterior Alkyd Wood Primer
No. 7-13 Exterior Oil Wood Primer
No. 8-13 Exterior Alkyd, Flat MPI Gloss Level 1 (EO)
No. 9-13 Exterior Alkyd Enamel MPI Gloss Level 6 (EO)
No. 10-13 Exterior Latex, Flat (AE)
No. 11-13 Exterior Latex, Semi-Gloss (AE)
No. 31-13 Polyurethane, Moisture Cured, Clear Gloss (PV)
No. 36-13 Knot Sealer
No. 43-13 Interior Satin Latex, MPI Gloss Level 4
No. 44-13 Interior Low Sheen Latex, MPI Gloss Level 2
No. 45-13 Interior Primer Sealer
No. 46-13 Interior Enamel Undercoat
No. 47-13 Interior Alkyd, Semi-Gloss, MPI Gloss Level 5
(AK)
No. 48-13 Interior Alkyd, Gloss, MPI Gloss Level 6 (AK)
No. 50-13 Interior Latex Primer Sealer
No. 51-13 Interior Alkyd, Eggshell, MPI Gloss Level 3
No. 52-13 Interior Latex, MPI Gloss Level 3 (LE)
No. 53-13 Interior Latex, Flat, MPI Gloss Level 1 (LE)
No. 54-13 Interior Latex, Semi-Gloss, MPI Gloss Level 5
(LE)
No. 60-13 Interior/Exterior Latex Porch & Floor Paint,
Low Gloss
No. 68-13 Interior/ Exterior Latex Porch & Floor Paint,
Gloss
No. 71-13 Polyurethane, Moisture Cured, Clear, Flat (PV)
No. 90-13 Interior Wood Stain, Semi-Transparent (WS)
No. 94-13 Exterior Alkyd, Semi-Gloss (EO)
No. 95-13 Fast Drying Metal Primer
No. 114-13 Interior Latex, Gloss (LE) and (LG)

| | |
|------------|--|
| No. 119-13 | Exterior Latex, High Gloss (acrylic) (AE) |
| No. 134-13 | Primer, Galvanized, Water Based |
| No. 138-13 | Interior High Performance Latex, MPI Gloss Level 2 (LF) |
| No. 139-13 | Interior High Performance Latex, MPI Gloss Level 3 (LL) |
| No. 140-13 | Interior High Performance Latex, MPI Gloss Level 4 |
| No. 141-13 | Interior High Performance Latex (SG) MPI Gloss Level 5 |

D. Steel Structures Painting Council (SSPC):

| | |
|--------------|---------------------|
| SSPC SP 1-04 | Solvent Cleaning |
| SSPC SP 2-04 | Hand Tool Cleaning |
| SSPC SP 3-04 | Power Tool Cleaning |

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Wood Sealer: Thinned with thinner recommended by manufacturer at rate of about one part of thinner to four parts of varnish.
- B. Polyurethane, Clear Gloss: MPI 31.
- C. Interior Satin Latex: MPI 43.
- D. Interior Primer Sealer: MPI 45.
- E. Interior Enamel Undercoat: MPI 46.
- F. Interior Alkyd, Semi-Gloss (AK): MPI 47.
- G. Interior Latex Primer Sealer: MPI 50.
- H. Interior Latex, Flat, MPI Gloss Level 1 (LE): MPI 53.
- I. Polyurethane, Moisture Cured, Clear, Flat (PV): MPI 71.
- J. Interior Wood Stain, Semi-Transparent (WS): MPI 90.
- K. Exterior Alkyd, Semi-Gloss (EO): MPI 94.
- L. Fast Drying Metal Primer: MPI 95.
- M. Waterborne Galvanized Primer: MPI 134.
- N. Interior High Performance Latex, MPI Gloss Level 3 (LL): MPI 139.

2.2 PAINT PROPERTIES

- A. Use ready-mixed (including colors), except two component epoxies, polyurethanes, polyesters, paints having metallic powders packaged separately and paints requiring specified additives.

- B. Where no requirements are given in the referenced specifications for primers, use primers with pigment and vehicle, compatible with substrate and finish coats specified.

2.3 REGULATORY REQUIREMENTS

- A. Paint materials must conform to the restrictions of the local Environmental and Toxic Control jurisdiction or the requirements of this section, whichever is most stringent.
1. Lead-Based Paint:
 - a. Lead based paint is not permitted to be used.
 - b. For lead-paint removal, see Section 02 83 33.13, LEAD-BASED PAINT REMOVAL AND DISPOSAL.
 2. Asbestos: Materials must not contain asbestos.
 3. Chromate, Cadmium, Mercury, and Silica: Materials must not contain zinc-chromate, strontium-chromate, Cadmium, mercury or mercury compounds or free crystalline silica.
 4. Human Carcinogens: Materials must not contain any of the ACGIH-BKLT and ACGHI-DOC confirmed or suspected human carcinogens.
 5. Use high performance acrylic paints in place of alkyd paints, where possible.
 6. VOC content for solvent-based paints must not exceed specified performance requirement; aromatic hydro carbons contained in solvent-based paints must not exceed one percent by weight.

PART 3 - EXECUTION

3.1 JOB CONDITIONS

- A. Safety: Observe required safety regulations and manufacturer's warning and instructions for storage, handling and application of painting materials.
1. Take necessary precautions to protect personnel and property from hazards due to falls, injuries, toxic fumes, fire, explosion, or other harm.
 2. Deposit soiled cleaning rags and waste materials in metal containers approved for that purpose. Dispose of such items off the site at end of each day's work.
- B. Atmospheric and Surface Conditions:
1. Do not apply coating when air or substrate conditions are:
 - a. Less than 3 degrees C (5 degrees F) above dew point.

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

3.2 SURFACE PREPARATION

- A. Method of surface preparation is optional, provided results of finish painting produce solid even color and texture specified with no overlays.
- B. General:
 1. Remove prefinished items not to be painted such as lighting fixtures, escutcheon plates, hardware, trim, and similar items for reinstallation after paint is dried.
 2. Remove items for reinstallation and complete painting of such items and adjacent areas when item or adjacent surface is not accessible or finish is different.
 3. See other sections of specifications for specified surface conditions and prime coat.
 4. Clean surfaces for painting with materials and methods compatible with substrate and specified finish. Remove any residue remaining

from cleaning agents used. Do not use solvents, acid, or steam on concrete and masonry.

C. Wood:

1. Sand to a smooth even surface and then dust off.
2. Sand surfaces showing raised grain smooth between each coat.
3. Wipe surface with a tack rag prior to applying finish.
4. Surface painted with an opaque finish:
 - a. Coat knots, sap and pitch streaks with Knot Sealer before applying paint.
 - b. Apply two coats of Knot Sealer over large knots.
5. After application of prime or first coat of stain, fill cracks, nail and screw holes, depressions and similar defects with wood filler paste. Sand the surface to make smooth and finish flush with adjacent surface.
6. Before applying finish coat, reapply wood filler paste if required, and sand surface to remove surface blemishes. Finish flush with adjacent surfaces.
7. Fill open grained wood such as oak, walnut, ash and mahogany with Wood Filler Paste, colored to match wood color.
 - a. Thin filler in accordance with manufacturer's instructions for application.
 - b. Remove excess filler, wipe as clean as possible, dry, and sand as specified.

D. Ferrous Metals:

1. Remove oil, grease, soil, drawing and cutting compounds, flux and other detrimental foreign matter in accordance with SSPC-SP 1 (Solvent Cleaning).
2. Remove loose mill scale, rust, and paint, by hand or power tool cleaning, as defined in SSPC-SP 2 (Hand Tool Cleaning) and SSPC-SP 3 (Power Tool Cleaning). Exception: where high temperature aluminum paint is used, prepare surface in accordance with paint manufacturer's instructions.
3. Fill dents, holes and similar voids and depressions in flat exposed surfaces of hollow steel doors and frames, access panels, roll-up steel doors and similar items specified to have semi-gloss or gloss finish with TT-F-322D (Filler, Two-Component Type, For Dents, Small Holes and Blow-Holes). Finish flush with adjacent surfaces.

- a. This includes flat head countersunk screws used for permanent anchors.
 - b. Do not fill screws of item intended for removal such as glazing beads.
4. Spot prime abraded and damaged areas in shop prime coat which expose bare metal with same type of paint used for prime coat. Feather edge of spot prime to produce smooth finish coat.
 5. Spot prime abraded and damaged areas which expose bare metal of factory finished items with paint as recommended by manufacturer of item.
- E. Zinc-Coated (Galvanized) Metal, Aluminum, 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 Organic Zinc Rich Coating. Prime or spot prime with MPI 134 (Waterborne Galvanized Primer) depending on finish coat compatibility.
- F. 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, MASONRY MORTARING, Section 04 05 16, MASONRY GROUTING. 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 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 CONCRETE Sections. Remove projections to level of adjacent surface by grinding or similar methods.
- G. Gypsum Plaster and Gypsum Board:

1. Remove efflorescence, loose and chalking plaster or finishing materials.
2. Remove dust, dirt, and other deterrents to paint adhesion.
3. Fill holes, cracks, and other depressions with CID-A-A-1272A [Plaster, Gypsum (Spackling Compound) finished flush with adjacent surface, with texture to match texture of adjacent surface. Patch holes over 25 mm (1-inch) in diameter as specified in Section for plaster or gypsum board.

3.3 PAINT PREPARATION

- A. Thoroughly mix painting materials to ensure uniformity of color, complete dispersion of pigment and uniform composition.
- B. Do not thin unless necessary for application and when finish paint is used for body and prime coats. Use materials and quantities for thinning as specified in manufacturer's printed instructions.
- C. Remove paint skins, then strain paint through commercial paint strainer to remove lumps and other particles.
- D. Mix two component and two part paint and those requiring additives in such a manner as to uniformly blend as specified in manufacturer's printed instructions unless specified otherwise.
- E. For tinting required to produce exact shades specified, use color pigment recommended by the paint manufacturer.

3.4 APPLICATION

- A. Start of surface preparation or painting will be construed as acceptance of the surface as satisfactory for the application of materials.
- B. Unless otherwise specified, apply paint in three coats; prime, body, and finish. When two coats applied to prime coat are the same, first coat applied over primer is body coat and second coat is finish coat.
- C. Apply each coat evenly and cover substrate completely.
- D. Allow not less than 48 hours between application of succeeding coats, except as allowed by manufacturer's printed instructions, and approved by PM.
- E. Finish surfaces to show solid even color, free from runs, lumps, brush marks, laps, holidays, or other defects.
- F. Apply by brush, roller or spray, except as otherwise specified.
- G. Do not spray paint in existing occupied spaces unless approved by PM, except in spaces sealed from existing occupied spaces.

1. Apply painting materials specifically required by manufacturer to be applied by spraying.
 2. In areas, where paint is applied by spray, mask or enclose with polyethylene, or similar air tight material with edges and seams continuously sealed including items specified in WORK NOT PAINTED, motors, controls, telephone, and electrical equipment, fronts of sterilizes and other recessed equipment and similar prefinished items.
- H. Do not paint in closed position operable items such as access doors and panels, window sashes, overhead doors, and similar items except overhead roll-up doors and shutters.

3.5 PRIME PAINTING

- A. After surface preparation, prime surfaces before application of body and finish coats, except as otherwise specified.
- B. Spot prime and apply body coat to damaged and abraded painted surfaces before applying succeeding coats.
- C. Additional field applied prime coats over shop or factory applied prime coats are not required except for exterior exposed steel. Apply an additional prime coat.
- D. Prime rebates for stop and face glazing of wood, and for face glazing of steel.
- E. Wood and Wood Particleboard:
 1. Use same kind of primer specified for exposed face surface.
 - a. Exterior wood: MPI 7 (Exterior Oil Wood Primer) for new construction and MPI 5 (Exterior Alkyd Wood Primer) for repainting bare wood primer except where Interior Wood Stain, Semi-Transparent (WS) is scheduled.
 - b. Interior wood except for transparent finish: MPI 45 (Interior Primer Sealer) or MPI 46 (Interior Enamel Undercoat), thinned if recommended by manufacturer.
 - c. Transparent finishes as specified under Transparent Finishes on Wood.
 2. Apply one coat of primer MPI 7 (Exterior Oil Wood Primer) or MPI 5 (Exterior Alkyd Wood Primer) or sealer MPI 45 (Interior Primer Sealer) or MPI 46 (Interior Enamel Undercoat) as soon as delivered to site to surfaces of unfinished woodwork, except concealed

surfaces of shop fabricated or assembled millwork and surfaces specified to have varnish, stain or natural finish.

3. Back prime and seal ends of exterior woodwork, and edges of exterior plywood specified to be finished.

F. Metals:

1. Steel and Iron: MPI 95 (Fast Drying Metal Primer).
2. Zinc-coated Steel and Iron: MPI 134 (Waterborne Galvanized Primer).
3. Machinery Not Factory Finished: MPI 9 (Exterior Alkyd Enamel (EO)).

G. Gypsum Board:

1. Primer: MPI 50 (Interior Latex Primer Sealer) except use MPI 45 (Interior Primer Sealer) or MPI 46 (Interior Enamel Undercoat) in shower and bathrooms.

H. Concrete Masonry Units except glazed or integrally colored and decorative units:

1. MPI 4 (Block Filler) on interior surfaces.

3.6 EXTERIOR FINISHES

A. Steel and Ferrous Metal, Including Tern:

1. MPI 94 (Exterior Alkyd, Semi-Gloss (EO)) on exposed surfaces, except on surfaces over 94 degrees C (200 degrees F).

C. Machinery without factory finish except for primer: MPI 94 (Exterior Alkyd, Semi-Gloss (EO)).

3.7 INTERIOR FINISHES

A. Metal Work:

1. Apply to exposed surfaces.
2. Omit body and finish coats on surfaces concealed after installation except electrical conduit containing conductors over 600 volts.
3. Ferrous Metal, Galvanized Metal, and Other Metals Scheduled:
 - a. Apply two coats of MPI 47 (Interior Alkyd, Semi-Gloss (AK)) unless specified otherwise.
 - b. Two coats of MPI 47 (Interior Alkyd Semi-Gloss (AK)).
 - c. Machinery: One coat MPI 9 (Exterior Alkyd Enamel (EO)).

B. Gypsum Board:

1. Two coats of of MPI 139 (Interior High Performance Latex, MPI Gloss level 3 (LL)).

C. Masonry and Concrete Walls:

1. Over MPI 4 (Interior/Exterior Latex Block Filler) on CMU surfaces.

2. Two coats of MPI 54 (Interior Latex, Semi-Gloss, MPI Gloss Level 5 (LE)).

D. Wood:

1. Sanding:

- a. Use 220-grit sandpaper.
- b. Sand sealers and varnish between coats.
- c. Sand enough to scarify surface to assure good adhesion of subsequent coats, to level roughly applied sealer and varnish, and to knock off "whiskers" of any raised grain as well as dust particles.

2. Sealers:

- a. Apply sealers specified except sealer may be omitted where pigmented, penetrating, or wiping stains containing resins are used.
- b. Allow manufacturer's recommended drying time before sanding, but not less than 24 hours or 36 hours in damp or muggy weather.
- c. Sand as specified.

3. Paint Finish:

- a. One coat of MPI 45 (Interior Primer Sealer) plus one coat of MPI 47 (Interior Alkyd, Semi-Gloss (AK)) (SG).
- b. One coat of MPI 45 Interior Primer Sealer.
- c. Two coats of MPI 51 (Interior Alkyd, Eggshell) (AK)).

4. Transparent Finishes on Wood Except Floors.

a. Stain Finish:

- 1) One coat of MPI 90 Interior Wood Stain, Semi-Transparent (WS).
- 2) Use wood stain of type and color required to achieve finish specified. Do not use varnish type stains.
- 3) One coat of sealer as written in 2.1 E.
- 4) Two coats of MPI 71 Polyurethane, Moisture Cured, Clear Flat (PV).

E. Concrete Floors

a. Concrete Sealer

- 1) Two coats of MPI 104, Sealer, Solvent Based, for concrete floors.

3.8 REFINISHING EXISTING PAINTED SURFACES

- A. Clean, patch and repair existing surfaces as specified under surface preparation.
- B. Remove and reinstall items as specified under surface preparation.
- C. Remove existing finishes or apply separation coats to prevent non-compatible coatings from having contact.
- D. Patched or Replaced Areas in Surfaces and Components: Apply spot prime and body coats as specified for new work to repaired areas or replaced components.
- E. Except where scheduled for complete painting apply finish coat over plane surface to nearest break in plane, such as corner, reveal, or frame.
- F. In existing rooms and areas where alterations occur, clean existing stained and natural finished wood retouch abraded surfaces and then give entire surface one coat of Polyurethane, Moisture Cured, Clear Flat (PV).
- G. Refinish areas as specified for new work to match adjoining work unless specified or scheduled otherwise.
- H. Coat knots and pitch streaks showing through old finish with Knot Sealer before refinishing.
- I. Sand or dull glossy surfaces prior to painting.
- J. Sand existing coatings to a feather edge so that transition between new and existing finish will not show in finished work.

3.9 PAINT COLOR

- A. Color and gloss of finish coats is specified in Section 09 06 00, SCHEDULE FOR FINISHES.
- B. For additional requirements regarding color see Articles, REFINISHING EXISTING PAINTED SURFACE and MECHANICAL AND ELECTRICAL FIELD PAINTING SCHEDULE.
- C. Coat Colors:
 - 1. Color of priming coat: Lighter than body coat.
 - 2. Color of body coat: Lighter than finish coat.
 - 3. Color prime and body coats to not show through the finish coat and to mask surface imperfections or contrasts.
- D. Painting, Caulking, Closures, and Fillers Adjacent to Casework:
 - 1. Paint to match color of casework where casework has a paint finish.

2. Paint to match color of wall where casework is stainless steel,
plastic laminate, or varnished wood.

3.10 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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Black Hills National Cemetery

NCA Project #884CM3015

Renovate and Expand Administration and Maintenance Buildings

10/31/22

20901 Pleasant Valley Drive

BID DOCUMENTS

Sturgis, SD 57785

PAINTING

09 91 00 - 16

**SECTION 10 11 13
CHALKBOARDS AND MARKERBOARDS**

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies markerboards.

1.2 RELATED WORK

A. Sustainable Design Requirements: Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

1.3 QUALITY ASSURANCE

A. Provide boards that are the products of a single manufacturer, who has provided units as specified for a minimum of three (3) years.

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. Volatile organic compounds per volume as specified in PART 2 - PRODUCTS.

C. Shop Drawings: Identifying all parts by name and material and showing design, construction, installation, anchorage and relation to adjacent construction.

D. Manufacturer's Literature and Data:

1. Chalkboard.
2. Markerboard.
3. Presentation Board.

E. Samples:

1. Chalkboard and markerboard writing surface, 152 x 152 mm (6 x 6 inches), each color, and texture mounted on backing.
2. Frame material, 305 mm (6 inch) length.

F. Manufacturer's qualifications.

1.5 WARRANTY

A. Construction Warranty: Comply with FAR clause 52.246-21, "Warranty of Construction".

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 Architectural Manufacturers Association (AAMA):
 - 611-14.....Voluntary Specification for Anodized Architectural Aluminum
 - 2603-20.....Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels (with Coiling Coating Appendix)
- C. American National Standards (ANSI):
 - Z97.1-2015.....Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test
- D. ASTM International (ASTM):
 - 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)
 - C1048-18.....Heat-Strengthened and Fully Tempered Flat Glass
- E. Code of Federal Regulation (CFR):
 - 40 CFR 59(2016) Subpart D National Volatile Organic Compound Emission Standards for Architectural Coatings
- F. Composite Panel Association (CPA):
 - A208.1-2016.....Particleboard
 - A135.4-12 (R2020).....Basic Hardboard
- G. National Association of Architectural Metal Manufacturers (NAAMM):
 - AMP 500-06.....Metal Finishes Manual
- H. Porcelain Enamel Institute (PEI)
 - 1001.....Manual of Architectural Porcelain Enamel

PART 2 - PRODUCTS

2.1 MARKERBOARD

- A. Provide markerboard with porcelain enamel writing surface and chalktray.
- B. Provide factory assembled unit complete in one (1) piece, without joints whenever possible. When markerboard dimensions require delivery in separate sections, prefit components at factory, disassembled for delivery and fit joints at site.
- C. Frame: Aluminum.

- D. Marker Tray: Same material as frame and extend full length of markerboard.
- E. Map Rail: Not required.
- F. Provide surface such that dry erase markings are removable with felt eraser or dry cloth without ghosting.
- G. Provide face fabricated from ferromagnetic material.

2.2 MATERIALS

A. Writing Surface:

- 1. Provide markerboard writing surface composed of porcelain enamel fused to nominal 0.378 mm (28 gauge) thick steel. Laminate to a minimum 6 mm (1/4 inch) thick core material with a steel or foil backing sheet.

B. Aluminum:

- 1. Aluminum frame extrusions to be alloy 6063-T5 or 6063-T6, conform to ASTM B221M (B221). Minimum 1.5 mm (0.06 inches) thick.
- 2. Provide straight, single lengths wherever possible.
- 3. Miter corners to have hairline closure.

C. 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 visual display unit manufacturer.
- 2. Adhesives to have VOC content of 50 g/L or less when calculated according to 40 CFR 59, (EPA Method 24).

2.3 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's AMP 500 Series for Architectural and Metal Products for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved samples and are assembled or installed to minimize contrast.

2.4 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm (.39 mil) or thicker.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Install units in accordance with the manufacturer's installation instructions with concealed fasteners.
- B. Verify partitions have received blocking and reinforcement before installation of markerboards.
- C. Assemble units in accordance with manufacturer's written instructions.
- D. Grounds Designed to Receive Clips for Snap-On Trim: Continuous and secured 305 mm (12 inches) on center.
- E. Miter trim at corners, conceal fasteners. Modify trim as required to conform to surrounding construction details.

3.2 CLEANING

- A. Clean in accordance with manufacturers' written instructions.
- B. Touch up factory-applied finishes to restore damaged or soiled areas.

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SECTION 10 14 05
INTERIOR SIGNAGE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies interior signage for rooms, directional signs, and code required signs.
- B. This section includes bronze Great Seal of the United States.
- C. Installation of Government-furnished dedication plaque.

1.2 RELATED WORK

- A. Electrical: Related Electrical Specification Sections.
- B. Lighted EXIT signs for egress purposes are specified under Division 26, ELECTRICAL.

1.3 MANUFACTURER'S QUALIFICATIONS

- A. Provide evidence that the sign manufacturer regularly and presently manufacture signs similar to those specified in this section as one of their principal products.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 00, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- B. Samples: Sign panels and frames, with letters and symbols, each type. Submit two sets; one set of samples will be retained by RE/COR, other returned to Contractor.
 - 1. Sign Panel, 200 mm x 250 mm (8 inches x 10 inches), with letters.
 - 2. Color samples of each color, 150 mm x 150 mm (6 inches x 6 inches. Show anticipated range of color and texture.
 - 3. Sample of typeface, arrow and symbols in a typical full size layout.
- C. Manufacturer's Literature:
 - 1. Show the methods and procedures proposed for the concealed anchorage of the signage system to each surface type.
 - 2. Manufacturer's printed specifications, anchorage details, installation and maintenance instructions.
- D. Provide sign location plan, showing location, type and total number of signs required.
- E. Shop Drawings: Scale for manufacture and fabrication of sign types. Identify materials, show joints, welds, anchorage, accessory items, mounting and finishes.
- F. Full size layout patterns for dimensional letters.

1.5 DELIVERY AND STORAGE

- A. Deliver materials to job in manufacturer's original sealed containers with brand name marked thereon.
- B. Protect materials from damage.
- C. 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.
- D. Deliver signs only when the site and mounting services are ready for installation work to proceed.
- E. Store products in dry condition inside enclosed facilities.

1.6 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by the basic designation only. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
- B. American Society for Testing and Materials (ASTM):
 - B209/B209M-21a Aluminum and Aluminum-Alloy Sheet and Plate
 - B491/B491M-15 Aluminum and Aluminum-Alloy Extruded Round Tubes for General Purpose Applications
 - B211/B211M-19 Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire
- C. Military Specifications (Mil. Spec.):
 - MIL-PRF-8184F Plastic Sheet, Acrylic, Modified
 - MIL-P-46144C Plastic Sheet, Polycarbonate

1.7 MINIMUM SIGN REQUIREMENTS

- A. Permanent Rooms and Spaces:
 - 1. Tactile and Braille Characters, raised minimum 0.793 mm (1/32 inch); characters must be accompanied by Grade 2 Braille.
 - 2. Topography:
 - a. Type Style: Helvetica Bold. Initial caps or all caps as indicated in Sign Message Schedule.
 - b. Provide text, arrows, and symbols in size, colors, typefaces and letter spacing shown; provide a true, clean, accurate reproduction of typeface(s) shown. Text shown in drawings is for layout purposes only; final text for signs is listed in Sign Message Schedule.
 - 3. Character Height: Minimum 16 mm (5/8 in) high, Maximum 50 mm (2 in).

4. Symbols (Pictograms): Place equivalent written description directly below symbol, outside of symbol's background field. Border dimensions of symbol background must be minimum 150 mm (6 in) high.
5. Finish and Contrast: Characters and background to be eggshell, matte or other non-glare finish with adequate contrast with background.
6. Mounting Location and Height: As shown or mounted on wall adjacent to the latch side of the door and to avoid door swing and protruding objects.

1.8 COLORS AND FINISHES

PART 2 - PRODUCTS

2.1 GENERAL

- A. Signs of type, size and design shown on the drawings and as specified.
- B. Signs complete with lettering, framing and related components for a complete installation.
- C. Provide graphics items as completed units produced by a single manufacturer, including necessary mounting accessories, fittings and fastenings.
- D. Do not scale drawings for dimensions; verify and be responsible for all dimensions and conditions indicated. RE/COR to be notified of any discrepancy in drawing, in field directions or conditions, and/or of any changes required for all such construction details.
- E. By commencing work of this section, Contractor assumes overall responsibility, as part of its warranty of work, to assure that assemblies, components and parts shown or required within the work of the section, comply with the Contract Documents. Contractor further warrants that all components, specified or required to satisfactorily complete the installation are compatible with each other and with conditions of installations.

2.2 PRODUCTS

- A. Cast Acrylic Sheet: MIL-PRF-8184F; Type II, class 1, Water white non-glare optically clear. Matt finish water white clear acrylic is not acceptable.
- B. Vinyl: 0.1 mm thick machine cut, having pressure sensitive adhesive and integral colors.

2.3 INTERIOR SIGNAGE TYPES FOR ROOMS

- A. General:

1. The interior sign system is comprised of sign types families that are identified by a letter and number which identify a particular group of signs. An additional number identifies a specific type of sign within that family.

C. Sign Type Families 14 and 15:

1. All text and graphics are to be first surface applied vinyl letters.
2. Tactile sign is to be made from a material that provides for letters, numbers and Braille to be integral with sign plaque material such as: photosensitive polyamide resin, etched metal, sandblasted phenolic or embossed material. Do not apply letters, numbers and Braille with adhesive.
3. Numbers, letters and Braille to be raised 0.793 mm (.0312 inches) from the background surface. The draft of the letters, numbers and Braille must be tapered, vertical and clean.
4. Braille dots are to conform with standard dimensions for literary Braille; (a) Dot base diameter: 1.5 mm (.059 inches) (b) Inter-dot spacing: 2.3 mm (.090 inches) (c) Horizontal separation between cells: 6.0 mm (.241 inches) (d) Vertical separation between cells: 10.0 mm (.395 inches)
5. Entire assembly is painted in specified color. After painting, apply white or other specified color to surface of the numbers and letters. Entire sign is to have a protective clear coat sealant applied.
6. Complete sign is to have an eggshell finish (11 to 19 degree on a 60 degree gloss meter).

2.4 FABRICATION

- A. Design components to allow for expansion and contraction for a minimum material temperature range of 56 °C (100 °F), without causing buckling, excessive opening of joints or over stressing of adhesives, welds and fasteners.
- B. Form work to required shapes and sizes, with true curve lines and angles. Provide necessary rebates, lugs and brackets for assembly of units. Use concealed fasteners whenever and wherever possible.
- C. Shop fabricate so far as practicable. Joints fastened flush to conceal reinforcement, or welded where thickness or section permits.

- D. Contact surfaces of connected members must be true and assembled so joints are tight and practically unnoticeable, without use of filling compound.
- E. Provide signs with fine, even texture, flat and sound. Lines and miters sharp, arises unbroken, profiles accurate and ornament true to pattern. Plane surfaces to be smooth flat and without oil-canning, free of rack and twist. Maximum variation from plane of surface is plus or minus 0.3 mm (0.015 inches). Restore texture to filed or cut areas.
- F. Level or straighten wrought work. Provide members with sharp lines and angles, and smooth surfaces.
- G. Extruded members to be free from extrusion marks. Square turns and corners sharp, curves true.
- H. Drill holes for bolts and screws. Conceal fastenings where possible. Exposed ends and edges mill smooth, with corners slightly rounded. Form joints exposed to weather to exclude water.
- I. Finish hollow signs with matching material on all faces, tops, bottoms and ends. Edge joints tightly mitered to give appearance of solid material.
- J. All painted surfaces properly primed. Finish coating of paint to have complete coverage with no light or thin applications allowing substrate or primer to show. Finished surface must be smooth, free of scratches, gouges, drips, bubbles, thickness variations, foreign matter and other imperfections.
- K. Movable parts, including hardware, are be cleaned and adjusted to operate as designed without binding or deformation of members. Doors and covers centered in opening or frame. All contact surfaces fit tight and even without forcing or warping components.
- L. Pre-assemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for re-assembly and coordinated installation.
- M. No signs are to be manufactured until final sign message schedule and location review has been completed by the RE/COR and forwarded to Contractor.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Protect products against damage during field handling and installation. Protect adjacent existing and newly placed construction, landscaping and finishes as necessary to prevent damage during installation. Paint and touch up any exposed fasteners and connecting hardware to match color and finish of surrounding surface.
- B. Mount signs in proper alignment, level and plumb according to the sign location plan and the dimensions given on elevation and sign location drawings. Install signs where best suited to provide a consistent appearance throughout the project, where otherwise not dimensioned. Contact RE/COR for clarification, when exact position, angle, height or location is in doubt.
- C. Contractor is responsible for all signs that are damaged, lost or stolen while materials are on the job site, until the completion and final acceptance of the job.
- D. Remove or correct signs or installation work RE/COR determines as unsafe or as an unsafe condition.
- E. At completion of sign installation, clean exposed sign surfaces. Clean and repair any adjoining surfaces and landscaping that became soiled or damaged as a result of installation of signs.
- F. Locate signs as shown on the Sign Location Plans.
- G. Certain signs may be installed on glass. A blank glass back up is required to be placed on opposite side of glass exactly behind sign being installed. This blank glass back up is to be the same size as sign being installed.
- H. Contractor will be responsible for verifying that behind each sign location there are no utility lines that will be affected by installation of signs. Any damage during installation of signs to utilities will be the sole responsibility of the Contractor to correct and repair.
- I. Furnish inserts and anchoring devices which must be set in concrete or other material for installation of signs. Provide setting drawings, templates, instructions and directions for installation of anchorage devices which may involve other trades.

- - - END - - -

**SECTION 10 21 13
TOILET COMPARTMENTS**

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies solid polyethylene and urinal screens.

1.2 RELATED WORK

A. Overhead structural steel supports for ceiling hung pilasters: Section 05 50 00, METAL FABRICATIONS.

B. Grab bars and toilet tissue holders: Section 10 28 00, TOILET, BATH, AND LAUNDRY ACCESSORIES.

1.3 SUSTAINABILITY REQUIREMENTS

A. Materials in this section may contribute towards contract compliance with sustainability requirements. See Section 01 81 11, SUSTAINABLE DESIGN REQUIREMENTS, for project low-emitting materials, recycled content requirements.

B. Biobased Material: For products designated by the USDA's BioPreferred® program, provide products that meet or exceed USDA recommendations for biobased content, subject to the products compliance with performance requirements in this Section. For more information regarding the product categories covered by the BioPreferred® program, visit <http://www.biopreferred.gov>.

1.4 REGULATORY REQUIREMENTS FOR RECYCLED CONTENT

A. Products and Materials with Post-Consumer Content and Recovered Materials Content:

1. Contractor is obligated by contract to satisfy Federal mandates for procurement of products and materials meeting recommendations for post-consumer content and recovered materials content; the list of designated product categories with recommendations has been compiled by the EPA - refer to <http://www.epa.gov/wastes/conserves/tools/cpg/products/>.

2. Materials or products specified by this section may be obligated to satisfy this Federal mandate and Comprehensive Procurement Guidelines program.

3. The EPA website also provides tools such as a Product Supplier Directory search engine and product resource guides.

B. Fulfillment of regulatory requirements does not relieve the Contractor of satisfying sustainability requirements stipulated by Section

01 81 11, SUSTAINABLE DESIGN REQUIREMENTS, as it relates to recycled content; additional product and material selections with recycled content may be required, as determined by Contractor's Sustainability Action Plan.

1.5 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data: Specified items indicating all hardware and fittings, material, finish, and latching.
- C. Shop Drawings: Construction details at 1/2 scale, showing installation details, anchoring and leveling devices.
- D. Manufacturer's certificate, attesting that zinc-coatings conform to specified requirements.

1.6 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by the basic designation only. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
- B. American National Standards Institute (ANSI):
 - ICC/ANSI A117.1-03 Guideline for Accessible and Usable Buildings and Facilities-Providing Accessibility and Usability for Physically Handicapped People
- C. American Society for Testing and Materials (ASTM):
 - A123/A123M-17 Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - A385/A385M-20 High Quality Zinc Coatings (Hot-Dip)

PART 2 - PRODUCTS

2.1 FABRICATION

- A. Solid polyethylene: water resistant; graffiti resistant; non-absorbent; contain a minimum 30 percent post-consumer recycled plastic; Class C flame spread rating.
- B. Conform to ICC A117.1 code for access for the handicapped operation of toilet compartment door and hardware.
- C. Fabricate to dimensions shown or specified.
- D. Toilet Enclosures:
 - 1. Type 1, C (overhead braced).

2. Reinforce panels shown to receive toilet tissue holders or grab bars.
 3. Provide sound deadening consisting of treated kraft paper honeycomb cores with a cell size of not more than 25 mm (1 inch); resin-material content minimum 11 percent of the finished core weight. Face expanded cores with kraft paper on both sides.
 4. Upper pivots and lower hinges adjustable to hold doors open 30 degrees.
 5. Keeper:
 - a. U-slot to engage bar of throw latch.
 - b. Combined with rubber bumper stop.
 6. Wheelchair Toilets:
 - a. Upper pivots and lower hinges to hold out swinging doors in closed position.
 - b. Provide U-type doors pulls, approximately 100 mm (four inches) long on pull side.
 7. Finish:
 - b. Solid polyethylene for doors, pilasters, and enclosure panels.
- E. Urinal Screens:
1. Type III, Style D (wall hung), stainless steel.
 - a. With integral flanges and continuous, full height wall anchor plate.
 - b. Option: Full height U-Type bracket.
 - c. Wall anchor plate drilled for 4 anchors on both sides of screen.
 2. Screen 600 mm (24 inches) wide and 1060 mm (42 inches high).

2.2 ANCHORING DEVICES AND FASTENERS

- A. Provide steel anchoring devices and fasteners hot-dipped galvanized after fabrication, in conformance with ASTM A385/A385M and ASTM A123/A123M. Conceal all galvanized anchoring devices.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General:
 1. Install in rigid manner, straight, plumb and with all horizontal lines level.
 2. Conceal evidence of drilling, cutting and fitting in finish work.
 3. Use hex-bolts for through-bolting.
 4. Adjust hardware and leave in freely working order.

5. Clean finished surfaces and leave free of imperfections.

B. Panels and Pilasters:

1. Support panels, except urinal screens, and pilaster abutting building walls near top and bottom by stirrup supports secured to partitions with through-bolts.
2. Secure stirrups to walls with two suitable anchoring devices for each stirrup.
3. Secure panels to faces of pilaster near top and bottom with stirrup supports, through-bolted to panels and machine screwed to each pilaster.
4. Secure edges of panels to edges of pilasters near top and bottom with "U" shaped brackets.
5. Where overhead braced, secure pilasters to building walls by headrails clamped on or set into top of each pilaster.
 - a. Secure clamps to pilasters with two through-bolts to each clamp.
 - b. When headrails are set into pilasters, through-bolt them to the pilasters.
 - c. Support headrails on wall flange fittings secured to building walls with minimum of two anchor bolts to each flange fitting.

C. Urinal Screens:

1. Anchor urinal screen flange to walls with minimum of four bolts both side of panel.
2. Space anchors at top and bottom and equally in between.

- - - E N D - - -

SECTION 10 28 00
TOILET AND BATH ACCESSORIES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies manufactured items usually used in toilets, baths, locker rooms, and at sinks in related spaces.
- B. Items Specified:
 - 1. Paper towel dispenser.
 - 2. Toilet tissue dispenser.
 - 3. Grab Bars
 - 4. Shower curtain rods
 - 5. Clothes hooks, robe or coat.
 - 6. Towel bars.
 - 7. Metal framed mirror
 - 8. Sanitary napkin disposal.
 - 9. Diaper changing station.
 - 10. Mop Holder
 - 11. Stainless steel shelves, Type 45 and Type 45C.
 - 12. Folding shower seats
- C. This section also specifies custom fabricated items used in toilets and related spaces.

1.2 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Shop Drawings:
 - 1. Provide for each product specified.
 - 2. Show material and finish, size of members, and details of construction, installation and anchorage of mop racks.
- C. Samples:
 - 1. One of each type of accessory specified.
 - 2. After approval, samples may be used in the work.
- D. Manufacturer's Literature and Data:
 - 1. Provide for all accessories specified.
 - 2. Show type of material, gages or metal thickness in inches, finishes, and when required, capacity of accessories.
 - 3. Show working operations of spindle for toilet tissue dispensers.
- E. Manufacturer's Certificates:

1. Attest that soap dispensers are fabricated of material that cannot be affected by liquid soap or aseptic detergents, PhisoHex and solutions containing hexachlorophene.
2. Confirm that anodized finish is as specified.

1.4 QUALITY ASSURANCE

- A. Each product must meet the requirements specified and be a standard commercial product of a manufacturer regularly presently manufacturing items of type specified.
- B. Each accessory type to be the same and be made by the same manufacturer.
- C. Assemble each accessory 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 PACKAGING AND DELIVERY

- A. Pack accessories individually to protect finish.
- B. Deliver accessories to the project only when installation work in rooms is ready to receive them.
- C. Deliver inserts and rough-in frames to site at appropriate time for building-in.
- D. Deliver products to site in sealed packages of containers; labeled for identification with manufacturer's name, brand, and contents.

1.6 STORAGE

- A. Store products in weathertight and dry storage facility.
- B. Protect from damage from handling, weather and construction operations before, during and after installation in accordance with manufacturer's instructions.

1.7 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by the basic designation only. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
- B. American Society for Testing and Materials (ASTM):
A269/A269M-15a(2019) Seamless and Welded Austenitic Stainless Steel Tubing for General Service

| | |
|---|--|
| A312/A312M-22 | Seamless and Welded Austenitic Stainless Steel Pipes |
| A653/A653M-20 | Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process |
| A1011/A1011M-18a | Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength |
| B456-17 | Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium |
| C1036-21 | Flat Glass |
| D635-22 | Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position |
| D3690-19 | Vinyl-Coated and Urethane-Coated Upholstery Fabrics - Indoor |
| F446-19 | Consumer Safety Specification for Grab Bars and Accessories Installed in the Bathing Area |
| C. American Welding Society (AWS): | |
| D10.4-86 (R2000) | Welding Austenitic Chromium-Nickel Stainless Steel Piping and Tubing |
| D. The National Association of Architectural Metal Manufacturers (NAAMM): | |
| AMP 500 Series | Metal Finishes Manual |
| AMP 500-505-06 | Metal Finishes Manual and Finishes for Stainless Steel |

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Stainless Steel:
1. Plate or sheet: ASTM A167, Type 302, 304, or 304L, except ASTM A176 where Type 430 is specified, 0.0299-inch thick unless otherwise specified.
 2. Tube: ASTM A269, Type 304 or 304L.
- B. Stainless Steel Tubing: ASTM A269, Grade 304 or 304L, seamless or welded.
- C. Stainless Steel Pipe: ASTM A312; Grade TP 304 or TP 304L.
- D. Steel Sheet: ASTM A653, zinc-coated (galvanized) coating designation G90.
- E. Glass: ASTM C1036, Type 1, Class 1, Quality q2, for mirrors.

F. Vinyl Covering: ASTM D3690, Vinyl coated fabric, Class A.

G. Plywood: PS1, Grade CD.

2.2 FASTENERS

A. Exposed Fasteners: Stainless steel or chromium plated brass, finish to match adjacent surface.

B. Concealed Fasteners: Steel, hot-dip galvanized//; except in high moisture areas such as showers, use stainless steel//.

C. Toggle Bolts: For use in hollow masonry or frame construction.

D. Hex Bolts: For through bolting on thin panels.

E. Expansion Shields: Lead or plastic as recommended by accessory manufacturer for component and substrate for use in solid masonry or concrete.

F. Screws:

1. ASME B18.6.4.

G. Adhesive: As recommended by manufacturer for products to be joined.

2.3 FINISH

A. In accordance with NAAMM AMP 500 series.

B. AA-M32 Mechanical finish, medium satin.

1. Chromium Plating: ASTM B456, satin or bright as specified, Service Condition No. SC2.

2. Stainless Steel: NAAMM AMP 503, finish number 4.

3. Ferrous Metal:

a. Shop Prime: Clean, pretreat and apply one coat of primer and bake.

b. Finish: Over primer apply two coats of alkyd or phenolic resin enamel, and bake.

4. Nylon Coated Steel: Nylon coating powder formulated for a fluidized bonding process to steel to provide a hard smooth, medium gloss finish, not less than 0.3 mm (0.012-inch) thick, rated as self-extinguishing when tested in accordance with ASTM D635.

2.4 FABRICATION - GENERAL

A. Perform welding in accordance AWS D10.4.

B. Grind dress, and finish welded joints to match finish of adjacent surface.

C. Form exposed surfaces from one sheet of stock, free of joints.

D. Provide steel anchors and components required for secure installation.

- E. Form flat surfaces without distortion. Keep exposed surfaces free from scratches and dents. Reinforce doors to prevent warp or twist.
- F. Shop assemble accessories and package with all components, anchors, fittings, fasteners and keys.
- G. Key items alike.
- H. Provide templates and rough-in measurements as required.
- I. Round and smooth edges of sheets to remove sharp edges.

2.5 PAPER TOWEL DISPENSERS

- A. Surface mounted type with sloping top.
- B. Dispensing capacity for 300 sheets of any type of paper toweling.
- C. Fabricate of stainless steel.
- D. Provide door with continuous hinge at bottom, and spring tension cam lock or tumbler lock, keyed alike, at top and a refill sight slot in front.

2.6 TOILET TISSUE DISPENSERS

- A. Double roll surface mounted type.
- B. Mount on continuous back plate.
- C. Removable spindle ABS plastic or chrome plated plastic.
- D. Wood rollers are not acceptable.

2.7 GRAB BARS

- A. Comply to ASTM F446.
- B. Fabricate of stainless steel or nylon coated steel, except use only one type throughout the project:
 - 1. Stainless Steel: Grab bars, flanges, mounting plates, supports, screws, bolts, and exposed nuts and washers.
 - 2. Nylon Coated Steel: Grab bars and flanges complete with mounting plates and fasteners.
- C. Concealed mount, except grab bars mounted at floor, swing up and on toilet partitions.
- D. Bars:
 - 1. Fabricate from 32 mm (1-1/4 inch) outside diameter tubing.
 - a. Stainless steel, minimum 1.2 mm (0.0478 inch) thick.
 - 2. Fabricate in one continuous piece with ends turned toward walls, except swing up and where grab bars are shown continuous around three sides of showers, bars may be fabricated in two sections, with concealed slip joint between.
 - 3. Continuous weld intermediate support to the grab bar.

4. Swing up bars manually operated. Designed to prevent bar from falling when in raised position.
- E. Flange for Concealed Mounting:
1. Minimum of 2.65 mm (0.1046 inch) thick, approximately 75 mm (3 inch) diameter by 13 mm (1/2 inch) deep, with provisions for not less than three set screws for securing flange to back plate.
 2. Insert grab bar through center of the flange and continuously weld perimeter of grab bar flush to back side of flange.
- F. Flange for Exposed Mounting:
1. Minimum 5 mm (3/16 inch) thick, approximately 75 mm (3 inch) diameter.
 2. Insert grab bar through flange and continuously weld perimeter of grab bar flush to backside of flange.
 3. Where mounted on toilet partitions, provide three equally spaced, countersunk holes, sized to accommodate 5 mm (3/16 inch) diameter bolts.
 4. Where mounted on floor, provide four equally spaced holes, sized to accommodate 5 mm (3/8 inch) diameter bolts, not more than 5 mm (3/8 inch) from edge of flange.
- G. Instead of providing flange for concealed mounting, and back plate as specified, grab rail may be secured by being welded to a back plate and be covered with flange.
- H. Back Plates:
1. Minimum 2.65 mm (0.1046 inch) thick metal.
 2. Fabricate in one piece, approximately 6 mm (1/4 inch) deep, with diameter sized to fit flange. Provide slotted holes to accommodate anchor bolts.
 3. Furnish spreaders, through bolt fasteners, and cap nuts, where grab bars are mounted on partitions.

2.8 SHOWER CURTAIN RODS

- A. Stainless steel tubing, ASTM A1011, minimum 1.27 mm (0.050 inch) wall thickness, 32 mm (1-1/4 inch) outside diameter.
- B. Flanges, stainless steel rings, 66 mm (2 5/8 inch) minimum outside diameter, with 2 holes opposite each other for 6 mm (1/4 inch) stainless steel fastening bolts. Provide a set screw within the curvature of each flange for securing the rod.

- C. Intermediate support for rods over 1800 mm (six feet) long or 90 degree rods. Provide adjustable ceiling flanges with set screws, tubular hangers and stirrups.

2.9 CLOTHES HOOKS-ROBE OR COAT

- A. Fabricate hook units of chromium plated brass, with a satin finish, or stainless steel, using 6 mm (1/4 inch) minimum thick stock, with edges and corners rounded smooth to the thickness of the metal, or 3 mm (1/8 inch) minimum radius.
- B. Fabricate each unit as a double hook on a single shaft, integral with or permanently fastened to the wall flange, provided with concealed fastenings.

2.10 METAL FRAMED MIRRORS

- A. Mirror Glass:
 - 1. Minimum 6 mm (1/4 inch) thick.
 - 2. Set mirror in a protective vinyl glazing tape.
- B. Frames:
 - 1. Channel or angle shaped section with face of frame not less than 9 mm (3/8 inch) wide. Fabricate with square corners.
 - 2. Use 0.9 mm (0.0359 inch) thick stainless steel.
 - 3. Filler:
 - a. Where mirrors are mounted on walls having ceramic tile wainscots not flush with wall above, provide fillers at void between back of mirror and wall surface.
 - b. Fabricate fillers from same material and finish as the mirror frame, contoured to conceal the void behind the mirror at sides and top.
- C. Back Plate:
 - 1. Fabricate back plate for concealed wall hanging of zinc-coated or cadmium plated 0.9 mm (0.036 inch) thick sheet steel, die cut to fit face of mirror frame, and furnish with theft resistant concealed wall fastenings.
 - 2. Use set screw type theft resistant concealed fastening system for mounting mirrors.
- D. Mounting Bracket:
 - 1. Designed to support mirror tight to wall.
 - 2. Designed to retain mirror with concealed set screw fastenings.

2.11 SANITARY NAPKIN DISPOSAL

- A. Fabricate a Type 304 stainless steel sanitary napkin disposal with removable leak-proof receptacle for disposable liners.
- B. Provide 50 disposable liners of the type standard with the manufacturer.
- C. Retain receptacle in cabinet by tumbler lock.
- D. Provide disposal with a door for inserting disposed napkins, recessed partition mounted, and surface mounted as indicated on drawings.

2.12 DIAPER CHANGING STATION

- A. Provide surface mounted diaper changing station fabricated of high impact plastic interior with no sharp edges; Type 304 stainless steel cover exterior closed position.
- B. Provide fold down platform concave to the child's shape, equipped with nylon and hook and loop safety straps and engineered to withstand a minimum static load of 113 kg (250 lb.).
- C. Provide an integral dispenser for sanitary liners for each unit.
- D. Provide pictorial for universal use of safety graphics.

2.13 MOP RACKS

- A. Minimum 1.0M (40 inches) long with five holders.
- B. Clamps:
 - 1. Minimum of 1.3 mm (0.050-inch) thick stainless steel bracket retaining channel with a hard rubber serrated cam; pivot mounted to channel.
 - 2. Provide clamps to hold handles from minimum 13 mm (1/2-inch) to 32 mm maximum (1-1/4 inch) diameter.
- C. Support:
 - 1. Minimum of 1 mm (0.0375 inch) thick stainless steel hat shape channel to hold clamps away from wall as shown.
 - 2. Drill wall flange for 3 mm (1/8 inch) fasteners above and below clamp locations.
- D. Secure clamps to support with oval head machine screws or rivets into continuous reinforcing back of clamps.
- E. Finish on stainless Steel: AMP 503-No. 4.

2.14 STAINLESS STEEL SHELVES, TYPES 45 AND 45C

- A. Fabricate shelves and brackets to design shown of 1.2 mm (0.0478-inch) thick stainless steel.

- B. Round and finish smooth projecting corners of shelves and edge corners of brackets. Drill brackets for 6 mm (1/4-inch) anchor bolts.
- C. Screw or weld brackets to shelves.

2.15 STAINLESS STEEL SHELVES AT WHEELCHAIR LAVATORY

- A. Side Wall Mounted:
 - 1. Fabricate to size and shape shown of 1.2 mm (0.0478 inch) thick sheet.
 - 2. Turn up edges and weld corners closed.
 - 3. Fabricate brackets and weld to shelf. Drill brackets for 6 mm (1/4 inch) anchor bolts.
- B. Back Wall Mounted:
 - 1. Fabricate to size and shape shown of plate and tube.
 - 2. Turn up edges and weld corners of shelf.
 - 3. Weld tube to back plate and shelf, weld back plate to shelf, filler plate to tube, and corners of shelf with continuous welds.
 - 4. Drill back plate for 6 mm (1/4 inch) anchor bolts.

2.16 FOLDING SHOWER SEATS

- A. Folding Reversible Shower Seat
 - 1. Solid Phenolic 1/2 inch thick.
 - 2. 1" stainless steel tubing frame, stainless steel wall brackets.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before starting work notify PM in writing of any conflicts detrimental to installation or operation of units.
- B. Verify with the PM the exact location of accessories.

3.2 INSTALLATION

- 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. Toggle bolt to steel anchorage plates in frame partitions or hollow masonry. Expansion bolt to concrete or solid masonry.
- C. Install accessories in accordance with the manufacturer's printed instructions and ASTM F446.
- D. Install accessories plumb and level and securely anchor to substrate.
- E. Install accessories in a manner that will permit the accessory to function as designed and allow for servicing as required without hampering or hindering the performance of other devices.

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- F. Position and install dispensers, and other devices in countertops, clear of drawers, permitting ample clearance below countertop between devices, and ready access for maintenance as needed.
- G. Align mirrors, dispensers and other accessories even and level, when installed in battery.
- H. Install accessories to prevent striking by other moving, items or interference with accessibility.

3.3 CLEANING

- A. After installation, clean as recommended by the manufacturer and protect from damage until completion of the project.

- - - E N D - - -

SECTION 10 44 13
FIRE EXTINGUISHER CABINETS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section covers recessed fire extinguisher cabinets.

1.2 RELATED WORK

A. Field Painting: Section 09 91 00, PAINTING.

1.3 SUBMITTALS

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

B. Manufacturer's Literature and Data: Fire extinguisher cabinet including installation instruction and rough opening required.

1.4 APPLICABLE PUBLICATIONS

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

B. American Society of Testing and Materials (ASTM):

D4802-10 Poly (Methyl Methacrylate) Acrylic Plastic Sheet

PART 2 - PRODUCTS

2.1 FIRE EXTINGUISHER CABINET

A. Recessed type with flat trim of size and design shown.

2.2 FABRICATION

A. Form body of cabinet from 0.9 mm (0.0359 inch) thick sheet steel.

B. Fabricate door and trim from 1.2 mm (0.0478 inch) thick sheet steel with all face joints fully welded and ground smooth.

1. Glaze doors with 6 mm (1/4 inch) thick ASTM D4802 clear acrylic sheet, Category B-1, Finish 1.

2. Design doors to open 180 degrees.

3. Provide continuous hinge, pull handle, and adjustable roller catch.

2.3 FINISH

A. Finish interior of cabinet body with baked-on semi-gloss white enamel.

B. Finish door, frame with manufacturer's standard baked-on prime coat suitable for field painting.

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PART 3 - EXECUTION

- A. Install fire extinguisher cabinets in prepared openings and secure in accordance with manufacturer's instructions.
- B. Install cabinet so that bottom of cabinet is 975 mm (39 inches) above finished floor.

- - - E N D - - -

SECTION 10 51 00
WOOD LOCKER BENCHES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Wood Locker Benches.

1.2 REFERENCES

- B. IBC - International Building Code.

1.3 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.

- B. Shop Drawings: Prepared specifically for this project; show dimensions of lockers and interface with other products.

- . Submit under provisions of LEED NC v3.0 reference guide: Product data for each type of accessory specified, with installation instructions for each unit built-in or connected to other construction:

1. Product Data for Low Emitting Materials-Adhesives and Sealants: Provide documentation including printed statement of VOC content for all adhesives and sealants.
4. Product Data for interior paints and coatings, verifying VOC levels and compliance for Green Seal Standard GS-11, GC-03 and SCAQMD Rule 1113.
5. Laboratory Test Reports for primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers".

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer shall have a Quality System in place to ensure and be able to substantiate that manufactured units conform to requirements and match the approved design and must be ISO 9001:2015 certified.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging, in a dry, ventilated area until ready for installation.
- B. Locker components shall be stored flat, if shipped unassembled, until assembly. All finishes shall be protected from soiling and damage during handling.
- C. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.6 WARRANTY

- A. Manufacturer's standard warranty to repair or replace components of locker products that fail in materials or workmanship within 3 years from date of Substantial Completion.

PART 2 PRODUCTS

2.2 WOOD LOCKER BENCHES

- A. Standard and ADA-compliant wood locker benches: Constructed of solid butcher block wood that is 1-1/4" (31.75 mm) thick; includes bolt mounted pedestals in a black powder coated finish or wall mounting brackets as indicated on construction documents.

2.5 CONSTRUCTION

- A. Locker Bench - Seating area:
 - 1. Locker shall made of clear hardwood, 1-1/4 inches (31.75 mm) in thickness.
 - 2. All corners are to be rounded and sanded.
 - 3. Surfaces shall be finished with two (2) coats of clear lacquer.
- B. Bench Pedestals:
 - 1. Pedestals shall consist of aluminum tubing, 3 inches (76 mm) in diameter.
 - 2. Base shall be 1/4" (6 mm) thick aluminum welded to each end of aluminum tubing.
 - 3. Finished in black powder coat.
- C. Fabricate locker bench parts square, rigid and without warp, with the finished faces flat and free of scratches and chips.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- A. Install in accordance with manufactureres installation instructions.
- B. Anchor the units to the floor through the bench pedestal's holes:
 - 1. Standard bench pedestals: Four (4) holes.
- C. Locker benches can be either floor-mounted or wall mounted as scheduled or indicated. Floor or base shall be level for proper installation.

3.4 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

- - - END - - -

SECTION 10 51 13
METAL LOCKERS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section includes metal lockers for Locker Rooms.

1.2 RELATED WORK

- A. Furring, blocking, and shims (required for installing metal lockers and concealed within other construction before metal locker installation):
Section 06 10 00, ROUGH CARPENTRY.
- B. Shop prime painting of steel and ferrous metals: Section 05 50 00,
METAL FABRICATIONS.
- C. Locker Base: Section 03 30 00, CAST-IN-PLACE CONCRETE.
- D. Type of Finish, Color, and Gloss Level of Finish Coat: Section
09 06 00, SCHEDULES AND FINISHES.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
1. Before fabrication of the lockers is started, submit manufacturer's literature which will be used to determine compliance with submittal requirements.
- C. Samples: Prior to fabrication, provide color samples on actual locker material to determine final color selection.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative of metal locker manufacturer for installation and maintenance of units required for this Project.
- B. Source Limitations: Obtain metal lockers and accessories through one source from a single manufacturer.
- C. Product Options: Drawings indicate size, profiles, and dimensional requirements of metal lockers and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
- D. Regulatory Requirements: Where metal lockers are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)".

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver metal lockers until spaces to receive them are clean, dry, and ready for metal locker installation.
- B. Deliver master and control keys to Owner by registered mail or overnight package service.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify the following by field measurements before fabrication and indicate measurements on Shop Drawings:
 - 1. Concealed framing, blocking, and reinforcements that support metal lockers before they are enclosed. Recessed openings.

1.7 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that metal lockers can be supported and installed as indicated.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal lockers that fail in materials or workmanship, excluding finish, within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures.
 - b. Faulty operation of latches and other door hardware.
 - 2. Damage from deliberate destruction and vandalism is excluded.
 - 3. Warranty Period for Knocked-Down Metal Lockers: Two years from date of Substantial Completion.

1.9 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by the basic designation only. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
- B. American Society for Testing and Materials (ASTM):
 - A1008/A1008M-21a Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
- C. Accessibility Standards:

| | |
|---------|---|
| ADA | Americans with Disabilities Act |
| ADA-ABA | Americans with Disabilities Act and the Architectural Barriers Act |
| ADAAG | Accessibility Guidelines for Buildings and Facilities |

D. Metal Finishes Manual for Architectural and Metal Products (NAAMM)

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008, Commercial Steel (CS) Type B, suitable for exposed applications.
- B. Fasteners: Zinc- or nickel-plated steel, slot-less type exposed bolt heads, and self-locking nuts or lock washers for nuts on moving parts.
- C. Anchors: Select material, type, size, and finish required for secure anchorage to each substrate.
 - 1. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance.
 - 2. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

2.2 METAL LOCKERS

- A. Locker Arrangement:
 - 1. Locker Rooms: Single tier.
- B. Locker Dimensions:
 - 1. Provide individual units with the following dimensions:
 - a. Locker Rooms: 18 inches wide, 21 inches deep and 72 inches high.
- C. Body: Assembled by riveting or bolting body components together. Fabricate from non-perforated, cold-rolled steel sheet with thicknesses as follows:
 - 1. Tops, Bottoms, and Intermediate Dividers: 0.55 mm (0.0209 inch), with single bend at sides.
 - 2. Backs and Sides: 0.55 mm (0.0209 inch) thick, with full-height, double-flanged connections.
 - 3. Shelf: 0.55 mm (0.0209 inch) thick, with double bend at front and single bend at sides and back.
- D. Frames: Channel formed; fabricated from 1.35 mm (0.0528 inch) thick, cold-rolled steel sheet; lapped and factory welded at corners; with top

and bottom main frames factory welded into vertical main frames. Form continuous, integral door strike full height on vertical main frames.

1. Cross Frames between Tiers: Channel formed and fabricated from same material as main frames; welded to vertical frame members.
 2. Frame Vents: Fabricate horizontal face frames with vents.
 3. Provide resilient bumpers to cushion door closing.
- E. Doors: One-piece; fabricated from 1.35 mm (0.0528 inch) thick, cold-rolled steel sheet; formed into channel shape with double bend at vertical edges, and with right-angle single bend at horizontal edges.
1. Reinforcement: Manufacturer's standard reinforcing angles, channels, or stiffeners for doors more than 381 mm (15 inches) wide; welded to inner face of doors.
 2. Stiffeners: Manufacturer's standard full-height stiffener fabricated from 1.1 mm (0.0428 inch) thick, cold-rolled steel sheet; welded to inner face of doors.
 3. Door Style: Non-perforated panel.
 - a. Concealed Vents: Slotted perforations in top and bottom horizontal return flanges of doors.
 4. Hinges: Self-closing; welded to door and attached to door frame with not less than 2 factory-installed rivets per hinge that are completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees.
 5. Continuous Hinges: May be provided if manufacturer's standard; steel continuous hinge.
 6. Recessed Door Handle and Latch: Stainless-steel cup with integral door pull, recessed so locking device does not protrude beyond face of door; pry resistant.
 7. Multipoint Latching: Finger-lift latch control designed for use with built-in combination locks, built-in key locks, or padlocks; positive automatic and pre-locking.
 - a. Latch Hooks: Equip doors less than 48 inches (1219 mm) high with 2 latch hooks; fabricated from minimum 0.0966-inch-(2.5-mm-) thick steel; welded or riveted to full-height door strikes; with resilient silencer on each latch hook.
 - b. Latching Mechanism: Manufacturer's standard rattle-free latching mechanism and moving components isolated with vinyl or nylon to prevent metal-to-metal contact, and incorporating a pre-locking

device that allows locker door to be locked while door is open and then closed without unlocking or damaging lock or latching mechanism.

8. Accessible Latching: Provide paddle latch control designed for use with built-in combination locks, built-in key locks, or padlocks; positive automatic and pre-locking at all lockers designated as accessible.
9. Equipment: Equip each metal locker with identification plate and the following, unless otherwise indicated.
10. Double-Tier Units: One double-prong ceiling hook and two single-prong wall hooks.

F. Accessories:

1. Continuous Sloping Tops: Fabricated from cold-rolled steel sheet, manufacturer's standard thickness, but not less than 0.0329 inch (0.85 mm) thick.
 - a. Closures: Hipped-end type.
 2. Finished End Panels: Fabricated from 0.0209-inch-(0.55-mm-) thick, cold-rolled steel sheet.
 3. End Filler Panels:
 - a. Provide filler panels at each end of locker run to completely fill any residual space between locker units and adjoining walls.
 - b. Center locker units in recess area.
 - c. Fabricate from sheet steel matching locker door specification.
- G. Base: Continuous Zee base fabricated from 0.075-inch minimal-thickness steel.
- H. Finish: Baked enamel.
1. Color(s): As scheduled or as selected from manufacturer's full color range.

2.3 FABRICATION

- A. General: Fabricate metal lockers square, rigid, and without warp; with metal faces flat and free of dents or distortion. Make exposed metal edges free of sharp edges and burrs, and safe to touch.
1. Form body panels, doors, shelves, and accessories from one-piece steel sheet, unless otherwise indicated.
 2. Provide fasteners, filler plates, supports, clips, and closures as required for a complete installation.

- B. Unit Principle: Fabricate each metal locker with an individual door and frame; individual top, bottom, and back; and common intermediate uprights separating compartments.
- C. Knocked-Down Construction: Fabricate metal lockers for nominal assembly at Project site using nuts, bolts, screws, or rivets. Factory weld frame members together, to form a rigid one-piece assembly.
- D. Hooks: Manufacturer's standard ball-pointed type, aluminum or steel; zinc plated.
- E. Coat Rods: Fabricated from 19 mm (3/4 inch) diameter steel; chrome finished.
- F. Identification Plates: Manufacturer's standard etched, embossed, or stamped aluminum plates; with numbers and letters at least 9 mm (3/8 inch) high.
- G. Continuous Base: Formed into channel or Z profile for stiffness, and fabricated in lengths as long as practicable to enclose base and base ends of metal lockers; finished to match lockers.
- H. Continuous Sloping Tops: Fabricated in lengths as long as practicable, without visible fasteners at splice locations; finished to match lockers.
 - 1. Sloped top corner fillers, mitered.
- I. Finished End Panels: Designed for concealing unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of non-recessed metal lockers; finished to match lockers.
 - 1. Provide one-piece panels for double-row (back-to-back) locker ends.

2.4 STEEL SHEET FINISHES

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Factory finish steel surfaces and accessories except stainless-steel and chrome-plated surfaces.
- C. Surface Preparation: Clean surfaces of dirt, oil, grease, mill scale, rust, and other contaminants that could impair paint bond. Use manufacturer's standard methods.
- D. Baked-Enamel Finish: Immediately after cleaning, pre-treating and phosphatizing, apply manufacturer's standard thermosetting baked-enamel finish. Comply with paint manufacturer's written instructions for application, baking, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls, floors, and support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install level, plumb, and true; shim as required, using concealed shims:
 - 1. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than 910 mm (36 inches) o.c. Install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion, using concealed fasteners.
 - 2. Anchor single rows of metal lockers to walls near top and bottom of lockers.
- B. Knocked-Down Metal Lockers: Assemble knocked-down metal lockers with standard fasteners, with no exposed fasteners on door faces or face frames.
- C. Equipment and Accessories: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.
 - 1. Attach hooks with at least two fasteners.
 - 2. Attach door locks on doors using security-type fasteners.
 - 3. Identification Plates: Identify metal lockers with identification indicated on Drawings.
 - a. Attach plates to each locker door, near top, centered, with at least two aluminum rivets.
 - 4. Attach sloping top units to metal lockers, with closures at exposed ends.
 - 5. Attach finished end panels with fasteners only at perimeter to conceal exposed ends of non-recessed metal lockers.

3.3 ADJUSTING, CLEANING, AND PROTECTION

- A. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding. Verify that integral locking devices operate properly.

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- B. Protect metal lockers from damage, abuse, dust, dirt, stain, or paint.
Do not permit metal locker use during construction.
- C. Touch up marred finishes, or replace metal lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by metal locker manufacturer.

- - - E N D - - -

SECTION 11 30 13
SMALL COMMERCIAL APPLIANCES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Cooking appliances:
 - 1. Microwaves.
 - 2. Coffee Brewer
- B. Refrigerators.

1.2 RELATED SECTIONS

- A. Section 26 00 00 - Electrical.

1.3 REFERENCES

- A. NSF International.
- B. US Environmental Protection Agency.
 - 1. Energy Star.
- C. Underwriters Laboratories (UL).

1.4 SUBMITTALS

- A. Submit under provisions of Section 01 33 23 - SHOP DRAWINGS, PRODUCT DATA & SUBMITTALS.
- B. Product Data:
 - 1. Manufacturer's data sheets on each product to be used.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with a minimum five years documented experience.
- B. Installer Qualifications: Company specializing in performing Work of this section with minimum two years documented experience with projects of similar scope and complexity.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store and handle in strict compliance with manufacturer's written instructions and recommendations.
- B. Protect from damage due to weather, excessive temperature, and construction operations.

1.7 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.8 WARRANTY

- A. Manufacturer's Warranty: Provide manufacturer's standard limited warranty.

PART 2 PRODUCTS

2.1 COOKING APPLIANCES

- A. Microwaves:
 - 1. Countertop Microwave Oven: JSN # K4665
 - a. Standards Compliance: UL and CUL listed.
 - b. Size: 1.5 cu.ft (40 liter).
 - c. Watts: 1200 minimum
 - d. Features: Electronic touch, 10-level cooking control, sensor cooking.
- B. Coffee Brewers:
 - 1. Three Warmer Automatic Coffee Brewer: JSN # K1552.
 - a. Brewing Capacity: 4.2 gal/hr
 - b. Features: Built-in pour over feature, digital temperature control, automatic warmer shut off.
 - 2. Provide with three decanters.

2.2 REFRIGERATORS

- A. Top Mount Refrigerator: JSN # R7250
 - 1. Size: 32 inches, 21.7 Cu. Ft.
 - 2. Features: Reversible door, adjustable shelves, Factory Ice Maker w/bin.
 - 3. Color: Stainless Steel or White
 - 4. Certifications: Energy Star Certified

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly constructed and prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect in writing of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

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- A. Install in accordance with manufacturer's instructions, approved submittals, and in proper relationship with adjacent construction.
- B. Test for operation and adjust until satisfactory results are obtained.

3.4 FIELD QUALITY CONTROL

- A. Field Inspection: Coordinate field inspection in accordance with appropriate sections in Division 01.
- B. Manufacturer's Services: Coordinate manufacturer's services in accordance with appropriate sections in Division 01.

3.5 CLEANING AND PROTECTION

- A. Clean products in accordance with the manufacturer's recommendations.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 12 24 00
WINDOW SHADES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Venetian blinds are specified in this section. Window shades must be furnished complete, including brackets, fittings and hardware.

1.2 QUALITY CONTROL

- A. Manufacturer's Qualification: Provide evidence that the manufacture of blinds are a major product, and that the blinds have performed satisfactorily on similar installations.

1.3 SUSTAINABILITY REQUIREMENTS

- A. Materials in this section may contribute towards contract compliance with sustainability requirements. See Section 01 81 11, SUSTAINABLE DESIGN REQUIREMENTS, for project low-emitting materials, and recycled content requirements.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Samples:
1. Shade cloth, each type, 600 mm (24 inches) square, including cord and ring, showing color, finish and texture.
 2. Vertical blind slats, 300 mm (12 inches) long, including chain and supporting channels, showing color and finish.
 3. Venetian blind slats, 300 mm (12 inches) long, including cord and tape, showing color and finish.
- C. Manufacturer's literature and data; showing details of construction and hardware for:
1. Cloth and window shades.
 2. Vertical blinds.
 3. Venetian blinds.

1.6 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by the basic designation only. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
- B. American Society for Testing and Materials (ASTM):
- | | |
|---------|---|
| B221-21 | Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes |
|---------|---|

Rate of Burning and/or Extent and Time of
Burning of Self-Supporting Plastics in a
Horizontal Position

D648-18

Deflection Temperature of Plastics Under
Flexural Load in the Edgewise Position

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Staples (For Cloth Window Shades): Nonferrous metal or zinc-coated steel.
- B. Stainless Steel: ASTM A167.
- D. Cords for Venetian Blinds: No. 4 braided nylon or No. 4-1/2 braided cotton having not less than 175 pounds breaking strength.
- E. Extruded Aluminum: ASTM B221.

2.2 VENETIAN BLINDS

- A. Type II, 25 mm (1 inch slats) fabricated of aluminum. Pre-production sample is not required.

2.3 FASTENINGS

- A. Zinc-coated or cadmium plated metal, aluminum or stainless steel fastenings of proper length and type.
- B. Except as otherwise specified, provide fastenings for use with various structural materials as follows:

| Type of Fastening | Structural Material |
|------------------------------------|--------------------------------------|
| Wood screw | Wood |
| Tap screw | Metal |
| Case-hardened, self-tapping screw | Sheet Metal |
| Screw or bolt in expansion shields | Solid masonry |
| Toggle bolts | Hollow blocks, wallboard and plaster |

2.4 FABRICATION

- A. Fabricate venetian blinds to fit measurements of finished openings obtained at site.
- C. Venetian Blinds:
 - 1. Venetian blinds to have 25 mm (1 inch) width horizontal slats positioned within ladder tapes.

2. Multiple blinds in openings are to be of same type and divided at mullions.
3. Head-rails to fully enclose operating mechanism on three sides and ends.
4. Bottom rails to be fully enclosed to prevent contact of tapes and sill at underside.
5. Finish concealed metal work of head-rails including concealed mechanism, with one shop coat of paint. Do not paint parts that have non-rusting finish, or parts where motion of friction occurs.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Venetian Blinds: Support blinds in level position by brackets and intermediate supports that will permit easy removal and replacement of units without damage to blind, or adjacent surfaces. Provide at least two fasteners for each bracket or other support.
1. Install blinds between jambs on window openings with steel trim. Mount brackets on trim reveal, flush with face of trim and secure with steel screws.
 2. Install blinds between jambs on window openings with wood trim. Mount brackets on trim or on wood plaster-mold set against plaster or other wall finish, and secure in place with screws.
 3. Mount brackets and intermediate supports of lobby blinds on face of trim members, and secure with stainless steel standard tap or thread-forming machine screws, or by cadmium-plated molley or toggle bolts. Penetrate through and lock screws and bolts behind steel sub-frame.
 4. Where blinds abut glass partitions of Vestibules, extend head rails to trim at head of partition frame with slats sufficiently long to clear transom bars.
 5. Provide one brush (for each 1 to 50 blind) of an approved type, suitable for cleaning blinds.

- - - E N D - - -

SECTION 12 32 00
MANUFACTURED WOOD CASEWORK

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies plastic laminate casework as detailed on the drawings, including related components and accessories required to form integral units. Provide wood casework items shown on the drawings, but not specified below, as part of the work under this section; applicable portions of the specification apply to these items. Provide like items of casework of the same design and by one manufacturer.

1.2 RELATED WORK

- A. Custom Casework: Section 06 20 00, FINISH CARPENTRY.
B. Color and Finish of Plastic Laminate: Section 09 06 00, SCHEDULE FOR FINISHES.
C. Lavatories and Plumbing in Casework: Section 22 40 00, PLUMBING FIXTURES.

1.3 PERFORMANCE REQUIREMENTS

- A. Sustainably Harvested Wood: Comply with requirements of Section 01 81 11, SUSTAINABLE DESIGN REQUIREMENTS.
B. Engineered Wood Products:
1. Provide products with no added urea formaldehyde; determine formaldehyde concentrations in air from wood products under test conditions of temperature and relative humidity in accordance with ASTM D6007 or E1333.
2. Bio-based Content:
a. Interior Panels: Engineered products designed specifically for interior applications and providing a surface that is impact-, scratch-, and wear-resistant and that does not absorb or retain moisture; provide minimum 55 percent bio-based content.
b. Structural Interior Panels: Engineered products designed for use in structural construction applications; provide minimum 89 percent bio-based content.
c. Structural Wall Panels: Engineered products designed for use in structural walls, curtain walls, floors and roofs; provide minimum 94 percent bio-based content.
3. VOC Emissions:
a. Provide low VOC products with Green Seal Certification to GS-36 and description of the basis for certification.

- A. Provide casework by a manufacturer who produces casework similar to the casework specified and shown.

1.5 SUSTAINABILITY REQUIREMENTS

- A. Materials in this section may contribute towards contract compliance with sustainability requirements. See Section 01 81 11, SUSTAINABLE DESIGN REQUIREMENTS, for project low-emitting materials, recycled content, and certified wood requirements.
- B. Biobased Material: For products designated by the USDA's BioPreferred® program, provide products that meet or exceed USDA recommendations for biobased content, subject to the products compliance with performance requirements in this Section. For more information regarding the product categories covered by the BioPreferred® program, visit <http://www.biopreferred.gov>.

1.6 SUBMITTALS

- A. Submit in accordance with Section `01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Provide documentation of conformance with performance requirements of this section.
- C. Manufacturer's Literature and Data:
 1. Sinks, trim and fittings.
 2. Locks for doors and drawers.
 3. Adhesive cements.
- D. Samples:
 1. Counter top, plastic laminate, 150 mm (six inch) square.
 2. Wood Face Veneer or Hardwood Plywood.
- E. Shop Drawings (1/2 size):
 1. All casework, showing details of construction, including materials, hardware and accessories.
 2. Cabinets and counters showing faucets in connection with sink bowls, and electrical fixtures and receptacles which are mounted on cabinets and counters.
 3. Fastenings and method of installation.

1.7 APPLICABLE PUBLICATIONS

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

B. Composite Panel Association (CPA):

ANSI A208.1-09 Particleboard

C. U.S. Department of Commerce Product Standards (Prod. Std):

PS1-09 Construction and Industrial Plywood

D. Hardwood, Plywood and Veneer Association (HPVA):

HP1-11 Hardwood and Decorative Plywood

E. Architectural Woodwork Institute (AWI):

Architectural Woodwork Quality Standards, Guide Specifications Quality Certification Program

F. American Society of Mechanical Engineers (ASME):

A112.18.1-12 Plumbing Fixture Fittings

G. National Electrical Manufacturers Association (NEMA):

LD3-05 High Pressure Decorative Laminates

LD3.1-95 Performance, Application Fabrication and Installations of High-Pressure Decorative Laminates

H. Builders Hardware Manufacturers Association (BHMA)

BHMA 156 Complete set of BHMA Standards

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

D6007-14 Determining Formaldehyde Concentrations in Air from Wood Products Using a Small-Scale Chamber

E1333-14 Determining Formaldehyde Concentrations in Air and Emission Rates from Wood Products Using a Large Chamber

PART 2 - PRODUCTS

2.1 PLASTIC LAMINATE

A. NEMA LD-3.

B. Exposed decorative surfaces including countertops, both sides of cabinet doors, and for items having plastic laminate finish.

C. Cabinet Interiors Including Shelving: Both of following options to comply with NEMA, LD3.1 as a minimum.

1. Plastic laminate clad plywood or particle board.

2.2 PLYWOOD, SOFTWOOD

A. Prod. Std. PS1, five ply construction from 13 mm to 28 mm (1/2 inch to 1-1/8 inch) thickness, and seven ply for 31 mm (1 1/4 inch) thickness.

2.3 PARTICLEBOARD

A. CPA A208.1, Type 1, Grade 1-M-3.

2.4 FIRE-RETARDANT TREATMENT

- A. Provide fire-retardant-treated wood products that are free of halogens, sulfates, ammonium phosphate and formaldehyde.
- B. Fire retardant treatment of wood products must conform to the requirements of AWPA Standard U1, Commodity Specification H and AWPA Standard T1, Section H.

2.5 HARDWARE

- A. Provide hardware and accessory materials associated with interior architectural woodwork.
- B. Comply with BHMA 156.9
 - 1. Extension drawer slides: ANSI/BHMA A156.9, Type B85071.
 - 2. Semi-concealed hinges: ANSI/BHMA A156.9, Type B81201, 1-1/2 inches.
 - 3. Full surface hinges: ANSI/BHMA A156.9, Type B81131, 1-1/2 inches.
 - 4. Knob pulls: ANSI/BHMA A156.9, 1-inch diameter, Type B12132.
 - 5. Bar type pulls: ANSI/BHMA A156.9, 4-inch overall length, Type B12012.
 - 6. Semi-concealed hinges: ANSI/BHMA A156.9, Type B81201, 40 millimeter.
 - 7. Full surface hinges: ANSI/BHMA A156.9, Type B81131, 40 millimeter.
 - 8. Knob pulls: ANSI/BHMA A156.9, 25 millimeter diameter, Type B12132.
 - 9. Bar type pulls: ANSI/BHMA A156.9, 100 millimeter overall length, Type B12012.
 - 10. Locks, keying, and keys: As directed.
 - 11. Catches: Magnetic, 22 newton 5-pound pull.
 - 12. Sliding door set: Impregnated fiberboard track; Nylon glides.
- C. Finishes: Comply with BHMA 156.18
- D. Shelf Standards (Except For Fixed Shelves):
 - 1. Bright zinc-plated steel for recessed mounting with screws, 16 mm (5/8 inch) wide by 5 mm (3/16 inch) high providing 13 mm (1/2 inch) adjustment, complete with shelf supports.

2.6 ADHESIVES

- A. Product compliant with Performance Requirements.

2.7 FABRICATION

- A. Casework to be of the flush overlay design and, except as otherwise specified, be of premium grade construction and of component thickness in conformance with AWI Quality Standards.
- B. Provide both wall and base cabinet assemblies to consisting of individual units joined into continuous sections as indicated.

- C. Provide fastenings to permit removal and replacement of individual units without affecting the remainder of the installation.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install woodwork to comply with AWI Section 1700.
- B. Field measure installation locations prior to fabrication.
- C. Set casework in place; level, plumb and accurately scribe and secure to walls, and/or floors.
- D. Provide complete installation including all trim and hardware; leave the casework clean and free from defects.
- E. Install without distortion so doors and drawers fit openings and operate unencumbered.

3.2 FASTENINGS

- A. Provide fastenings for securing casework to adjoining construction as detailed on the shop drawings.
- B. See Section 05 50 00, METAL FABRICATIONS, for reinforcement of walls and partitions for casework anchorage.

3.3 TOLERANCES

- A. Install woodwork plumb, level, true, and straight with no distortions.
- B. Install to a tolerance of 3 mm in 2400 mm (1/8 inch in 96 inches) for plumb and level including countertops.
- C. Install cabinets and countertops no more than 3 mm in 2400 mm (1/8 inch in 96 inches) sag, bow, or other variation from a straight line.

3.4 REPAIR, ADJUSTING, AND CLEANING

- A. It is at the PM's discretion to reject any visually damaged or defective woodwork, or insufficient repairs, and in the event of woodwork unaccepted due to quality, will be replaced.
- B. Repair damaged and defective woodwork where possible. Where not possible to repair, replace woodwork.
- C. Clean, lubricate, and adjust all hardware to operate as intended.
- D. Clean all woodwork on all exposed and all interior surfaces.

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**SECTION 12 36 00
COUNTERTOPS**

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies casework countertops.

1.2 RELATED WORK

- A. DIVISION 22, PLUMBING.
- B. DIVISION 26, ELECTRICAL.
- C. Plastic Laminate Casework; Section 12 32 00, MANUFACTURED WOOD CASEWORK.
- D. Equipment Reference Manual for SECTION 12 36 00, COUNTERTOPS.

1.3 SUBMITTALS

- A. Submit in accordance with SECTION 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Shop Drawings
 - 1. Show dimensions of section and method of assembly.
 - 2. Show details of construction at a scale of 1/2 inch to a foot.
- C. Samples:
 - 1. 150 mm (6 inch) square samples each top.
 - 2. Front edge, back splash, end splash and core with surface material and booking.

1.4 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.
- B. American Hardboard Association (AHA):
A135.4-95.....Basic Hardboard
- C. Composite Panel Association (CPA):
A208.1-09.....Particleboard
- D. American Society of Mechanical Engineers (ASME):
A112.18.1-12.....Plumbing Supply Fittings
A112.1.2-12.....Air Gaps in Plumbing System
A112.19.3-08(R2004).....Stainless Steel Plumbing Fixtures (Designed for Residential Use)
- E. American Society for Testing and Materials (ASTM):
A167-99 (R2009).....Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip

- A1008-10.....Steel, Sheet, Cold-Rolled, Carbon, Structural,
High Strength, Low Alloy
- D256-10.....Pendulum Impact Resistance of Plastic
- D570-98(R2005).....Water Absorption of Plastics
- D638-10.....Tensile Properties of Plastics
- D785-08.....Rockwell Hardness of Plastics and Electrical
Insulating Materials
- D790-10.....Flexural Properties of Unreinforced and
Reinforced Plastics and Electrical Insulating
Materials
- D4690-99(2005).....Urea-Formaldehyde Resin Adhesives

F. Federal Specifications (FS):

- A-A-1936.....Adhesive, Contact, Neoprene Rubber

G. U.S. Department of Commerce, Product Standards (PS):

- PS 1-95.....Construction and Industrial Plywood

H. National Electrical Manufacturers Association (NEMA):

- LD 3-05.....High Pressure Decorative Laminates

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Plastic Laminate: NEMA LD 3.
 - 1. Concealed backing sheet Type BKL.
 - 2. Decorative surfaces:
 - a. Flat components: Type GP-HGL.
 - b. Post forming: Type PF-HGP.
- B. Stainless Steel: ASTM A167, Type 304.
- C. Sheet Steel: ASTM A1008, cold rolled, Class 1 finish, stretcher leveled.
- C. Particleboard: CPA A208.1, Grade 2-M-2.
- D. Plywood: PS 1, Exterior type, veneer grade AC not less than five ply construction.
- E. Hardboard: ANSI/AHA A135.4, Type I, tempered, fire retardant treated, smooth surface one side.
- F. Adhesive
 - 1. For plastic laminate FS A-A-1936.
 - 2. For wood products: ASTM D4690, unextended urea resin or unextended melamine resin, phenol resin, or resorcinol resin.
 - 3. For Field Joints:

- a. Epoxy type, resistant to chemicals as specified for plastic laminate laboratory surfaces.
 - b. Fungi resistant: ASTM G-21, rating of 0.
- G. Fasteners:
- 1. Metals used for welding same metal as materials joined.
 - 2. Use studs, bolts, spaces, threaded rods with nuts or screws suitable for materials being joined with metal splice plates, channels or other supporting shape.
- H. Solid Polymer Material:
- 1. Filled Methyl Methacrylic Polymer.
 - 2. Performance properties required:

| Property | Result | Test |
|----------------------------------|---|---|
| Elongation | 0.3% min. | ASTM D638 |
| Hardness | 90 Rockwell M | ASTM D785 |
| Gloss (60° Gordon) | 5-20 | NEMA LD3.1 |
| Color stability | No change | NEMA LD3 except 200 hour |
| Abrasion resistance | No loss of pattern Max wear depth 0.0762 mm (0.003 in) - 10000 cycles | NEMA LD3 |
| Water absorption weight (5 max) | 24 hours 0.9 | ASTM D-570 |
| Izod impact | 14 N·m/m (0.25 ft-lb/in) | ASTM D256 (Method A) |
| Impact resistance | No fracture | NEMA LD-3 900 mm (36") drop 1 kg (2 lb.) ball |
| Boiling water surface resistance | No visible change | NEMA LD3 |
| High temperature resistance | Slight surface dulling | NEMA LD3 |

- 3. Cast into sheet form and bowl form.
- 4. Color throughout with subtle veining through thickness.
- 5. Joint adhesive and sealer: Manufacturers silicone adhesive and sealant for joining methyl methacrylic polymer sheet.
- 6. Bio-based products will be preferred.

2.10 COUNTERTOPS

- A. Fabricate in largest sections practicable.
- B. Fabricate with joints flush on top surface.

- C. Fabricate countertops to overhang front of cabinets and end of assemblies 25 mm (one inch) except where against walls or cabinets.
- D. Provide 1 mm (0.039 inch) thick metal plate connectors or fastening devices (except epoxy resin tops).
- E. Join edges in a chemical resistant waterproof cement or epoxy cement, except weld metal tops.
- F. Fabricate with end splashes where against walls or cabinets.
- G. Splash Backs and End Splashes:
 - 1. Not less than 19 mm (3/4 inch) thick.
 - 2. Height 100 mm (4 inches) unless noted otherwise.
 - 3. Laboratories and pharmacy heights or where fixtures or outlets occur: Not less than 150 mm (6 inches) unless noted otherwise.
 - 4. Fabricate epoxy splash back in maximum lengths practical of the same material.
- H. Drill or cutout for sinks, and penetrations.
 - 1. Accurately cut for size of penetration.
 - 2. Cutout for VL 81 photographic enlarger cabinet.
 - a. Finish cutout to fit flush with vertical side of cabinet, allowing adjustable shelf to fit into cutout space of cabinet at counter top level. Finish cutout surface as an exposed edge.
 - b. Provide braces under enlarger space to support not less than 45 kg (100 pounds) centered on opening side along backsplash.
- I. Plastic Laminate Countertops:
 - 1. Fabricate plastic laminate on five-ply plywood or particleboard core 19 mm (3/4 inch) thick with plastic laminate backing sheet.
 - 2. Front edge over cabinets not less than 38 mm (1-1/2 inches) thick except where plastic "T" insert is used, not less than 19 mm (3/4 inch) thick.
 - 3. Exposed Surface and edges of decorative laminated plastic or laboratory chemical resistant surface.
 - a. Use chemical resistant surface on tops 6A, 6B, and 6C.
 - b. Use decorative surface tops when noted plastic laminate, for tops 10A, 10B and 10C.
- J. Methyl Methacrylic Polymer Tops:
 - 1. Fabricate countertop of methyl methacrylic polymer cast sheet, 13 mm (1/2 inch) thick.
 - 2. Fabricate back splash and end splash to height shown.

3. Fabricate skirt to depth shown.
4. Fabricate with marine edge where sinks occur.
5. Fabricate in one piece for full length from corner to corner up to 3600 mm (12 feet).
6. Join pieces with adhesive sealant.
7. Cut out countertop for lavatories, plumbing trim.
8. Provide concealed fasteners and epoxy cement for anchorage of sinks to countertop.

K. Countertop products shall comply with following standards for biobased materials:

| Material Type | Percent by Weight |
|-----------------|------------------------------|
| Composite Panel | 89 percent biobased material |
| Hardwood | 89 percent biobased material |
| Particleboard | 89 percent biobased material |
| Plywood | 89 percent biobased material |

The minimum-content standards are based on the weight (not the volume) of the material in the insulating core only.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Before installing countertops verify that wall surfaces have been finished as specified and that mechanical and electrical service locations are as required.
- B. Secure countertops to supporting rails of cabinets with metal fastening devices, or screws through pierced slots in rails.
 1. Where type, size or spacing of fastenings is not shown or specified, submit shop drawings showing proposed fastenings and method of installation.
 2. Use round head bolts or screws.
 3. Use epoxy or silicone to fasten the epoxy resin countertops to the cabinets.
 4. Use wood or sheet metal screws for wood or plastic laminate tops; minimum penetration into top 16 mm (5/8 inch), screw size No 8, or 10.
- C. Sinks
 1. Install stainless steel sink in plastic laminate tops with epoxy compound to form watertight seal under shelf rim.

- a. In laboratory and pharmacy fit stainless steel sink with overflow standpipe.
 - b. Install faucets and fittings on sink ledges with watertight seals where shown.
2. Install molded resin sinks with epoxy compound to form watertight seal with underside of molded resin top.
 - a. Install sink with not less than two channel supports with threaded rods and nuts at each end, expansion bolted to molded resin top.
 - b. Design support for a twice the full sink weight.
 - c. Install with overflow standpipes.
 3. Install methyl methacrylic polymer sinks in manufacturers recommended adhesive sealer or epoxy compound to underside of methyl methacrylic polymer countertop.
 - a. Bolt or screw to countertop to prevent separation of bowl and fracture of adhesive sealant joint.
 - b. Install drain and traps to sink.

E. Faucets, Fixtures, and Outlets:

1. Seal opening between fixture and top.
2. Secure to top with manufacturers standard fittings.

3.2 PROTECTION AND CLEANING

- A. Tightly cover and protect against dirt, water, and chemical or mechanical injury.
- B. Clean at completion of work.

- - - E N D - - -

**SECTION 22 05 11
COMMON WORK RESULTS FOR PLUMBING**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The requirements of this Section apply to all sections of Division 22.
- B. Definitions:
 - 1. Exposed: Piping and equipment exposed to view in finished rooms.
- C. Abbreviations/Acronyms:
 - 1. ABS: Acrylonitrile Butadiene Styrene
 - 2. AC: Alternating Current
 - 3. ACR: Air Conditioning
 - 4. AI: Analog Input
 - 5. AISI: American Iron and Steel Institute
 - 6. AO: Analog Output
 - 7. AWG: American Wire Gauge
 - 8. BACnet: Building Automation and Control Network
 - 9. BA_g: Silver-Copper-Zinc Brazing Alloy
 - 10. BAS: Building Automation System
 - 11. BCuP: Silver-Copper-Phosphorus Brazing Alloy
 - 12. BSG: Borosilicate Glass Pipe
 - 13. CDA: Copper Development Association
 - 14. C: Celsius
 - 15. CLR: Color
 - 16. CO: Carbon Monoxide
 - 17. COR: Contracting Officer's Representative
 - 18. CPVC: Chlorinated Polyvinyl Chloride
 - 19. CR: Chloroprene
 - 20. CRS: Corrosion Resistant Steel
 - 21. CWP: Cold Working Pressure
 - 22. CxA: Commissioning Agent
 - 23. db(A): Decibels (A weighted)
 - 24. DDC: Direct Digital Control
 - 25. DI: Digital Input
 - 26. DISS: Diameter Index Safety System
 - 27. DO: Digital Output

- 28. DVD: Digital Video Disc
- 29. DN: Diameter Nominal
- 30. DWV: Drainage, Waste and Vent
- 31. ECC: Engineering Control Center
- 32. EPDM: Ethylene Propylene Diene Monomer
- 33. EPT: Ethylene Propylene Terpolymer
- 34. ETO: Ethylene Oxide
- 35. F: Fahrenheit
- 36. FAR: Federal Acquisition Regulations
- 37. FD: Floor Drain
- 38. FED: Federal
- 39. FG: Fiberglass
- 40. FNPT: Female National Pipe Thread
- 41. FPM: Fluoroelastomer Polymer
- 42. GPM: Gallons Per Minute
- 43. HDPE: High Density Polyethylene
- 44. Hg: Mercury
- 45. HOA: Hands-Off-Automatic
- 46. HP: Horsepower
- 47. HVE: High Volume Evacuation
- 48. ID: Inside Diameter
- 49. IPS: Iron Pipe Size
- 50. Kg: Kilogram
- 51. kPa: Kilopascal
- 52. lb: Pound
- 53. L/s: Liters Per Second
- 54. L/min: Liters Per Minute
- 55. MAWP: Maximum Allowable Working Pressure
- 56. MAX: Maximum
- 57. MED: Medical
- 58. m: Meter
- 59. MFG: Manufacturer
- 60. mg: Milligram
- 61. mg/L: Milligrams per Liter
- 62. ml: Milliliter
- 63. mm: Millimeter

- 64. MIN: Minimum
- 65. NF: Oil Free Dry (Nitrogen)
- 66. NPTF: National Pipe Thread Female
- 67. NPS: Nominal Pipe Size
- 68. NPT: Nominal Pipe Thread
- 69. OD: Outside Diameter
- 70. OSD: Open Sight Drain
- 71. OS&Y: Outside Stem and Yoke
- 72. OXY: Oxygen
- 73. PBP: Prefabricated Bedside Patient Units
- 74. PH: Power of Hydrogen
- 75. PLC: Programmable Logic Controllers
- 76. PP: Polypropylene
- 77. PPM: Parts per Million
- 78. PSIG: Pounds per Square Inch
- 79. PTFE: Polytetrafluoroethylene
- 80. PVC: Polyvinyl Chloride
- 81. PVDF: Polyvinylidene Fluoride
- 82. RAD: Radians
- 83. RO: Reverse Osmosis
- 84. RPM: Revolutions Per Minute
- 85. RTRP: Reinforced Thermosetting Resin Pipe
- 86. SCFM: Standard Cubic Feet Per Minute
- 87. SDI: Silt Density Index
- 88. SPEC: Specification
- 89. SPS: Sterile Processing Services
- 90. STD: Standard
- 91. SUS: Saybolt Universal Second
- 92. SWP: Steam Working Pressure
- 93. TEFC: Totally Enclosed Fan-Cooled
- 94. TFE: Tetrafluoroethylene
- 95. THHN: Thermoplastic High-Heat Resistant Nylon Coated Wire
- 96. THWN: Thermoplastic Heat & Water Resistant Nylon Coated Wire
- 97. T/P: Temperature and Pressure
- 98. USDA: U.S. Department of Agriculture
- 99. V: Volt

- 100. VAC: Vacuum
- 101. VA: Veterans Administration
- 102. VAMC: Veterans Administration Medical Center
- 103. VAC: Voltage in Alternating Current
- 104. WAGD: Waste Anesthesia Gas Disposal
- 105. WOG: Water, Oil, Gas

1.2 RELATED WORK

- A. Section 01 00 02, GENERAL REQUIREMENTS (Minor NCA Projects).
- 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 03 30 00, CAST-IN-PLACE CONCRETE: Concrete and Grout.
- G. Section 05 50 00, METAL FABRICATIONS.
- H. Section 07 60 00, FLASHING AND SHEET METAL: Flashing for Wall and Roof Penetrations.
- I. Section 07 84 00, FIRESTOPPING.
- J. Section 07 92 00, JOINT SEALANTS.
- K. Section 09 91 00, PAINTING.
- L. Section 22 05 12, GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT.
- M. Section 22 07 11, PLUMBING INSULATION.
- N. Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.
- O. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.
- P. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS
- Q. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES.
- R. Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS.
- S. Section 31 20 00, EARTH MOVING: 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.
- B. American Society of Mechanical Engineers (ASME):
 - Boiler and Pressure Vessel Code (BPVC):
 - SEC IX-2013Welding and Brazing Qualifications
 - B31.1-2012Power Piping

- C. American Society for Testing and Materials (ASTM):
 - A36/A36M-2012Carbon Structural Steel
 - A575-96(R2013)e1Steel Bars, Carbon, Merchant Quality, M-Grades
 - E84-2013aStandard Test Method for Burning
Characteristics of Building Materials
 - E119-2012aStandard Test Method for Fire Tests of Building
Construction and Materials
 - F1760-01(R2011)Standard Specification for Coextruded
Poly(Vinyl Chloride) (PVC) Non-Pressure Plastic
Pipe Having Reprocessed-Recycled Content
- D. International Code Council, (ICC):
 - IBC-2015International Building Code
 - IPC-2015International Plumbing Code
- E. Manufacturers Standardization Society (MSS) of the Valve and Fittings
Industry, Inc:
 - SP-58-2009Pipe Hangers and Supports-Materials, Design and
Manufacture
 - SP 69-2003Pipe Hangers and Supports-Selection and
Application
- F. Military Specifications (MIL):
 - P-21035BPaint High Zinc Dust Content, Galvanizing
Repair (Metric)
- G. National Electrical Manufacturers Association (NEMA):
 - MG1-2007Motors and Generators
- H. National Fire Protection Association (NFPA):
 - 51B-2014Standard for Fire Prevention During Welding,
Cutting and Other Hot Work
 - 54-2012National Fuel Gas Code
 - 70-2014National Electrical Code (NEC)
- I. NSF International (NSF):
 - 5-2012Water Heaters, Hot Water Supply Boilers, and
Heat Recovery Equipment
 - 14-2012Plastic Piping System Components and Related
Materials
 - 61-2012Drinking Water System Components - Health
Effects

372-2011Drinking Water System Components - Lead Content

J. Department of Veterans Affairs (VA):

PG-18-10Plumbing Design Manual

PG-18-13-2011Barrier Free Design Guide

1.4 SUBMITTALS

- A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 22 05 11, COMMON WORK RESULTS FOR PLUMBING", with applicable paragraph identification.
- C. Contractor shall make all necessary field measurements and investigations to assure that the equipment and assemblies will meet contract requirements and will fit the space available.
- D. If equipment is submitted which differs in arrangement from that shown, provide drawings that show the rearrangement of all associated systems. Approval by VA will be given only if all features of the equipment and associated systems, including accessibility, are equivalent to that required by the contract.
- E. Prior to submitting shop drawings for approval, contractor shall certify in writing that manufacturers of all major items of equipment have each reviewed drawings and specifications, and have jointly coordinated and properly integrated their equipment and controls to provide a complete and efficient installation.
- F. Installing Contractor shall provide lists of previous installations for selected items of equipment. Contact persons who will serve as references, with telephone numbers and e-mail addresses shall be submitted with the references.
- G. Manufacturer's Literature and Data: Manufacturer's literature shall be submitted under the pertinent section rather than under this section.
 - 1. Electric motor data and variable speed drive data shall be submitted with the driven equipment.
 - 2. Equipment and materials identification.
 - 3. Firestopping materials.
 - 4. Hangers, inserts, supports and bracing. Provide load calculations for variable spring and constant support hangers.

5. Wall, floor, and ceiling plates.
- H. Submittals and shop drawings for interdependent items, containing applicable descriptive information, shall be furnished together and complete in a group. Coordinate and properly integrate materials and equipment in each group to provide a completely compatible and efficient installation. Final review and approvals will be made only by groups.
- I. Coordination Drawings: Complete consolidated and coordinated layout drawings shall be submitted for all new systems, and for existing systems that are in the same areas. The drawings shall include plan views, elevations and sections of all systems and shall be on a scale of not less than 1:32 (3/8 inch equal to one foot). Clearly identify and dimension the proposed locations of the principal items of equipment. The drawings shall clearly show the proposed location and adequate clearance for all equipment, controls, piping, pumps, valves and other items. All valves, trap primer valves, water hammer arrestors, strainers, and equipment requiring service shall be provided with an access door sized for the complete removal of plumbing device, component, or equipment. Equipment foundations shall not be installed until equipment or piping layout drawings have been approved. Detailed layout drawings shall be provided for all piping systems. In addition, details of the following shall be provided.
 1. Mechanical equipment rooms.
 2. Interstitial space.
 3. Hangers, inserts, supports, and bracing.
 4. Pipe sleeves.
 5. Equipment penetrations of floors, walls, ceilings, or roofs.
- J. Maintenance Data and Operating Instructions:
 1. Maintenance and operating manuals in accordance with Section 01 00 00, GENERAL REQUIREMENTS, Article, INSTRUCTIONS, for systems and equipment. Include complete list indicating all components of the systems with diagrams of the internal wiring for each item of equipment.

2. Include listing of recommended replacement parts for keeping in stock supply, including sources of supply, for equipment shall be provided. The listing shall include belts for equipment: Belt manufacturer, model number, size and style, and distinguished whether of multiple belt sets.
- K. 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 22 08 00 COMMISSIONING OF PLUMBING SYSTEMS.
- L. 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. Products Criteria:
 1. Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture, supply and servicing of the specified products for at least 5 years. However, digital electronics devices, software and systems such as controls, instruments, computer work station, shall be the current generation of technology and basic design that has a proven satisfactory service record of at least 5 years.
 2. Equipment Service: There shall be permanent service organizations, authorized and trained by manufacturers of the equipment supplied, located within 160 km (100 miles) of the project. These organizations shall come to the site and provide acceptable service to restore operations within four hours of receipt of notification by phone, e-mail or fax in event of an emergency, such as the shut-down of equipment; or within 24 hours in a non-emergency. Names, mail and e-mail addresses and phone numbers of service organizations providing service under these conditions for (as applicable to the project): pumps, compressors, water heaters, critical instrumentation, computer workstation and programming shall be submitted for project record and inserted into the operations and maintenance manual.

3. All items furnished shall be free from defects that would adversely affect the performance, maintainability and appearance of individual components and overall assembly.
 4. The products and execution of work specified in Division 22 shall conform to the referenced codes and standards as required by the specifications. Local codes and amendments enforced by the local code official shall be enforced, if required by local authorities such as the natural gas supplier. If the local codes are more stringent, then the local code shall apply. Any conflicts shall be brought to the attention of the (COR).
 5. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.
 6. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.
 7. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.
 8. Asbestos products or equipment or materials containing asbestos are prohibited.
 9. Bio-Based Materials: For products designated by the USDA's Bio-Preferred Program, provide products that meet or exceed USDA recommendations for bio-based content, so long as products meet all performance requirements in this specifications section. For more information regarding the product categories covered by the Bio-Preferred Program, visit <http://www.biopreferred.gov> .
- B. Welding: Before any welding is performed, contractor shall submit a certificate certifying that welders comply with the following requirements:
1. Qualify welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code", Section IX, "Welding and Brazing Qualifications".
 2. Comply with provisions of ASME B31 series "Code for Pressure Piping".

3. Certify that each welder and welding operator has passed American Welding Society (AWS) qualification tests for the welding processes involved, and that certification is current.
 4. All welds shall be stamped according to the provisions of the American Welding Society.
- C. Manufacturer's Recommendations: Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, electronic copies of these recommendations shall be furnished to the COR prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.
- D. Execution (Installation, Construction) Quality:
1. All items shall be applied and installed in accordance with manufacturer's written instructions. Conflicts between the manufacturer's instructions and the contract documents shall be referred to the COR for resolution. Printed copies or electronic files of manufacturer's installation instructions shall be provided to the COR at least 10 working days prior to commencing installation of any item.
 2. All items that require access, such as for operating, cleaning, servicing, maintenance, and calibration, shall be easily and safely accessible by persons standing at floor level, or standing on permanent platforms, without the use of portable ladders. Examples of these items include, but are not limited to: all types of valves, filters and strainers, transmitters, and control devices. Prior to commencing installation work, refer conflicts between this requirement and contract documents to COR for resolution.
 3. Complete layout drawings shall be required by Paragraph, SUBMITTALS. Construction work shall not start on any system until the layout drawings have been approved by VA.
 4. Installer Qualifications: Installer shall be licensed and shall provide evidence of the successful completion of at least five projects of equal or greater size and complexity. Provide tradesmen skilled in the appropriate trade.

5. If an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no additional cost or additional time to the Government.
- E. Plumbing Systems: IPC, International Plumbing Code. Unless otherwise required herein, perform plumbing work in accordance with the latest version of the IPC. For IPC codes referenced in the contract documents, advisory provisions shall be considered mandatory, the word "should" shall be interpreted as "shall". Reference to the "code official" or "owner" shall be interpreted to mean the COR.
- F. Cleanliness of Piping and Equipment Systems:
1. Care shall be exercised in the storage and handling of equipment and piping material to be incorporated in the work. Debris arising from cutting, threading and welding of piping shall be removed.
 2. Piping systems shall be flushed, blown or pigged as necessary to deliver clean systems.
 3. The interior of all tanks shall be cleaned prior to delivery and beneficial use by the Government. All piping shall be tested in accordance with the specifications and the International Plumbing Code (IPC). All filters, strainers, fixture faucets shall be flushed of debris prior to final acceptance.
 4. Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Protection of Equipment:
1. Equipment and material placed on the job site shall remain in the custody of the Contractor until final acceptance, whether or not the Government has reimbursed the Contractor for the equipment and material. The Contractor is solely responsible for the protection of such equipment and material against any damage.
 2. Damaged equipment shall be replaced with an identical unit as determined and directed by the COR. Such replacement shall be at no additional cost or additional time to the Government.
 3. Interiors of new equipment and piping systems shall be protected against entry of foreign matter. Both inside and outside shall be cleaned before painting or placing equipment in operation.

4. Existing equipment and piping being worked on by the Contractor shall be under the custody and responsibility of the Contractor and shall be protected as required for new work.

1.7 AS-BUILT DOCUMENTATION

- A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.
Submit operation and maintenance data updated to include submittal review comments, substitutions and construction revisions shall be inserted into a three ring binder. All aspects of system operation and maintenance procedures, including piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices such as damper and door closure interlocks shall be included. A List of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.
- B. The installing contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. As-built drawings are to be provided, and a copy of them on Auto-Cad version 2018 or later 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.
- C. Certification documentation shall be provided prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and a certification that all results of tests were within limits specified.

PART 2 - PRODUCTS

2.1 MATERIALS FOR VARIOUS SERVICES

- A. Material or equipment containing a weighted average of greater than 0.25 percent lead shall not be used in any potable water system intended for human consumption, and shall be certified in accordance with NSF 61 or NSF 372.
- B. In-line devices such as water meters, building valves, check valves, stops, valves, fittings, tanks and backflow preventers shall comply with NSF 61 and NSF 372.
- C. End point devices such as drinking fountains, lavatory faucets, kitchen and bar faucets, ice makers supply stops, and end-point control valves used to dispense drinking water must meet requirements of NSF 61 and NSF 372.

2.2 FACTORY-ASSEMBLED PRODUCTS

- A. Provide maximum standardization of components to reduce spare part requirements.
- B. Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for final assembled unit.
 - 1. All components of an assembled unit need not be products of same manufacturer.
 - 2. Constituent parts that are alike shall be products of a single manufacturer.
 - 3. Components shall be compatible with each other and with the total assembly for intended service.
 - 4. Contractor shall guarantee performance of assemblies of components, and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.
- C. Components of equipment shall bear manufacturer's name and trademark, model number, serial number and performance data on a name plate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.
- D. Major items of equipment, which serve the same function, must be the same make and model. Exceptions will be permitted if performance requirements cannot be met.

2.3 COMPATIBILITY OF RELATED EQUIPMENT

- A. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that the result will be a complete and fully operational building that conforms to contract requirements.

2.4 SAFETY GUARDS

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

2.5 LIFTING ATTACHMENTS

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

2.6 ELECTRIC MOTORS, MOTOR CONTROL, CONTROL WIRING

- A. All material and equipment furnished and installation methods shall conform to the requirements of Section 22 05 12, GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT; Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS; and, Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES. All electrical wiring, conduit, and devices necessary for the proper connection, protection and operation of the systems shall be provided. Premium efficient motors shall be provided. Unless otherwise specified for a particular application, electric motors shall have the following requirements. Unless otherwise specified for a particular application use electric motors with the following requirements.
- B. Special Requirements:
 - 1. Where motor power requirements of equipment furnished deviate from power shown on plans, provide electrical service designed under the requirements of NFPA 70 without additional time or cost to the Government.

2. Assemblies of motors, starters, controls and interlocks on factory assembled and wired devices shall be in accordance with the requirements of this specification.
 3. Wire and cable materials specified in the electrical division of the specifications shall be modified as follows:
 - a. Wiring material located where temperatures can exceed 71° C (160° F) shall be stranded copper with Teflon FEP insulation with jacket. This includes wiring on the boilers and water heaters.
 - b. Other wiring at boilers and water heaters, and to control panels, shall be NFPA 70 designation THWN.
 - c. Shielded conductors or wiring in separate conduits for all instrumentation and control systems shall be provided where recommended by manufacturer of equipment.
 4. Motor sizes shall be selected so that the motors do not operate into the service factor at maximum required loads on the driven equipment. Motors on pumps shall be sized for non-overloading at all points on the pump performance curves.
 5. Motors utilized with variable frequency drives shall be rated "inverter-ready" per NEMA Standard, MG1.
- C. Motor Efficiency and Power Factor: All motors, when specified as "high efficiency or Premium Efficiency" by the project specifications on driven equipment, shall conform to efficiency and power factor requirements in Section 22 05 12, GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT, with no consideration of annual service hours. Motor manufacturers generally define these efficiency requirements as "NEMA premium efficient" and the requirements generally exceed those of the Energy Policy Act (EPACT) revised 2005. Motors not specified as "high efficiency or Premium Efficiency" shall comply with EPACT.
- D. Single-phase Motors: Capacitor-start type for hard starting applications. Motors for pumps may be split phase or permanent split capacitor (PSC).
- E. Poly-phase Motors: NEMA Design B, Squirrel cage, induction type. Each two-speed motor shall have two separate windings. Provide a time- delay (20 seconds minimum) relay shall be provided for switching from high to low speed.

- F. Rating: Continuous duty at 100 percent capacity in an ambient temperature of 40 degrees C (104 degrees F); minimum horsepower as shown on drawings; maximum horsepower in normal operation shall not to exceed nameplate rating without service factor.
- G. Insulation Resistance: Not less than one-half meg-ohm between stator conductors and frame shall be measured at the time of final inspection.

2.7 EQUIPMENT AND MATERIALS IDENTIFICATION

- A. Use symbols, nomenclature and equipment numbers specified, shown on the drawings and shown in the maintenance manuals. Coordinate equipment and valve identification with local NCA maintenance 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 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. Unit components such as water heaters, tanks, coils, filters, etc. shall be identified.
- C. Exterior (Outdoor) Equipment: Brass nameplates, with engraved black filled letters, not less than 5 (3/16-inch) high riveted or bolted to the equipment.
- D. Control Items: All temperature, pressure, and controllers shall be labeled and the component's function identified. Identify and label each item as they appear on the control diagrams.
- E. Valve Tags and Lists:
 - 1. Prior to assigning valve number designation, inquire with the plumbing shop or Chief of Engineering regarding if they already have a specific nomenclature already in use.
 - 2. Plumbing: All valves shall be provided with valve tags and listed on a valve list (Fixture stops not included).
 - 3. 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 gage 38 mm (1-1/2 inches) round brass disc, attached with brass "S" hook or brass chain.

4. Valve lists: Valve lists shall be created using a word processing program and printed on plastic coated cards. The 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. The valve list shall be in a punched 3 ring binder notebook. An additional copy of the valve list shall be mounted in picture frames for mounting to a wall. COR shall instruct contractor where frames shall be mounted.
5. A detailed plan for each floor of the building indicating the location and valve number for each valve shall be provided in the 3 ring binder notebook. Each valve location shall be identified with a color coded sticker or thumb tack in ceiling or access door.

2.8 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 firestop pipe insulation.

2.9 GALVANIZED REPAIR COMPOUND

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

2.10 PIPE AND EQUIPMENT SUPPORTS AND RESTRAINTS

- A. In lieu of the paragraph which follows, suspended equipment support and restraints may be designed and installed in accordance with the International Building Code (IBC) Submittals based on the International Building Code (IBC) requirements, or the following paragraphs of this Section shall be stamped and signed by a professional engineer registered in a state where the project is located. Support of suspended equipment over 227 kg (500 pounds) shall 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. For selection and application refer to MSS SP-69. Refer to Section 05 50 00, METAL FABRICATIONS, for miscellaneous metal support materials and prime coat painting.
- C. For Attachment to Concrete Construction:
 1. Concrete insert: Type 18, MSS SP-58.

2. Self-drilling expansion shields and machine bolt expansion anchors:
Permitted in concrete not less than 102 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 102 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 23mm (7/8-inch) outside diameter.
- E. For Attachment to Wood Construction: Wood screws or lag bolts.
- F. Hanger Rods: Hot rolled steel, ASTM A36/A36M or ASTM A575 for allowable load listed in MSS SP 58. For piping, provide adjustment means for controlling level or slope. Types 13 or 15 turn buckles shall provide 40 mm (1 1/2 inches) minimum of adjustment and incorporate locknuts. All-thread rods are acceptable.
- G. Multiple (Trapeze) Hangers: Galvanized, cold formed, lipped steel channel horizontal member, not less than 41mm by 41mm (1-5/8 inches by 1-5/8 inches), 2.7 mm (No. 12 gage), designed to accept special spring held, hardened steel nuts.
1. Allowable hanger load: Manufacturers rating less 91kg (200 pounds).
 2. Guide individual pipes on the horizontal member of every other trapeze hanger with 6 mm (1/4-inch) U-bolt fabricated from steel rod. Provide Type 40 insulation shield, secured by two 13mm (1/2-inch) galvanized steel bands or insulated calcium silicate shield for insulated piping at each hanger.
- H. Pipe Hangers and Supports: (MSS SP-58), use hangers sized to encircle insulation on insulated piping. Refer to Section 22 07 11, PLUMBING INSULATION for insulation thickness. To protect insulation, provide Type 39 saddles for roller type supports or insulated calcium silicate shields. Provide Type 40 insulation shield or insulated calcium silicate shield at all other types of supports and hangers including those for preinsulated piping.

1. General Types (MSS SP-58):

- a. Standard clevis hanger: Type 1; provide locknut.
- b. Wall brackets: Types 31, 32 or 33.
- c. Roller supports: Type 41, 43, 44 and 46.
- d. Saddle support: Type 36, 37 or 38.
- e. Turnbuckle: Types 13 or 15.
- f. U-bolt clamp: Type 24.
- g. Riser clamps: Type 8.
- h. Copper Tube:
 - 1) Hangers, clamps and other support material in contact with tubing shall be painted with copper colored epoxy paint, plastic coated or taped with non-adhesive isolation tape to prevent electrolysis.
 - 2) For vertical runs use epoxy painted, copper-coated, or plastic coated riser clamps.
 - 3) For supporting tube to strut: Provide epoxy painted pipe straps for copper tube or plastic inserted vibration isolation clamps.
 - 4) Insulated Lines: Provide pre-insulated calcium silicate shields sized for copper tube.
- i. Supports for plastic piping : As recommended by the pipe manufacturer with black rubber tape extending one inch beyond steel support or clamp.
- j. Spring Supports (Expansion and contraction of vertical piping):
 - 1) Movement up to 20 mm (3/4-inch): Type 51 or 52 variable spring unit with integral turn buckle and load indicator.
 - 2) Movement more than 20 mm (3/4-inch): Type 54 or 55 constant support unit with integral adjusting nut, turn buckle and travel position indicator.
- k. Spring hangers are required on all plumbing system pumps one horsepower and greater.

2. Plumbing Piping:

- a. Horizontal piping: Type 1, 5, 7, 9, and 10.
- b. Chrome plated piping: Chrome plated supports.

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

I. Pre-insulated Calcium Silicate Shields:

- 1. Provide 182 C(360 F) water resistant high density 965 kPa (140 psig) compressive strength calcium silicate shields encased in galvanized metal.
- 2. Pre-insulated calcium silicate shields to be installed at the point of support during erection.
- 3. Shield thickness shall match the pipe insulation.
- 4. The type of shield is selected by the temperature of the pipe, the load it must carry, and the type of support it will be used with.
 - a. Shields for supporting cold water shall have insulation that extends a minimum of 25 mm (1 inch) past the sheet metal.
 - b. The insulated calcium silicate shield shall support the maximum allowable water filled span as indicated in MSS SP-69. To support the load, the shields shall have one or more of the following features: structural inserts 4138 kPa (600 psig) compressive strength, an extra bottom metal shield, or formed structural steel (ASTM A36/A36M) wear plates welded to the bottom sheet metal jacket.
- 5. Shields may be used on steel clevis hanger type supports, trapeze hangers, roller supports or flat surfaces.

2.11 PIPE PENETRATIONS

- A. Pipe penetration sleeves shall be installed for all pipe other than rectangular blocked out floor openings for risers in mechanical bays. Install sleeves during construction.
- B. Pipe penetration sleeve materials shall comply with all firestopping requirements for each penetration.

- C. To prevent accidental liquid spills from passing to a lower level, provide the following:
1. For sleeves: Extend sleeve 25 mm (1 inch) above finished floor and provide sealant for watertight joint.
 2. For blocked out floor openings: Provide 40 mm (1-1/2 inch) angle set in silicone adhesive around opening.
 3. For drilled penetrations: Provide 40 mm (1-1/2 inch) angle ring or square set in silicone adhesive around penetration.
- D. Penetrations are not allowed through beams or ribs, but may be installed in concrete beam flanges. Any deviation from these requirements must receive prior approval of COR.
- E. Sheet metal, plastic, or moisture resistant fiber sleeves shall be provided for pipe passing through floors, interior walls, and partitions, unless brass or steel pipe sleeves are specifically called for below.
- F. Cast iron or zinc coated pipe sleeves shall be provided for pipe passing through exterior walls below grade. The space between the sleeve and pipe shall be made watertight with a modular or link rubber seal. The link seal shall be applied at both ends of the sleeve.
- G. Galvanized steel or an alternate black iron pipe with asphalt coating sleeves shall be for pipe passing through concrete beam flanges, except where brass pipe sleeves are called for. A galvanized steel sleeve shall be provided for pipe passing through floor of mechanical rooms and laundry work rooms above basement. Except in mechanical rooms, sleeves shall be connected with a floor plate.
- H. Brass Pipe Sleeves shall be provided for pipe passing through quarry tile, terrazzo or ceramic tile floors. The sleeve shall be connected with a floor plate.
- I. Sleeve clearance through floors, walls, partitions, and beam flanges shall be 25 mm (1 inch) greater in diameter than external diameter of pipe. Sleeve for pipe with insulation shall be large enough to accommodate the insulation plus 25 mm (1 inch) in diameter. Interior openings shall be caulked tight with 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. Bio-based materials shall be utilized when possible.

K. Pipe passing through roof shall be installed through a 4.9 kg per square meter copper flashing with an integral skirt or flange. Skirt or flange shall extend not less than 200 mm (8 inches) from the pipe and set in a solid coating of bituminous cement. Extend flashing a minimum of 250 mm (10 inches) up the pipe. Pipe passing through a waterproofing membrane shall be provided with a clamping flange. The annular space between the sleeve and pipe shall be sealed watertight.

2.12 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 76 mm (3-inch pipe), 0.89 mm (0.035-inch) for larger pipe.
- C. Locations: Use where pipe penetrates floors, walls and ceilings in exposed locations, in finished areas only. Wall plates shall be used where insulation ends on exposed water supply pipe drop from overhead. A watertight joint shall be provided in spaces where brass or steel pipe sleeves are specified.

2.13 ASBESTOS

- A. Materials containing asbestos are prohibited.

2.14 TOOLS AND LUBRICANTS

- A. Furnish, and turn over to the COR, special tools not readily available commercially, that are required for disassembly or adjustment of equipment and machinery furnished.
- B. Grease Guns with Attachments for Applicable Fittings: One for each type of grease required for each motor or other equipment.
- C. Tool Containers: metal, permanently identified for intended service and mounted, or located, where directed by the COR.
- D. Lubricants: A minimum of 0.95 L (1 quart) of oil, and 0.45 kg (1 pound) of grease, of equipment manufacturer's recommended grade and type, in unopened containers and properly identified as to use for each different application. Bio-based materials shall be utilized when possible.

PART 3 - EXECUTION

3.1 ARRANGEMENT AND INSTALLATION OF EQUIPMENT AND PIPING

- A. Location of piping, sleeves, inserts, hangers, and equipment, access provisions shall be coordinated with the work of all trades. Piping, sleeves, inserts, hangers, and equipment shall be located clear of windows, doors, openings, light outlets, and other services and utilities. Equipment layout drawings shall be prepared to coordinate proper location and personnel access of all facilities. The drawings shall be submitted for review.
- B. Manufacturer's published recommendations shall be followed for installation methods not otherwise specified.
- C. Operating Personnel Access and Observation Provisions: All equipment and systems shall be arranged to provide clear view and easy access, without use of portable ladders, for maintenance and operation of all devices including, but not limited to: all equipment items, valves, filters, strainers, transmitters, sensors, and control devices. All gages and indicators shall be clearly visible by personnel standing on the floor or on permanent platforms. Maintenance and operating space and access provisions that are shown on the drawings shall not be changed nor reduced.
- D. Structural systems necessary for pipe and equipment support shall be coordinated to permit proper installation.
- E. Location of pipe sleeves, trenches and chases shall be accurately coordinated with equipment and piping locations.
- F. Cutting Holes:
 - 1. Holes through concrete and masonry shall be cut by rotary core drill. Pneumatic hammer, impact electric, and hand or manual hammer type drill will not be allowed, except as permitted by COR where working area space is limited.
 - 2. Holes shall be located to avoid interference with structural members such as beams or grade beams. Holes shall be laid out in advance and drilling done only after approval by COR. If the Contractor considers it necessary to drill through structural members, this matter shall be referred to COR for approval prior to drilling.

3. Waterproof membrane shall not be penetrated. Pipe floor penetration block outs shall be provided outside the extents of the waterproof membrane.
- G. Minor Piping: Generally, small diameter pipe runs from drips and drains, water cooling, and other service are not shown but must be provided.
- H. Protection and Cleaning:
1. Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations and as approved by the COR. Damaged or defective items in the opinion of the COR shall be replaced at no additional cost or time to the Government.
 2. Protect all finished parts of equipment, such as shafts and bearings where accessible, from rust prior to operation by means of protective grease coating and wrapping. Close pipe openings with caps or plugs during installation. Pipe openings, equipment, and plumbing fixtures shall be tightly covered against dirt or mechanical injury. At completion of all work thoroughly clean fixtures, exposed materials and equipment.
- I. Concrete and Grout: Use concrete and shrink compensating grout 25 MPa (3000 psi) minimum, specified in Section 03 30 00, CAST-IN-PLACE CONCRETE shall be used for all pad or floor mounted equipment.
- J. Gages, thermometers, valves and other devices shall be installed with due regard for ease in reading or operating and maintaining said devices. Locate and position thermometers and gages to be easily read by operator or staff standing on floor or walkway provided. Servicing shall not require dismantling adjacent equipment or pipe work.
- K. Interconnection of Controls and Instruments: Electrical interconnection is generally not shown but shall be provided. This includes interconnections of sensors, transmitters, transducers, control devices, control and instrumentation panels, alarms, instruments and computer workstations. Comply with NFPA 70.
- L. Many plumbing systems interface with the HVAC control system. See the HVAC control points list and Section 23 09 23, DIRECT DIGITAL CONTROL SYSTEM FOR HVAC.

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 least interfere with normal operation of the facility.

N. Work in bathrooms, restrooms, housekeeping closets: All pipe penetrations behind escutcheons shall be sealed with plumber's putty.

O. Switchgear Drip Protection: Every effort shall be made to eliminate the installation of pipe above data equipment and electrical & telephone switchgear. If this is not possible, encase pipe in a second pipe with a minimum of joints. Drain valve shall be provided in low point of casement pipe.

P. Inaccessible Equipment:

1. Where the Government determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled or remedial action performed as directed at no additional cost or time to the Government.
2. The term "conveniently accessible" is defined as capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as electrical conduit, motors, fans, pumps, belt guards, transformers, high voltage lines, piping, and ductwork.

3.2 TEMPORARY PIPING AND EQUIPMENT

A. Continuity of operation of existing facilities will generally require temporary installation or relocation of equipment and piping. Temporary equipment or pipe installation or relocation shall be provided to maintain continuity of operation of existing facilities.

- B. The Contractor shall provide all required facilities in accordance with the requirements of phased construction and maintenance of service. All piping and equipment shall be properly supported, sloped to drain, operate without excessive stress, and shall be insulated where injury can occur to personnel by contact with operating facilities. The requirements of paragraph 3.1 apply.
- C. Temporary facilities and piping shall be completely removed back to the nearest active distribution branch or main pipe line and any openings in structures sealed. Dead legs are not allowed in potable water systems. Necessary blind flanges and caps shall be provided to seal open piping remaining in service.

3.3 RIGGING

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

3.4 PIPE AND EQUIPMENT SUPPORTS

- A. Where hanger spacing does not correspond with joist or rib spacing, use structural steel channels secured directly to joist and rib structure that will correspond to the required hanger spacing, and then suspend the equipment and piping from the channels. Drill or burn holes in structural steel only with the prior approval of the RE/COTR.

- B. Use of chain, wire or strap hangers; wood for blocking, stays and bracing; or hangers suspended from piping above will not be permitted. Replace or thoroughly clean rusty products and paint with zinc primer.
- C. Use hanger rods that are straight and vertical. Turnbuckles for vertical adjustments may be omitted where limited space prevents use. Provide a minimum of 15 mm (1/2 inch) clearance between pipe or piping covering and adjacent work.
- D. Plumbing horizontal and vertical pipe supports, refer to the International Plumbing Code.
- 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.
- F. Floor Supports:
 - 1. Provide concrete bases, concrete anchor blocks and pedestals, and structural steel systems for support of equipment and piping. Anchor and dowel concrete bases and structural systems to resist forces under operating conditions without excessive displacement or structural failure.
 - 2. Do not locate or install bases and supports until equipment mounted thereon has been approved. Size bases to match equipment mounted thereon plus 50 mm (2 inch) excess on all edges. 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.

3.5 LUBRICATION

- A. All equipment and devices requiring lubrication shall be lubricated prior to initial operation. All devices and equipment shall be field checked for proper lubrication.

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

3.6 PLUMBING SYSTEMS DEMOLITION

- A. Rigging access, other than indicated on the drawings, shall be provided after approval for structural integrity by the COR. Such access shall be provided without additional cost or time to the Government. Where work is in an operating plant, approved protection from dust and debris shall be provided at all times for the safety of plant personnel and maintenance of plant operation and environment of the plant.
- B. In an operating plant, cleanliness and safety shall be maintained. The plant shall be kept in an operating condition. Government personnel will be carrying on their normal duties of operating, cleaning and maintaining equipment and plant operation. Work shall be confined to the immediate area concerned; maintain cleanliness and wet down demolished materials to eliminate dust. Dust and debris shall not be permitted to accumulate in the area to the detriment of plant operation. All flame cutting shall be performed to maintain the fire safety integrity of this plant. Adequate fire extinguishing facilities shall be available at all times. All work shall be performed in accordance with recognized fire protection standards including NFPA 51B. Inspections will be made by personnel of the NCA, and the Contractor shall follow all directives of the COR with regard to rigging, safety, fire safety, and maintenance of operations.
- C. Unless specified otherwise, all piping, wiring, conduit, and other devices associated with the equipment not re-used in the new work shall be completely removed from Government property per Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT.

This includes all concrete equipment pads, pipe, valves, fittings, insulation, and all hangers including the top connection and any fastenings to building structural systems. Seal all openings, after removal of equipment, pipes, ducts, and other penetrations in roof, walls, floors, in an approved manner and in accordance with plans and specifications where specifically covered. Structural integrity of the building system shall be maintained. Reference shall also be made to the drawings and specifications of the other disciplines in the project for additional facilities to be demolished or handled.

- D. All valves including gate, globe, ball, butterfly and check, all pressure gages and thermometers with wells shall remain Government property and shall be removed and delivered to COR and stored as directed. The Contractor shall remove all other material and equipment, devices and demolition debris under these plans and specifications. Such material shall be removed from Government property expeditiously and shall not be allowed to accumulate.

3.7 CLEANING AND PAINTING

- A. Prior to final inspection and acceptance of the facilities for beneficial use by the Government, the facilities, equipment and systems shall be thoroughly cleaned and painted. Refer to Section 09 91 00, PAINTING.
- B. In addition, the following special conditions apply:
1. Cleaning shall be thorough. Solvents, cleaning materials and methods recommended by the manufacturers shall be used for the specific tasks. All rust shall be removed prior to painting and from surfaces to remain unpainted. Scratches, scuffs, and abrasions shall be repaired prior to applying prime and finish coats.
 2. The following Material and Equipment shall NOT be painted:
 - a. Motors, controllers, control switches, and safety switches.
 - b. Control and interlock devices.
 - c. Regulators.
 - d. Pressure reducing valves.
 - e. Control valves and thermostatic elements.
 - f. Lubrication devices and grease fittings.
 - g. Copper, brass, aluminum, stainless steel and bronze surfaces.
 - h. Valve stems and rotating shafts.

- i. Pressure gauges and thermometers.
 - j. Glass.
 - k. Name plates.
3. Control and instrument panels shall be cleaned and damaged surfaces repaired. Touch-up painting shall be made with matching paint type and color obtained from manufacturer or computer matched.
4. Pumps, motors, steel and cast iron bases, and coupling guards shall be cleaned, and shall be touched-up with the same paint type and color as utilized by the pump manufacturer.
5. Temporary Facilities: Apply paint to surfaces that do not have existing finish coats per Section 09 91 00, Painting.
6. The final result shall be smooth, even-colored, even-textured factory finish on all items. The entire piece of equipment shall be repainted, if necessary, to achieve this. Lead based paints are prohibited.

3.8 IDENTIFICATION SIGNS

- A. Laminated plastic signs, with engraved lettering not less than 7 mm (3/16 inch) high, shall be provided that designates equipment function, for all equipment, switches, motor controllers, relays, meters, control devices, including automatic control valves. Nomenclature and identification symbols shall correspond to that used in maintenance manual, and in diagrams specified elsewhere. Refer to 2.8.E.1 in this document for exact nomenclature parameters. 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 data shall be placed on factory built equipment.
- C. Pipe Identification: Refer to Section 09 91 00, PAINTING.

3.9 STARTUP AND TEMPORARY OPERATION

- A. Startup of equipment shall be performed as described in the equipment specifications. Vibration within specified tolerance shall be verified prior to extended operation. Temporary use of equipment is specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, TEMPORARY USE OF MECHANICAL AND ELECTRICAL EQUIPMENT.

- B. The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the Contracting Officer's Representative and Commissioning Agent. Provide a minimum of 4 weeks prior notice.

3.10 OPERATING AND PERFORMANCE TESTS

- A. Prior to the final inspection, all required tests shall be performed as specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, TESTS and submit the test reports and records to the COR.
- B. Should evidence of malfunction in any tested system, or piece of equipment or component part thereof, occur during or as a result of tests, make proper corrections, repairs or replacements, and repeat tests at no additional cost or time to the Government.
- C. When completion of certain work or systems occurs at a time when final control settings and adjustments cannot be properly made to make performance tests, then conduct such performance tests and finalize control settings during the first actual seasonal use of the respective systems following completion of work. Rescheduling of these tests shall be requested in writing to COR for approval.
- D. Perform tests as required for commissioning provisions in accordance with Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS and Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

3.11 OPERATION AND MAINTENANCE MANUALS

- A. All new and temporary equipment and all elements of each assembly shall be included.
- B. Data sheet on each device listing model, size, capacity, pressure, speed, horsepower, impeller size, and other information shall be included.
- C. Manufacturer's installation, maintenance, repair, and operation instructions for each device shall be included. Assembly drawings and parts lists shall also be included. A summary of operating precautions and reasons for precautions shall be included in the Operations and Maintenance Manual.
- D. Lubrication instructions, type and quantity of lubricant shall be included.
- E. Schematic diagrams and wiring diagrams of all control systems corrected to include all field modifications shall be included.

- F. Set points of all interlock devices shall be listed.
- G. Trouble-shooting guide for the control system troubleshooting shall be inserted into the Operations and Maintenance Manual.
- H. The control system sequence of operation corrected with submittal review comments shall be inserted into the Operations and Maintenance Manual.
- I. Emergency procedures for shutdown and startup of equipment and systems.

3.12 COMMISSIONING

- A. Provide commissioning documentation in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.
- B. Components provided under this section of the specification will be tested as part of a larger system.

3.13 DEMONSTRATION AND TRAINING

- A. 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.

- - - E N D - - -

**SECTION 22 05 12
GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section describes the general motor requirements for plumbing equipment and applies to all sections of Division 22.
- 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 02, GENERAL REQUIREMENTS (Minor NCA Projects).
- 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 08 00, COMMISSIONING OF PLUMBING SYSTEMS.
- F. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- G. Section 26 24 19, MOTOR-CONTROL CENTERS: Motor Control Centers.
- H. Section 26 29 11, MOTOR CONTROLLERS: Starters, control and protection of motors.

1.3 APPLICABLE PUBLICATIONS

- A. The 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 Bearing Manufacturers Association (ABMA):
ABMA 9-1990 (R2008)Load Ratings and Fatigue Life for Ball Bearings
- C. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
841-2009IEEE 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)
- D. International Code Council (ICC):
IPC-2015International Plumbing Code
- E. National Electrical Manufacturers Association (NEMA):
MG 1-2011Motors and Generators

- MG 2-2001 (R2007)Safety Standard for Construction and Guide for Selection, Installation and Use of Electric Motors and Generators
- 250-2008Enclosures for Electrical Equipment (1000 Volts Maximum)

- F. National Fire Protection Association (NFPA):
 - 70-2011National 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 22 05 12, GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT", with applicable paragraph identification.
- C. Shop Drawings:
 - 1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
 - 2. Motor nameplate information shall be submitted including electrical ratings, dimensions, mounting details, materials, horsepower, power factor, current as a function of speed, current efficiency, speed as a function of load, RPM, enclosure, starting characteristics, torque characteristics, code letter, full load and locked rotor current, service factor, and lubrication method.
 - 3. Motor parameters required for the determination of the Reed Critical Frequency of vertical hollow shaft motors shall be submitted.
- D. Operating and Maintenance Manuals: Companion copies of complete maintenance and operating manuals, including technical data sheets and application data shall be submitted simultaneously with the shop drawings. 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. Certification: Two weeks prior to final inspection, unless otherwise noted, the following certification shall be submitted to the Contracting Officer's Representative (COR).

1. Certification shall be submitted stating that the motors have been properly applied, installed, adjusted, lubricated, and tested.

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

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 totally enclosed motors, IEEE 841 shall apply.
- C. 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: 230/460 volts, dual connection.
 - c. Motors, 74.6 kW (100 HP) or larger, connected to 240-volt systems: 230 volts.
 - d. Motors, 74.6 kW (100 HP) or larger, connected to 480-volt systems: 460 volts.
 - e. Motors connected to high voltage systems: Shall conform to NEMA MG 1 Standards for connection to the nominal system voltage shown on the drawings.

D. 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 larger: 3 phase.
3. Exceptions:
 - a. Hermetically sealed motors.
 - b. Motors for equipment assemblies, less than 746 W (1 HP), may be single phase provided the manufacturer of the proposed assemblies cannot supply the assemblies with three phase motors.

E. 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 rise for the motor insulation.

F. 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.

G. Motor Enclosures:

1. Shall be the NEMA types shown on the drawings for the motors.
2. Where the types of motor enclosures are not shown on the drawings, they shall be the NEMA types per NEMA 250, which are most suitable for the environmental conditions where the motors are being installed.
3. Enclosures shall be primed and finish coated at the factory with manufacturer's prime coat and standard finish.
4. All motors in hazardous locations shall be approved for the application and meet the Class and Group as required by the area classification.

H. 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 (144 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.

I. Mechanical Design Requirements:

1. Bearings shall be rated 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 hour 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 larger 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.

- J. Additional requirements for specific motors, as indicated in other sections, shall also apply.

K. 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, and as specified in this specification. Motors of 746 W (1 HP) or more with open, drip-proof or totally enclosed fan-cooled 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 Efficiencies | | | | | | | |
|-------------------------------|-------------|-------------|-------------|-----------------------------|-------------|-------------|-------------|
| Open Drip-Proof | | | | Totally Enclosed Fan-Cooled | | | |
| 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% |
| Minimum Efficiencies (cont'd) | | | | | | | |
| Open Drip-Proof | | | | Totally Enclosed Fan-Cooled | | | |
| Rating kW (HP) | 1200 RPM | 1800 RPM | 3600 RPM | Rating kW (HP) | 1200 RPM | 1800 RPM | 3600 RPM |
| 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% |

L. 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 installed unless 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.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install motors in accordance with manufacturer's recommendations, the NEC, NEMA, as shown on the drawings and/or as required by other sections of these specifications.
- B. If an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no additional cost or time to the Government.

3.2 FIELD TESTS

- A. Megger all motors after installation, before start-up. All shall test free from grounds.

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.

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SECTION 22 05 19
METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section describes the requirements for water meters and gages primarily used for troubleshooting the system and to indicate system performance.
- B. A complete listing of all acronyms and abbreviations are included in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

1.2 RELATED WORK

- A. Section 01 00 02, GENERAL REQUIREMENTS (Minor NCA Projects).
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.
- D. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

1.3 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society of Mechanical Engineers (ASME):
 - B40.100-2013Pressure Gauges and Gauge Attachments
 - B40.200-2008Thermometers, Direct Reading and Remote Reading
- C. American Water Works Association (AWWA):
 - C700-2009Standard for Cold Water Meters, Displacement Type, Bronze Main Case
 - C701-2012Cold Water Meters-Turbine Type, for Customer Service
 - C702-2010Cold Water Meters - Compound Type
 - C706-2010Direct-Reading, Remote-Registration Systems for Cold-Water Meters
- D. Institute of Electrical and Electronics Engineers (IEEE):
 - C2-2012National Electrical Safety Code (NESC)
- E. International Code Council, (ICC):
 - IPC-2015International Plumbing Code
- F. National Fire Protection Association (NFPA):
 - 70-2014National Electrical Code (NEC)

G. NSF International (NSF):

61-2012Drinking Water System Components - Health
Effects

372-2011Drinking Water System Components - Lead Content

1.4 SUBMITTALS

- A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 22 05 19, METERS AND GAGES FOR PLUMBING PIPING", with applicable paragraph identification.
- C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.
 - 1. Water Meter.
 - 2. Pressure Gages.
 - 3. Thermometers.
 - 4. Product certificates for each type of meter and gage.
 - 5. BACnet communication protocol.
- D. Operations and Maintenance manual shall include:
 - 1. System Description.
 - 2. Major assembly block diagrams.
 - 3. Troubleshooting and preventive maintenance guidelines.
 - 4. Spare parts information.
- E. Shop Drawings shall include the following: One line, wiring and terminal diagrams including terminals identified, protocol or communication modules, and Ethernet connections.

1.5 AS-BUILT DOCUMENTATION

- A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.
- B. Submit copies of complete operation and maintenance data updated to include submittal review comments, substitutions and construction revisions shall be inserted into a three ring binder per the requirements of Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.

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. 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. Certification documentation shall be provided prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and a certification that all results of tests were within limits specified.

1.6 QUALITY ASSURANCE

A. Products Criteria:

1. Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture, supply and servicing of the specified products for at least 5 years. However, digital electronics devices, software and systems such as controls, instruments, computer work station, shall be the current generation of technology and basic design that has a proven satisfactory service record of at least 5 years.
2. Equipment Service: There shall be permanent service organizations, authorized and trained by manufacturers of the equipment supplied, located within 160 km (100 miles) of the project. These organizations shall come to the site and provide acceptable service to restore operations within four hours of receipt of notification by phone, e-mail or fax in event of an emergency, such as the shut-down of equipment; or within 24 hours in a non-emergency. Names, mail and e-mail addresses and phone numbers of service organizations providing service under these conditions for (as applicable to the project): critical instrumentation, computer workstation and programming shall be submitted for project record and inserted into the operations and maintenance manual.

3. All items furnished shall be free from defects that would adversely affect the performance, maintainability and appearance of individual components and overall assembly.

B. Execution (Installation, Construction) Quality:

1. All items shall be applied and installed in accordance with manufacturer's written instructions. Conflicts between the manufacturer's instructions and the contract documents shall be referred to the COR for resolution. Printed copies or electronic files of manufacturer's installation instructions shall be provided to the COR at least 10 working days prior to commencing installation of any item.
2. All items that require access, such as for operating, cleaning, servicing, maintenance, and calibration, shall be easily and safely accessible by persons standing at floor level, or standing on permanent platforms, without the use of portable ladders. Examples of these items include, but are not limited to: all types of valves, filters and strainers, transmitters, and control devices. Prior to commencing installation work, refer conflicts between this requirement and contract documents to COR for resolution.
3. If an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no additional cost or additional time to the Government.

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

D. Cleanliness of Piping and Equipment Systems:

1. Care shall be exercised in the storage and handling of equipment and piping material to be incorporated in the work. Debris arising from cutting, threading and welding of piping shall be removed.
2. Piping systems shall be flushed, blown or pigged as necessary to deliver clean systems.
3. All piping shall be tested in accordance with the specifications and the International Plumbing Code (IPC). All filters and strainers shall be flushed of debris prior to final acceptance.
4. Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems.

PART 2 - PRODUCTS

2.1 PRESSURE GAGES 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) gage.
- B. The pressure element assembly shall be bourdon tube. The mechanical movement shall be lined to pressure element and connected to pointer.
- C. The dial shall be non-reflective aluminum with permanently etched scale markings graduated in kPa and psig.
- D. The pointer shall be dark colored metal.
- E. The window shall be glass.
- F. The ring shall be brass or stainless steel.
- G. The accuracy shall be grade A, plus or minus 1 percent of middle half of scale range.
- H. The pressure gage for water domestic use shall conform to NSF 61.

2.2 THERMOMETERS

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 OF EQUIPMENT

- A. Direct mounted pressure gages shall be installed in piping tees with pressure gage located on pipe at the most readable position.
- B. Valves and snubbers shall be installed in piping for each pressure gage.
- C. Test plugs shall be installed on the inlet and outlet pipes of all heat exchangers or water heaters serving more than one plumbing fixture.
- D. Pressure gages shall be installed where indicated on the drawings and at the following locations:
 - 1. Building water service entrance into building.
 - 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 on 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 cost to the Government.
- I. Protection and Cleaning:
 - 1. Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations and as approved by the COR. Damaged or defective items in the opinion of the COR shall be replaced at no additional cost or time to the Government.
 - 2. Pipe openings shall be tightly covered against dirt or mechanical injury. Close pipe openings with caps or plugs during installation. At completion of all work thoroughly clean fixtures, exposed materials and equipment.
- J. Gages, thermometers, and other devices shall be installed with due regard for ease in reading or operating and maintaining said devices. Locate and position thermometers and gages to be easily read by operator or staff standing on floor or walkway provided. Servicing shall not require dismantling adjacent equipment or pipe work.
- K. Inaccessible Equipment:
 - 1. Where the Government determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled or remedial action performed as directed at no additional cost or 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 FIELD QUALITY CONTROL

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 CLEANING AND PAINTING

- A. Prior to final inspection and acceptance of the facilities for beneficial use by the Government, the facilities, equipment and systems shall be thoroughly cleaned and painted. Refer to Section 09 91 00, PAINTING.
- B. In addition, the following special conditions apply:
 1. Cleaning shall be thorough. Solvents, cleaning materials and methods recommended by the manufacturers shall be used for the specific tasks. All rust shall be removed prior to painting and from surfaces to remain unpainted. Scratches, scuffs, and abrasions shall be repaired prior to applying prime and finish coats.
 2. Pressure gauges and thermometers shall NOT be painted.

- - - E N D - - -

SECTION 22 05 23
GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section describes the requirements for general-duty valves for domestic water and sewer systems.
- B. A complete listing of all acronyms and abbreviations are included in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

1.2 RELATED WORK

- A. Section 01 00 02, GENERAL REQUIREMENTS (Minor NCA Projects).
- 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 (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 Mechanical Engineers (ASME):
 - A112.1.2-04Air Gaps in Plumbing Systems
 - A112.14.1-2003Backwater Valves
- C. American Society of Sanitary Engineering (ASSE):
 - 1001-2008Atmospheric Type Vacuum Breakers
 - 1003-2009Water Pressure Reducing Valves for Domestic
Water Distribution Systems
 - 1017-2009Temperature Actuated Mixing Valves for Hot
Water Distribution Systems
 - 1020-2004Pressure Vacuum Breaker Assembly
 - 1035-2008Laboratory Faucet Backflow Preventers
 - 1069-2005Automatic Temperature Control Mixing Valves
 - 1070-2004Water Temperature Limiting Devices
 - 1071-2012Temperature Actuated Mixing Valves for Plumbed
Emergency Equipment

- D. American Society for Testing and Materials (ASTM):
 - A126-2004 (R2009)Standard Specification for Gray Iron Castings
for Valves, Flanges, and Pipe Fittings
 - A276-2013aStandard Specification for Stainless Steel Bars
and Shapes
 - A536-1984 (R2009)Standard Specification for Ductile Iron
Castings
 - B62-2009Standard Specification for Composition Bronze
or Ounce Metal Castings
 - B584-2013Standard Specification for Copper Alloy Sand
Castings for General Applications
- E. International Code Council (ICC):
 - IPC-2015International Plumbing Code
- F. Manufacturers Standardization Society of the Valve and Fittings
Industry, Inc. (MSS):
 - SP-25-2008Standard Marking Systems for Valves, Fittings,
Flanges and Unions
 - SP-67-2011Butterfly Valves
 - SP-70-2011Gray Iron Gate Valves, Flanged and Threaded
Ends
 - SP-71-2011Gray Iron Swing Check Valves, Flanged and
Threaded Ends
 - SP-80-2013Bronze Gate, Globe, Angle, and Check Valves
 - SP-85-2011Gray Iron Globe & Angle Valves, Flanged and
Threaded Ends
 - SP-110-2010Ball Valves Threaded, Socket-Welding, Solder
Joint, Grooved and Flared Ends
- G. National Environmental Balancing Bureau (NEBB):
 - 7th Edition 2005Procedural Standards for Testing, Adjusting,
Balancing of Environmental Systems
- H. NSF International (NSF):
 - 61-2012Drinking Water System Components - Health
Effects
 - 372-2011Drinking Water System Components - Lead Content
- I. University of Southern California Foundation for Cross Connection
Control and Hydraulic Research (USC FCCCHR):

9th EditionManual of Cross-Connection Control

1.4 SUBMITTALS

- A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 22 05 23, GENERAL-DUTY VALVES FOR PLUMBING PIPING", with applicable paragraph identification.
- C. Manufacturer's Literature and Data Including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.
 - 1. Ball Valves.
 - 2. Gate Valves.
 - 3. Butterfly Valves.
 - 4. Balancing Valves.
 - 5. Check Valves.
 - 6. Globe Valves.
 - 7. Water Pressure Reducing Valves and Connections.
 - 8. Thermostatic Mixing Valves.
- D. Test and Balance reports for balancing valves.
- E. Complete operating and maintenance manuals including wiring diagrams, technical data sheets and information for ordering replaceable parts:
 - 1. Include complete list indicating all components of the systems.
 - 2. Include complete diagrams of the internal wiring for each item of equipment.
 - 3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.
 - 4. Piping diagrams of thermostatic mixing valves to be installed.
- F. 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 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.
- D. Guaranty: Warranty of Construction, FAR clause 52.246-21.

PART 2 - PRODUCTS

2.1 VALVES, GENERAL

- A. Asbestos packing and gaskets are prohibited.
- B. Bronze valves shall be made with dezincification resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc shall not be permitted.
- C. Valves in insulated piping shall have 50 mm or DN50 (2 inch) stem extensions and extended handles of non-thermal conductive material that allows operating the valve without breaking the vapor seal or disturbing the insulation. Memory stops shall be fully adjustable after insulation is applied.
- D. Exposed Valves over 65 mm or DN65 (2-1/2 inches) installed at an elevation over 3.6 m (12 feet) shall have a chain-wheel attachment to valve hand-wheel, stem, or other actuator.
- E. All valves used to supply potable water shall meet the requirements of NSF 61 and NSF 372.
- F. Bio-Based Materials: For products designated by the USDA's Bio-Preferred Program, provide products that meet or exceed USDA recommendations for bio-based content, so long as products meet all performance requirements in this specifications section. For more information regarding the product categories covered by the Bio-Preferred Program, visit <http://www.biopreferred.gov>.

2.2 SHUT-OFF VALVES

A. Cold, Hot and Re-circulating Hot Water:

1. 50 mm or DN50 (2 inches) and smaller: Ball, MSS SP-110, Ball valve shall be full port three piece or two piece with a union design with adjustable stem package. Threaded stem designs are not allowed. The ball valve shall have a SWP rating of 1035 kPa (150 psig) and a CWP rating of 4138 kPa (600 psig). The body material shall be Bronze ASTM B584, Alloy C844. The ends shall be non-lead solder.
2. Less than 100 mm DN100 (4 inches): Butterfly shall have an iron body with EPDM seat 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.

2.3 BALANCING VALVES

- A. Hot Water Re-circulating, 75 mm or DN75 (3 inches) and smaller manual balancing valve shall be of bronze body, brass ball construction with glass and carbon filled TFE seat rings and designed for positive shutoff. The manual balancing valve shall have differential pressure read-out ports across the valve seat area. The read out ports shall be fitting with internal EPT inserts and check valves. The valve body shall have 8 mm or DN8 NPT (1/4 inch NPT) tapped drain and purge port. The valves shall have memory stops that allow the valve to close for service and then reopened to set point without disturbing the balance position. All valves shall have calibrated nameplates to assure specific valve settings.
- B. Larger than 75 mm or DN75 (3 inches): Manual balancing valves shall be of heavy duty cast iron flanged construction with 861 kPa (125 psig) flange connections. The flanged manual balancing valves shall have either a brass ball with glass and carbon filled TFE seal rings or fitted with a bronze seat, replaceable bronze disc with EPDM seal insert and stainless steel stem. The design pressure shall be 1200 kPa (175 psig) at 121 degrees C (250 degrees F).

2.4 CHECK VALVES

- A. 75 mm or DN75 (3 inches) and smaller shall be Class 125, bronze swing check valves with non-metallic disc suitable for type of service. The check valve shall meet MSS SP-80 Type 4 standard. The check valve shall have a CWP rating of 1380 kPa (200 psig). The check valve shall have a Y pattern horizontal body design with bronze body material conforming to ASTM B62, solder joints, and PTFE or TFE disc.

2.5 GLOBE VALVES

- A. 75 mm or DN75 (3 inches) or smaller: Class 150, bronze globe valve with non-metallic disc. The globe valve shall meet MSS SP-80, Type 2 standard. The globe valve shall have a CWP rating of 2070 kPa (300 psig). The valve material shall be bronze with integral seal and union ring bonnet conforming to ASTM B62 with solder ends, copper-silicon bronze stem, PTFE or TFE disc, and malleable iron hand wheel.

2.6 THERMOSTATIC MIXING VALVES

- A. Thermostatic Mixing Valves shall comply with the following general performance requirements:
1. Shall meet ASSE requirements for water temperature control.
 2. The body shall be cast bronze with corrosion resistant internal parts preventing scale and biofilm build-up. Provide chrome-plated finish in exposed areas.
 3. No special tool shall be required for temperature adjustment, maintenance, replacing parts and disinfecting operations.
 4. Valve shall be able to be placed in various positions without making temperature adjustment or reading difficult.
 5. Valve finish shall be chrome plated in exposed areas.
 6. Valve shall allow easy temperature adjustments to allow hot water circulation. Internal parts shall be able to withstand disinfecting operations of chemical and thermal treatment of water temperatures up to 82°C (180°F) for 30 minutes or 50 mg/L (50 ppm) chlorine residual concentration for 24 hours.
 7. Parts shall be easily removed or replaced without dismantling the valves, for easy scale removal and disinfecting of parts.

8. Valve shall have a manual adjustable temperature control with locking mechanism to prevent tampering by end user. Outlet temperature shall be visible to ensure outlet temperature does not exceed specified limits, particularly after thermal eradication procedures.
 9. Provide mixing valves with integral check valves with screens and stop valves.
- B. Automatic Water Temperature Control Mixing Valves:
1. Application: Gang plumbing fixtures point-of-use when no other mixing at fixtures occurs.
 2. Standard: ASSE 1069.
 3. Pressure Rating: 861 kPa (125 psig).
 4. Type: Thermostatically controlled water mixing valve set at 43 degrees C (110 degrees F).
 5. Connections: Threaded union or soldered inlets and outlet.
 6. Thermometers shall be provided to indicate mixed water temperature.
 7. Upon cold water supply failure the hot water flow shall automatically be reduced to 0.5 gpm maximum.
- C. Water Temperature Limiting Devices:
1. Application: Single plumbing fixture point-of-use such as sinks or lavatories.
 2. Standard: ASSE 1070.
 3. Pressure Rating: 861 kPa (125 psig).
 4. Type: Thermostatically controlled water mixing valve set at 43 degrees C (110 degrees F).
 5. Connections: Threaded union, compression or soldered inlets and outlet.
 6. Upon cold water supply failure the hot water flow shall automatically be reduced to 0.2 gpm maximum.
- D. Temperature Activated Mixing Valves:
1. Application: Emergency eye/face/drench shower equipment.
 2. Standard: ASSE 1071.
 3. Pressure Rating: 861 kPa (125 psig).
 4. Type: Thermostatically controlled water mixing valve set at 24-30 degrees C (75-85 degrees F).
 5. Connections: Soldered or threaded union inlets and outlet.

6. Thermometers shall be provided to indicate mixed water temperature.
7. Upon cold water supply failure the hot water flow shall automatically be reduced to 0.5 gpm maximum.

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 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.

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

3.3 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 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.

Black Hills National Cemetery
Renovate and Expand Administration and Maintenance Buildings
20901 Pleasant Valley Drive
Sturgis, SD 57785

NCA Project # 884CM3015

10/31/22

Bid Documents

3.6 DEMONSTRATION AND TRAINING

- A. Provide services of manufacturer's technical representative for four hours to instruct VA Personnel in operation and maintenance of the system.
- B. Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

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**SECTION 22 05 33
HEAT TRACING FOR PLUMBING PIPING**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section describes the requirement for supplying, installing, and testing of the electric heat tracing system of the plumbing piping. Freeze protection shall be utilized for domestic water piping in areas subject to freezing temperatures.
- 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 01, GENERAL REQUIREMENTS (Major NCA Projects).
- 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 07 11, PLUMBING INSULATION.
- G. Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.
- H. Section 26 05 19, LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES.

1.3 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. The Institute of Electrical and Electronic Engineers (IEEE):
515.1-2012Standard for the Testing, Design, Installation,
and Maintenance of Electrical Resistance Trace
Heating for Commercial Applications
- C. International Code Council (ICC):
IPC-2015International Plumbing Code
- D. National Fire Protection Association (NFPA):
70-2011National Electrical Code (NEC)
- E. Underwriters' Laboratories, Inc. (UL):
508-99 (R2013)Standard for Industrial Control Equipment

1.4 SUBMITTALS

- A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 22 05 33, HEAT TRACING 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 along with the following:
 - 1. Rated capacity.
 - 2. Length of cable.
 - 3. Cable spacing.
 - 4. Electrical power requirements.
 - 5. Controls.
 - 6. Enclosures.
 - 7. Accessories.
- D. The shop drawings shall include plans, sections, details, wiring diagrams, and attachments to other work. The wiring diagrams shall include power, signal, and control wiring.
- E. Field quality control test reports shall be submitted.
- F. Operation and Maintenance data in accordance with section 1.6.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Ten years' experience in design, engineering, manufacture and support of specified system and components.
- B. Product Requirements:
 - 1. Pipe or tank tracing cable assembly shall be factory assembled, immersed in water for a minimum of 12 hours, and then tested for insulation resistance, high potential breakdown and continuity before leaving the factory.
 - 2. Factory Mutual approved heating cable that has the same wattage per lineal foot (power output), throughout its entire length.
 - 3. UL Listed, thermostat and contactor panel.
 - 4. UL Listed Control/Monitor Panel.

- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- 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. Guaranty: Warranty of Construction, FAR clause 52.246-21.

1.6 AS-BUILT DOCUMENTATION

- A. Submit manufacturer's literature and data updated to include submittal review comments, construction revisions and any equipment substitutions.
- B. Submit operation and maintenance data updated to include submittal review comments 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.

PART 2 - PRODUCTS

2.1 SELF-REGULATING PARALLEL RESISTANCE HEATING CABLES

- A. Self-regulating parallel resistance heating cables shall comply with IEEE 515.1.
- B. The heating element shall be a pair of parallel No. 16 AWG tinned or nickel coated stranded copper bus wires embedded in cross linked conductive polymer core, which varies heat output in response to temperature along its length.

Cables shall be terminated with waterproof, factory assembled non heating leads with connects at one and seal the opposite end watertight. The cable shall be capable of crossing over itself without overheating.

- C. The electrical insulating jacket shall be flame-retardant polyolefin.
- D. The cable cover shall be tinned copper, stainless steel braid ,and polyolefin outer jacket with UV inhibitor.
- E. The maximum power on operating temperature shall be 65 degrees C (150 degrees F).
- F. The maximum power off exposure temperature shall be 85 degrees C (185 degrees F).
- G. The capacities and characteristics shall be:
 - 1. Maximum heat output 26.0 W/m (8.0 W/foot).
 - 2. Pipe Diameter: varies, see plans.
 - 3. Number of parallel cables: refer to drawings.
 - 4. Spiral wrap pitch: refer to drawings.
 - 5. Volts: 110.
 - 6. Phase: single.
 - 7. Hertz: 60.
 - 8. Full load amps: refer to drawings.
 - 9. Minimum circuit ampacity: refer to drawings.
 - 10. Maximum over current Protection: refer to drawings.

2.2 CONTROLS

- A. Pipe mounting thermostats for Freeze protection shall have been a remote bulb unit with adjustable temperature range from minus 1 to 10 degrees C (34 to 50 degrees F). The thermostat shall be snap action, open-on-rise, single pole switch with minimum current rating adequate for the connected cable. The thermostat shall be remote bulb on capillary, resistance temperature device, or thermistor for direct sensing of pipe wall temperature. The control enclosure shall be corrosion resistant and waterproof.
- B. The enclosure shall be the NEMA 4X type.
- C. A minimum 30-amp contactor shall be provided to energize cable or close other contactors. Provide relay with contacts to indicate operational status, on/off, and for interface with central energy management and control system.

2.3 ACCESSORIES

- A. Cable Installation Accessories: Fiberglass tape, heat-conductive putty, cable ties, silicone end seals and splice kits, and installation clips all furnished by manufacturer, or as recommended in writing by manufacturer.
- B. Warning Labels: Shall comply with NFPA 70.
- C. Warning Tape: Continuously printed "Electrical Tracing"; vinyl, at least 0.08 mm (3 mils) thick, and with pressure-sensitive, permanent, waterproof, self-adhesive back.
 - 1. Width for Markers on Pipes with Outside Dimension, Including Insulation, Less Than 150 mm (6 inches): 19 mm (3/4 inch) minimum.
 - 2. Width for Markers on Pipes with Outside Dimension, Including Insulation, 150 mm (6 inches) or Larger: 38 mm (1-1/2 inches) minimum.

3.1 GENERAL

- A. Inspect surfaces and substrates of electric heating cables for compliance with requirements of this specification. Ensure surfaces and pipes in contact with electric heating cables are free of burrs and sharp protrusions.
- B. Notify COR if the existing substrate conditions are unsuitable for application of heating cables in accordance with manufacturer's recommendations.
- C. If the installation of the heat tracing is unsatisfactory, then the Contractor shall correct the installation at no cost or additional time to the Government.

3.2 INSTALLATION

- A. Electric heating cable shall be installed for the following applications:
 - 1. Freeze protection of plumbing piping: Self-regulating parallel-resistance heating cable.
- B. Electric heating cable shall be installed across expansion, construction, and control joints according to the manufacturer's recommendations using cable protection conduit and slack cable to allow for movement without damage to cable.

- C. The installation of electric heating cable for snow and ice melting on roofs, gutters and downspouts, and roof drain leaders shall be provided with clips furnished by the manufacturer that are compatible with roof, gutters and downspouts and roof drain leaders.
- D. Electric heating cable for pipe freeze protection shall be installed according to the following:
 - 1. Electric heating cables shall be installed after piping has been tested and before insulation is installed.
 - 2. Electric heat cables shall be installed according to IEEE 515.1
 - 3. Insulation shall be installed or applied over piping with electric cables. Refer to Section 22 07 11, PLUMBING INSULATION.
 - 4. Warning tape shall be installed on pipe insulation where piping is equipped with electric heating cables.
- E. Field adjustable switches and circuit breaker trip ranges shall be set.
- F. Heating cables including leads shall be protected from damage.
- G. Equipment shall be grounded according to Section 26 05 19, LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES.
- H. Wiring shall be connected according to Section 26 05 19, LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES.

3.3 TESTS

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Perform tests after cable installation but before application of coverings such as insulation, wall or ceiling construction, or concrete.
 - 2. Test cables for electrical continuity and insulation integrity before energizing.
 - 3. Test cables to verify rating and power input. Energize and measure voltage and current simultaneously.
- C. Repeat tests for continuity, insulation resistance, and input power after applying thermal insulation on pipe-mounted cables.
- D. If deficiency is found, Contractor shall correct all deficiencies at no cost to the Government.
- E. Prepare test and inspection reports.

- - - E N D - - -

SECTION 22 07 11
PLUMBING INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Field applied insulation for thermal efficiency and condensation control for the following:
1. Plumbing piping and equipment.
- 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, interstitial spaces, unfinished attics, crawl spaces and pipe basements are not considered finished areas.
 7. FSK: Foil-scrim-Kraft facing.
 8. Hot: Plumbing equipment or piping handling media above 40 degrees C (104 degrees F).
 9. Density: kg/m^3 - kilograms per cubic meter (Pcf - pounds per cubic foot).
 10. Thermal conductance: Heat flow rate through materials.
 - a. Flat surface: Watts per square meter (BTU per hour per square foot).
 - b. Pipe or Cylinder: Watts per linear meter (BTU per hour per linear foot) for a given outside diameter.

11. Thermal Conductivity (k): Watts per meter, per degree K (BTU - inch thickness, per hour, per square foot, per degree F temperature difference).
12. Vapor Retarder (Vapor Barrier): A material which retards the transmission (migration) of water vapor. Performance of the vapor retarder is rated in terms of permeance (perms). For the purpose of this specification, vapor retarders/vapor barriers shall have a maximum published permeance of .02 perms.
13. HWR: Hot water recirculating.
14. CW: Cold water.
16. HW: Hot water.
17. PVDC: Polyvinylidene chloride vapor retarder jacketing, white.

1.2 RELATED WORK

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS: Insulation material and insulation production method.
- D. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.
- E. Section 07 84 00, FIRESTOPPING: Mineral fiber and bond breaker behind sealant.
- F. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING: General mechanical requirements and items, which are common to more than one section of Division 22.
- G. Section 22 05 19, METERS AND GAGES FOR PLUMBING PIPING: Hot and cold water piping.
- H. Section 22 05 23, GENERAL-DUTY VALVES FOR PLUMBING PIPING: Hot and cold water piping.
- I. Section 22 05 33, HEAT TRACING FOR PLUMBING PIPING: Insulation over heating cables.
- 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 basic designation only.
- B. American Society for Testing and Materials (ASTM):
B209-2014Standard Specification for Aluminum and
Aluminum-Alloy Sheet and Plate

- C411-2011Standard Test Method for Hot-Surface
Performance of High-Temperature Thermal
Insulation
- C449-2007 (R2013)Standard Specification for Mineral Fiber
Hydraulic-Setting Thermal Insulating and
Finishing Cement
- C450-2008 (R2014)Standard Practice for Fabrication of Thermal
Insulating Fitting Covers for NPS Piping, and
Vessel Lagging
- Adjunct to C450Compilation of Tables that Provide Recommended
Dimensions for Prefab and Field Thermal
Insulating Covers, etc.
- C533-2013Standard Specification for Calcium Silicate
Block and Pipe Thermal Insulation
- C534/C534M-2014Standard Specification for Preformed Flexible
Elastomeric Cellular Thermal Insulation in
Sheet and Tubular Form
- C547-2015Standard Specification for Mineral Fiber Pipe
Insulation
- C552-2014Standard Specification for Cellular Glass
Thermal Insulation
- C553-2013Standard Specification for Mineral Fiber
Blanket Thermal Insulation for Commercial and
Industrial Applications
- C591-2013Standard Specification for Unfaced Preformed
Rigid Cellular Polyisocyanurate Thermal
Insulation
- C680-2014Standard Practice for Estimate of the Heat Gain
or Loss and the Surface Temperatures of
Insulated Flat, Cylindrical, and Spherical
Systems by Use of Computer Programs
- C612-2014Standard Specification for Mineral Fiber Block
and Board Thermal Insulation
- C1126-2014Standard Specification for Faced or Unfaced
Rigid Cellular Phenolic Thermal Insulation

- C1136-2012Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation
- C1710-2011Standard Guide for Installation of Flexible Closed Cell Preformed Insulation in Tube and Sheet Form
- D1668/D1668M-1997a (2014)e1 Standard Specification for Glass Fabrics (Woven and Treated) for Roofing and Waterproofing
- E84-2015aStandard Test Method for Surface Burning Characteristics of Building Materials
- E2231-2015Standard Practice for Specimen Preparation and Mounting of Pipe and Duct Insulation to Assess Surface Burning Characteristics
- C. Federal Specifications (Fed. Spec.):
 - L-P-535E-1979Plastic Sheet (Sheeting): Plastic Strip; Poly (Vinyl Chloride) and Poly (Vinyl Chloride - Vinyl Acetate), Rigid.
- D. International Code Council, (ICC):
 - IMC-2012International Mechanical Code
- E. Military Specifications (Mil. Spec.):
 - MIL-A-3316C (2)-1990 ...Adhesives, Fire-Resistant, Thermal Insulation
 - MIL-A-24179A (2)-1987 ..Adhesive, Flexible Unicellular-Plastic Thermal Insulation
 - MIL-PRF-19565C (1)-1988 Coating Compounds, Thermal Insulation, Fire-and Water-Resistant, Vapor-Barrier
 - MIL-C-20079H-1987Cloth, Glass; Tape, Textile Glass; and Thread, Glass and Wire-Reinforced Glass
- F. National Fire Protection Association (NFPA):
 - 90A-2015Standard for the Installation of Air-Conditioning and Ventilating Systems
- G. Underwriters Laboratories, Inc (UL):
 - 723-2008 (R2013)Standard for Test for Surface Burning Characteristics of Building Materials
 - 1887-2004 (R2013)Standard for Fire Test of Plastic Sprinkler Pipe for Visible Flame and Smoke Characteristics

- H. 3E Plus® version 4.1 Insulation Thickness Computer Program: Available from NAIMA with free download; <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 version 2018 or later 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) // Class B-5, Density 32 kg/m³ (nominal 2 pcf), $k = 0.04$ (0.27) // at 24 degrees C (75 degrees F), for use at temperatures up to 204 degrees C (400 degrees F).
- C. ASTM C547 (Pipe Fitting Insulation and Preformed Pipe Insulation), Class 1, $k = 0.037$ (0.26) at 24 degrees C (75 degrees F), for use at temperatures up to 230 degrees C (446 degrees F) with an all service vapor retarder jacket (ASJ) and with polyvinyl chloride (PVC) premolded fitting covering.

2.2 MINERAL WOOL OR REFRACTORY FIBER

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

2.3 RIGID CELLULAR PHENOLIC FOAM

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

2.4 CELLULAR GLASS CLOSED-CELL

- A. Comply with Standard ASTM C552, density 120 kg/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 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).

2.8 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.

2.9 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.

2.10 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.

2.11 FIRESTOPPING MATERIAL

- A. Other than pipe insulation, refer to Section 07 84 00, FIRESTOPPING.

2.12 FLAME AND SMOKE

- A. Unless shown otherwise all assembled systems shall meet flame spread 25 and smoke developed 50 rating as developed under ASTM and UL standards and specifications. See paragraph "Quality Assurance".

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Required pressure tests of piping joints and connections shall be completed and the work approved by the Contracting Officer's Representative (COR) for application of insulation. Surface shall be clean and dry with all foreign materials, such as dirt, oil, loose scale and rust removed.
- B. Except for specific exceptions or as noted, insulate all specified equipment, and piping (pipe, fittings, valves, accessories). Insulate each pipe individually. Do not use scrap pieces of insulation where a full length section will fit.
- C. Insulation materials shall be installed with smooth and even surfaces, with jackets and facings drawn tight and smoothly cemented down and sealed at all laps. Insulation shall be continuous through all sleeves and openings, except at fire dampers and duct heaters (NFPA 90A).

- D. Vapor retarders shall be continuous and uninterrupted throughout systems with operating temperature 15 degrees C (60 degrees F) and below. Lap and seal vapor barrier over ends and exposed edges of insulation. Anchors, supports and other metal projections through insulation on cold surfaces shall be insulated and vapor sealed for a minimum length of 150 mm (6 inches).
- E. Install vapor stops with operating temperature 15 degrees C (60 degrees F) and below at all insulation terminations on either side of valves, pumps, fittings, and equipment and particularly in straight lengths every 4.6 to 6.1 meters (approx. 15 to 20 feet) of pipe insulation. The annular space between the pipe and pipe insulation of approx. 25 mm (1 inch) in length at every vapor stop shall be sealed with appropriate vapor barrier sealant. Bio-based materials shall be utilized when possible.
- F. Construct insulation on parts of equipment such as cold water pumps and heat exchangers that must be opened periodically for maintenance or repair, so insulation can be removed and replaced without damage. Install insulation with bolted 1 mm thick (20 gage) galvanized steel or aluminum covers as complete units, or in sections, with all necessary supports, and split to coincide with flange/split of the equipment. Do not insulate over equipment nameplate data.
- G. Insulation on hot piping and equipment shall be terminated square at items not to be insulated, access openings and nameplates. Cover all exposed raw insulation with white sealer coating (caution about coating's maximum temperature limit) or jacket material.
- H. Protect all insulations outside of buildings with aluminum jacket using lock joint or other approved system for a continuous weather tight system. Access doors and other items requiring maintenance or access shall be removable and sealable.
- I. Plumbing work not to be insulated unless otherwise noted:
 - 1. Piping and valves of fire protection system.
 - 2. Chromium plated brass piping.
 - 3. Water piping in contact with earth.
 - 4. Distilled water piping.

- J. Apply insulation materials subject to the manufacturer's recommended temperature limits. Apply adhesives, mastic and coatings at the manufacturer's recommended minimum wet or dry film thickness. Bio-based materials shall be utilized when possible.
- K. Elbows, flanges and other fittings shall be insulated with the same material as is used on the pipe straights. Use of polyurethane or polyisocyanurate spray-foam to fill a PVC elbow jacket is prohibited on cold applications.
- L. Firestop Pipe insulation:
1. Provide firestopping insulation at fire and smoke barriers through penetrations. Firestopping insulation shall be UL listed as defined in Section 07 84 00, FIRESTOPPING.
 2. Pipe penetrations requiring fire stop insulation including, but not limited to the following:
 - a. Pipe risers through floors
 - b. Pipe chase walls and floors
 - c. Smoke partitions
 - d. Fire partitions
 - e. Hourly rated walls
- M. Freeze protection of above grade outdoor piping (over heat tracing tape): 20 mm (3/4 inch) thick insulation, for all pipe sizes 75 mm (3 inches) and smaller and 25 mm (1 inch) thick insulation for larger pipes. Provide metal jackets for all pipe insulations. Provide freeze protection for cold water make-up piping and equipment where indicated on the drawings as described in Section 23 21 13, HYDRONIC PIPING (electrical heat tracing systems).
- N. Provide vapor barrier systems as follows:
1. All interior piping conveying fluids exposed to outdoor air (i.e. in attics, ventilated (not air conditioned) spaces, etc.)/below ambient air temperature in high humidity locations.
- 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. Waste piping from electric water coolers and icemakers to drainage system.
 - c. Waste piping located above basement floor from ice making and film developing equipment and air handling units, from equipment (including trap) to main vertical waste pipe.
 - d. MRI quench vent piping.
 - e. Bedpan sanitizer atmospheric vent
 - f. Reagent grade water piping.
 - g. Cold water piping, exterior only.

D. Cellular Glass Insulation:

1. Pipe and tubing, covering nominal thickness in millimeters and inches as specified in the schedule at the end of this section.

2. Underground piping other than or in lieu of that specified in Section 22 11 00, FACILITY WATER DISTRIBUTION: Type II, factory jacketed with a 3 mm laminate jacketing consisting of 3000 mm x 3000 mm (10 ft x 10 ft) asphalt impregnated glass fabric, bituminous mastic and outside protective plastic film.
 - a. 75 mm (3 inches) thick for hot water piping.
 - b. As scheduled at the end of this section for chilled water piping.
 - c. Underground piping: Apply insulation with joints tightly butted. Seal longitudinal self-sealing lap. Use field fabricated or factory made fittings. Seal butt joints and fitting with jacketing as recommended by the insulation manufacturer. Use 100 mm (4 inch) wide strips to seal butt joints.
 - d. Provide expansion chambers for pipe loops, anchors and wall penetrations as recommended by the insulation manufacturer.
 - e. Underground insulation shall be inspected and approved by the COR as follows:
 - 1) Insulation in place before coating.
 - 2) After coating.
 - f. Sand bed and backfill: Minimum 75 mm (3 inches) all around insulated pipe or tank, applied after coating has dried.
 - g. All piping up to 482 degrees C (900 degrees F) requiring protection from physical heavy contact/abuse including in mechanical rooms and exposures to the public.
 3. Cold equipment: 50 mm (2 inch) thick insulation faced with ASJ.
- E. 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) | Flexible Elastomeric Cellular Thermal (Above ground piping only) | 38 (1.5) | 38 (1.5) | 50 (2.0) | 50 (2.0) |
| 38-60 degrees C (100-140 degrees F) (Domestic Hot Water Supply and Return) | Cellular Glass Thermal | 38 (1.5) | 38 (1.5) | 50 (2.0) | 50 (2.0) |
| (4-15 degrees C (40-60 degrees F) Domestic cold water piping | Flexible Elastomeric Cellular Thermal (Above | 25 (1.0) | 25 (1.0) | 25 (1.0) | 25 (1.0) |

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| 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 |
| | ground piping only) | | | | |
| 4-15 degrees C (40-60 degrees F) (Domestic Cold water piping) | Cellular Glass Thermal | 38 (1.5) | 38 (1.5) | 38 (1.5) | 38 (1.5) |

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SECTION 22 08 00
COMMISSIONING OF PLUMBING SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The requirements of this Section apply to all sections of Division 22.
- B. This project will have selected building systems commissioned. The complete list of equipment and systems to be commissioned are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. The commissioning process, which the Contractor is responsible to execute, is defined in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. A Commissioning Agent (CxA) appointed by the Department of Veterans Affairs will manage the commissioning process.

1.2 RELATED WORK

- A. Section 01 00 02 GENERAL REQUIREMENTS (MINOR NCA PROJECTS)
- B. Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.
- C. Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

1.3 SUMMARY

- A. This Section includes requirements for commissioning plumbing systems, subsystems and equipment. This Section supplements the general requirements specified in Section 01 91 00 General Commissioning Requirements.
- B. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for more specifics regarding processes and procedures as well as roles and responsibilities for all Commissioning Team members.

1.4 DEFINITIONS

- A. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for definitions.

1.5 COMMISSIONED SYSTEMS

- A. Commissioning of a system or systems specified in Division 22 is part of the construction process. Documentation and testing of these systems, as well as training of the VA's Operation and Maintenance personnel in accordance with the requirements of Section 01 91 00 and of Division 22, is required in cooperation with the VA and the Commissioning Agent.
- B. The Plumbing systems commissioning will include the systems listed in Section 01 91 00 General Commissioning Requirements:

1.6 SUBMITTALS

- A. The commissioning process requires review of selected Submittals. The Commissioning Agent will provide a list of submittals that will be reviewed by the Commissioning Agent. This list will be reviewed and approved by the VA prior to forwarding to the Contractor. Refer to Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, and SAMPLES for further details.
- B. The commissioning process requires Submittal review simultaneously with engineering review. Specific submittal requirements related to the commissioning process are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 CONSTRUCTION INSPECTIONS

- A. Commissioning of the Building Plumbing Systems will require inspection of individual elements of the Plumbing construction throughout the construction period. The Contractor shall coordinate with the Commissioning Agent in accordance with Section 01 91 00 and the Commissioning Plan to schedule inspections as required to support the commissioning process.

3.2 PRE-FUNCTIONAL CHECKLISTS

- A. The Contractor shall complete Pre-Functional Checklists to verify systems, subsystems, and equipment installation is complete and systems are ready for Systems Functional Performance Testing. The Commissioning Agent will prepare Pre-Functional Checklists to be used to document equipment installation. The Contractor shall complete the checklists. Completed checklists shall be submitted to the VA and to the Commissioning Agent for review. The Commissioning Agent may spot check a sample of completed checklists. If the Commissioning Agent determines that the information provided on the checklist is not accurate, the Commissioning Agent will return the marked-up checklist to the Contractor for correction and resubmission. If the Commissioning Agent determines that a significant number of completed checklists for similar equipment are not accurate, the Commissioning Agent will select a broader sample of checklists for review.

If the Commissioning Agent determines that a significant number of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and resubmission. Refer to SECTION 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for Pre-Functional Checklists, Equipment Startup Reports, and other commissioning documents.

3.3 CONTRACTORS TESTS

- A. Contractor tests as required by other sections of Division 22 shall be scheduled and documented in accordance with Section 01 00 00 GENERAL REQUIREMENTS. . All testing shall be incorporated into the project schedule. Contractor shall provide no less than 7 calendar days' notice of testing. The Commissioning Agent will witness selected Contractor tests at the sole discretion of the Commissioning Agent. Contractor tests shall be completed prior to scheduling Systems Functional Performance Testing.

3.4 SYSTEMS FUNCTIONAL PERFORMANCE TESTING:

- A. The Commissioning Process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions. The Commissioning Agent will prepare detailed Systems Functional Performance Test procedures for review and approval by the Resident Engineer. The Contractor shall review and comment on the tests prior to approval. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The Commissioning Agent will witness and document the testing. The Contractor shall sign the test reports to verify tests were performed. See Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS, for additional details.

3.5 TRAINING OF VA PERSONNEL

- A. Training of the VA operation and maintenance personnel is required in cooperation with the Resident Engineer and Commissioning Agent. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. Contractor shall submit training agendas and trainer resumes in accordance with the requirements of Section 01 91 00.

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The instruction shall be scheduled in coordination with the Resident Engineer after submission and approval of formal training plans. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS and Division 22 Sections for additional Contractor training requirements.

----- END -----

**SECTION 22 11 00
FACILITY WATER DISTRIBUTION**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Domestic water systems, including piping, equipment and all necessary accessories as designated in this section.
- B. A complete listing of all acronyms and abbreviations are included in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

1.2 RELATED WORK

- A. Section 01 00 02, GENERAL REQUIREMENTS (Minor NCA Projects.
- 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):
 - A13.1-2007 (R2013)Scheme for Identification of Piping Systems
 - B16.3-2011Malleable Iron Threaded Fittings: Classes 150 and 300
 - B16.9-2012Factory-Made Wrought Buttwelding Fittings
 - B16.11-2011Forged Fittings, Socket-Welding and Threaded
 - B16.12-2009 (R2014)Cast Iron Threaded Drainage Fittings
 - B16.15-2013Cast Copper Alloy Threaded Fittings: Classes 125 and 250
 - B16.18-2012Cast Copper Alloy Solder Joint Pressure Fittings

- B16.22-2013Wrought Copper and Copper Alloy Solder-Joint
Pressure Fittings
- B16.24-2011Cast Copper Alloy Pipe Flanges and Flanged
Fittings: Classes 150, 300, 600, 900, 1500, and
2500
- B16.51-2013Copper and Copper Alloy Press-Connect Fittings
ASME Boiler and Pressure Vessel Code -
BPVC Section IX-2015 ...Welding, Brazing, and Fusing Qualifications
- C. American Society of Sanitary Engineers (ASSE):
 - 1010-2004Performance 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-2012Standard Specification for Pipe, Steel, Black
and Hot-Dipped, Zinc-Coated, Welded and
Seamless
 - A183-2014Standard Specification for Carbon Steel Track
Bolts and Nuts
 - A269/A269M-2014e1Standard Specification for Seamless and Welded
Austenitic Stainless-Steel Tubing for General
Service
 - A312/A312M-2015Standard Specification for Seamless, Welded,
and Heavily Cold Worked Austenitic Stainless-
Steel Pipes
 - A403/A403M-2014Standard Specification for Wrought Austenitic
Stainless Steel Piping Fittings
 - A536-1984 (R2014)Standard Specification for Ductile Iron
Castings
 - A733-2013Standard Specification for Welded and Seamless
Carbon Steel and Austenitic Stainless Steel
Pipe Nipples
 - B32-2008 (R2014)Standard Specification for Solder Metal
 - B43-2014Standard Specification for Seamless Red Brass
Pipe, Standard Sizes

- B61-2008 (R2013)Standard Specification for Steam or Valve
Bronze Castings
- B62-2009Standard Specification for Composition Bronze
or Ounce Metal Castings
- B75/B75M-2011Standard Specification for Seamless Copper Tube
- B88-2014Standard Specification for Seamless Copper
Water Tube
- B584-2014Standard Specification for Copper Alloy Sand
Castings for General Applications
- B687-1999 (R2011)Standard Specification for Brass, Copper, and
Chromium-Plated Pipe Nipples
- C919-2012Standard Practice for Use of Sealants in
Acoustical Applications
- D1785-2012Standard Specification for Poly (Vinyl
Chloride) (PVC) Plastic Pipe, Schedules 40, 80,
and 120
- D2000-2012Standard Classification System for Rubber
Products in Automotive Applications
- D2564-2012Standard Specification for Solvent Cements for
Poly (Vinyl Chloride) (PVC) Plastic Piping
Systems
- D2657-2007Standard Practice for Heat Fusion Joining of
Polyolefin Pipe and Fittings
- D2855-1996 (R2010)Standard Practice for Making Solvent-Cemented
Joints with Poly (Vinyl Chloride) (PVC) Pipe
and Fittings
- D4101-2014Standard Specification for Polypropylene
Injection and Extrusion Materials
- E1120-2008Standard Specification for Liquid Chlorine
- E1229-2008Standard Specification for Calcium Hypochlorite
- F2389-2010Standard Specification for Pressure-rated
Polypropylene (PP) Piping Systems
- F2620-2013Standard Practice for Heat Fusion Joining of
Polyethylene Pipe and Fittings

- F2769-2014Standard Specification for Polyethylene of
Raised Temperature (PE-RT) Plastic Hot and
Cold-Water Tubing and Distribution Systems
- E. American Water Works Association (AWWA):
 - C110-2012Ductile-Iron and Gray-Iron Fittings
 - C151-2009Ductile Iron Pipe, Centrifugally Cast
 - C153-2011Ductile-Iron Compact Fittings
 - C203-2008Coal-Tar Protective Coatings and Linings for
Steel Water Pipelines - Enamel and Tape - Hot
Applied
 - C213-2007Fusion-Bonded Epoxy Coating for the Interior
and Exterior of Steel Water Pipelines
 - C651-2014Disinfecting Water Mains
- F. American Welding Society (AWS):
 - A5.8M/A5.8-2011-AMD1 ...Specification for Filler Metals for Brazing and
Braze Welding
- G. International Code Council (ICC):
 - IPC-2015International Plumbing Code
- H. Manufacturers Specification Society (MSS):
 - SP-58-2009Pipe Hangers and Supports - Materials, Design,
Manufacture, Selection, Application, and
Installation
 - SP-72-2010aBall Valves with Flanged or Butt-Welding Ends
for General Service
 - SP-110-2010Ball Valves Threaded, Socket-Welding, Solder
Joint, Grooved and Flared Ends
- I. NSF International (NSF):
 - 14-2015Plastics Piping System Components and Related
Materials
 - 61-2014aDrinking Water System Components - Health
Effects
 - 372-2011Drinking Water System Components - Lead Content
- J. Plumbing and Drainage Institute (PDI):
 - PDI-WH 201-2010Water Hammer Arrestors
- K. Department of Veterans Affairs:
 - H-18-8-2013Seismic Design Handbook

1.4 SUBMITTALS

- A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 22 11 00, FACILITY WATER DISTRIBUTIONS", with applicable paragraph identification.
- C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.
 - 1. All items listed in Part 2 - Products.
- D. Complete operating and maintenance manuals including wiring diagrams, technical data sheets and information for ordering replacement parts:
 - 1. Include complete list indicating all components of the systems.
 - 2. Include complete diagrams of the internal wiring for each item of equipment.
 - 3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.
- E. Completed System Readiness Checklist provided by the CxA and completed by the Contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.
- F. Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

1.5 QUALITY ASSURANCE

- A. A certificate shall be submitted prior to welding of steel piping showing the Welder's certification. The certificate shall be current and no more than one year old. Welder's qualifications shall be in accordance with ASME BPVC Section IX.
- B. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be by the same manufacturer as the groove components.

- C. All pipe, couplings, fittings, and specialties shall bear the identification of the manufacturer and any markings required by the applicable referenced standards.
- D. Bio-Based Materials: For products designated by the USDA's Bio-Preferred Program, provide products that meet or exceed USDA recommendations for bio-based content, so long as products meet all performance requirements in this specifications section. For more information regarding the product categories covered by the Bio-Preferred Program, visit <http://www.biopreferred.gov>.
- E. Guaranty: Warranty of Construction, FAR clause 52.246-21.

1.6 SPARE PARTS

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

1.7 AS-BUILT DOCUMENTATION

- A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.
- B. Submit operation and maintenance data updated to include submittal review comments, substitutions and construction revisions shall be in electronic version on compact disc or DVD. 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 2018 or later provided on compact disk or DVD.

Should the installing contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement.

- D. Certification documentation shall be provided to COR 10 working days prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and certificate if applicable that all results of tests were within limits specified. If a certificate is not available, all documentation shall be on the Certifier's letterhead.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Material or equipment containing a weighted average of greater than 0.25 percent lead are prohibited in any potable water system intended for human consumption, and shall be certified in accordance with NSF 61 or NSF 372. Endpoint devices used to dispense water for drinking shall meet the requirements of NSF 61, Section 9.
- B. Plastic pipe, fittings, and solvent cement shall meet NSF 14 and shall be NSF listed for the service intended.

2.2 UNDERGROUND WATER SERVICE CONNECTIONS TO BUILDINGS

- A. From inside face of exterior wall to a distance of 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 10 shall be used.
- B. Fittings for Copper Tube:
 - 1. Wrought copper or bronze castings conforming to ASME B16.18 and B16.22. Unions shall be bronze, MSS SP-72, MSS SP-110, solder or braze joints. Use 95/5 tin and antimony for all soldered joints.
 - 2. Grooved fittings, 50 to 150 mm (2 to 6 inch) wrought copper ASTM B75/B75M C12200, 125 to 150 mm (5 to 6 inch) bronze casting ASTM B584, C84400. Mechanical grooved couplings, 2070 kPa (300 psig) minimum ductile iron, ASTM A536 Grade 448-310-12 (Grade 65-45-12), or malleable iron, ASTM A47/A47M Grade 22410 (Grade 32510) housing, with EPDM gasket, steel track head bolts, ASTM A183, coated with copper colored alkyd enamel.
 - 3. Mechanical press-connect fittings for copper pipe and tube shall conform to the material and sizing requirements of ASME B16.51, NSF 61 approved, 50 mm (2 inch) size and smaller mechanical press-connect fittings, double pressed type, with EPDM (ethylene propylene diene monomer) non-toxic synthetic rubber sealing elements and un-pressed fitting identification feature.

4. 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 10 conforming to ASTM A403/A403M. Segmentally fabricated fittings are not allowed. Mechanical grooved couplings, ductile iron, 4138 kPa (600 psig), ASTM A536 Grade 448-310-12 (Grade 65-45-12), or malleable iron, ASTM A47/A47M Grade 22410 (Grade 32510) housing, with EPDM gasket, steel track head bolts, ASTM A183, coated with copper colored alkyd enamel.

D. Adapters: Provide adapters for joining pipe or tubing with dissimilar end connections.

E. Solder: ASTM B32 alloy type Sb5, HA or HB. Provide non-corrosive flux.

F. Brazing alloy: AWS A5.8M/A5.8, brazing filler metals shall be BCuP series for copper to copper joints and BAg series for copper to steel joints.

2.4 EXPOSED WATER PIPING

A. Finished Room: Use full iron pipe size chrome plated brass piping for exposed water piping connecting fixtures, casework, cabinets, equipment and reagent racks when not concealed by apron including those furnished by the Government or specified in other sections.

1. Pipe: ASTM B43, standard weight.
2. Fittings: ASME B16.15 cast bronze threaded fittings with chrome finish.
3. Nipples: ASTM B687, Chromium-plated.

4. Unions: MSS SP-72, MSS SP-110, brass or bronze with chrome finish. Unions 65 mm (2-1/2 inches) and larger shall be flange type with approved gaskets.

B. Unfinished Rooms, Mechanical Rooms: 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 WATERPOOFING

A. Provide at points where pipes pass through membrane waterproofed floors or walls in contact with earth.

B. Floors: Provide cast iron stack sleeve with flashing device and an underdeck clamp. After stack is passed through sleeve, provide a waterproofed caulked joint at top hub.

C. Walls: See detail shown on drawings.

2.7 STRAINERS

A. Provide on high pressure side of pressure reducing valves, on suction side of pumps, on inlet side of indicating and control instruments and equipment subject to sediment damage and where shown on drawings. Strainer element shall be removable without disconnection of piping.

B. Water: Basket or "Y" type with easily removable cover and brass strainer basket.

C. Body: Less than 75 mm (3 inches), brass or bronze; 75 mm (3 inches) and greater, cast iron or semi-steel.

2.8 DIELECTRIC FITTINGS

A. Provide dielectric couplings or unions between pipes of dissimilar metals.

2.9 STERILIZATION CHEMICALS

A. Hypochlorite: ASTM E1120.

B. Liquid Chlorine: ASTM E1229.

2.10 WATER HAMMER ARRESTER

A. Closed copper tube chamber with permanently sealed 413 kPa (60 psig) air charge above a Double O-ring piston. Two high heat Buna-N O-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 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.

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. Fire-stopping: 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 fire-stopping 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.

8. Mechanical press-connect fitting connections shall be made in accordance with the manufacturer's installation instructions. The tubing shall be fully inserted into the fitting and the tubing marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing to assure the tubing is fully engaged (inserted) in the fitting. Ensure the tube is completely inserted to the fitting stop (appropriate depth) and squared with the fitting prior to applying the pressing jaws onto the fitting. The joints shall be pressed using the tool(s) approved by the manufacturer. Minimum distance between fittings shall be in accordance with the manufacturer's requirements. When the pressing cycle is complete, visually inspect the joint to ensure the tube has remained fully inserted, as evidenced by the visible insertion mark.

B. Domestic Water piping shall conform to the following:

1. Grade all lines to facilitate drainage. Provide drain valves at bottom of risers and all low points in system. Design domestic hot water circulating lines with no traps.
2. Connect branch lines at bottom of main serving fixtures below and pitch down so that main may be drained through fixture. Connect branch lines to top of main serving only fixtures located on floor above.

3.2 TESTS

- A. General: Test system either in its entirety or in sections. Submit testing plan to COR 10 working days prior to test date.
- B. Potable Water System: Test after installation of piping and domestic water heaters, but before piping is concealed, before covering is applied, and before plumbing fixtures are connected. Fill systems with water and maintain hydrostatic pressure of 1035 kPa (150 psig) gage for two hours. No decrease in pressure is allowed. Provide a pressure gage with a shutoff and bleeder valve at the highest point of the piping being tested. Pressure gauge shall have 1 psig increments.
- C. Re-agent Grade Water Systems: Fill system with water and maintain hydrostatic pressure of 1380 kPa (200 psig) gage during inspection and prove tight.
- D. All Other Piping Tests: Test new installed piping under 1-1/2 times actual operating conditions and prove tight.
- E. The test pressure shall hold for the minimum time duration required by the applicable plumbing code or authority having jurisdiction.

3.3 STERILIZATION

- A. After tests have been successfully completed, thoroughly flush and sterilize the interior domestic water distribution system in accordance with AWWA C651.
- B. Use liquid chlorine or hypochlorite for sterilization.

3.4 COMMISSIONING

- A. Provide commissioning documentation in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.
- B. Components provided under this section of the specification will be tested as part of a larger system.

3.5 DEMONSTRATION AND TRAINING

- A. Provide services of manufacturer's technical representative for four hours to instruct VA Personnel in operation and maintenance of the system.
- B. Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

- - - E N D - - -

**SECTION 22 11 00
FACILITY WATER DISTRIBUTION**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Hot water circulating pump, hot water recirculation pump, and domestic water pressure booster system.
- 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 02, GENERAL REQUIREMENTS (Minor NCA Projects).
- 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 05 12, GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT.
- G. Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS: Requirements for commissioning, systems readiness checklist, and training.
- H. Section 26 29 11, MOTOR CONTROLLERS.

1.3 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society of Mechanical Engineers (ASME):
 - ASME Boiler and Pressure Code -
 - BPVC Section VIII-1-2015 Rules for Construction of Pressure Vessels, Division 1
 - BPVC Section VIII-2-2015 Rules for Construction of Pressure Vessels, Division 2-Alternative Rules
- C. American Society for Testing and Materials (ASTM):
 - A48/A48M-2003 (R2012) ..Standard Specification for Gray Iron Castings
 - B584-2014Standard Specification for Copper Alloy Sand Castings for General Applications
- D. International Code Council (ICC)
 - IPC-2015International Plumbing Code
- E. National Electrical Manufacturers Association (NEMA):

ICS 6-1993 (R2006)Industrial Control and Systems: Enclosures
250-2014Enclosures for Electrical Equipment (1000 Volts
Maximum)

F. NSF International (NSF)

61-2014aDrinking Water System Components - Health
Effects

372-2011Drinking Water System Components - Lead Content

G. Underwriters' Laboratories, Inc. (UL):

508-1999 (R2013)Standards for Industrial Control Equipment

778-2010 (R2014)Standard for Motor-Operated Water Pumps

1.4 SUBMITTALS

- A. 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 23, DOMESTIC WATER PUMPS", with applicable paragraph identification.
- C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.
 - 1. Pump:
 - a. Manufacturer and model.
 - b. Operating speed.
 - c. Capacity.
 - d. Characteristic performance curves.
 - 2. Motor:
 - a. Manufacturer, frame and type.
 - b. Speed.
 - c. Current Characteristics.
 - d. Efficiency.
- D. Certificate of shop test for domestic water booster system. Provide certified performance curves.
- E. Certified copies of all the factory and construction site test data sheets and reports.

- 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 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.
- H. Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

1.5 QUALITY ASSURANCE

- A. General:
 - 1. UL Compliance: Comply with UL 778 for motor-operated water pumps.
 - 2. Design Criteria:
 - a. Pump sizes, capacities, pressures, operating characteristics and efficiency shall be as scheduled.
 - b. Head capacity curves shall slope up to maximum head at shut off. Select pumps near the midrange of the curve, and near the point of maximum efficiency, without approaching the pump curve end point and possible cavitation and unstable operation. Select pumps for open systems so that required net positive suction head (NPSHR) does not exceed the net positive head available (NPSHA).
 - c. Pump Driver: Furnish with pump. Size shall be non-overloading at any point on the head capacity curve, including in a parallel or series pumping installation with one pump in operation.
 - d. Provide all pumps with motors, impellers, drive assemblies, bearings, coupling guard and other accessories specified. Statically and dynamically balance all rotating parts.

- e. Furnish each pump and motor with a nameplate giving the manufacturers name, serial number of pump, capacity in GPM and head in feet at design condition, horsepower, voltage, frequency, speed and full load current and motor efficiency.
 - f. Test all pumps before shipment. The manufacturer shall certify all pump ratings.
 - g. After completion of balancing, provide replacement of impellers or trim impellers to provide specified flow at actual pumping head, as installed.
- B. Hot Water Circulating and Recirculating Pumps: Components shall be assembled by a single manufacturer and the pump motor assembly shall be the standard cataloged product of the manufacturer.
- C. Bio-Based Materials: For products designated by the USDA's Bio-Preferred Program, provide products that meet or exceed USDA recommendations for bio-based content, so long as products meet all performance requirements in this specifications section. For more information regarding the product categories covered by the Bio-Preferred Program, visit <http://www.biopreferred.gov>.
- D. Guaranty: Warranty of Construction, FAR clause 52.246-21.

1.6 AS-BUILT DOCUMENTATION

- A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.
- B. Submit operation and maintenance data updated to include submittal review comments, substitutions and construction revisions shall be in electronic version on compact disc or DVD inserted into a three ring binder. All aspects of system operation and maintenance procedures, including piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices such as damper and door closure interlocks shall be included. A List of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.

- C. The installing contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. As-built drawings are to be provided, and a copy of them in Auto-CAD version 2018 or later provided on compact disk or DVD. Should the installing contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement.
- D. Certification documentation shall be provided to COR 10 working days prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and certification that all results of tests were within limits specified.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Material or equipment containing a weighted average of greater than 0.25 percent lead are prohibited in any potable water system intended for human consumption, and shall be certified in accordance with NSF 61 or NSF 372.

2.2 HOT WATER RECIRCULATING PUMP

- A. General:
 - 1. Centrifugal, single stage, pump. Driver shall be electric motor, close coupled or connected by flexible or magnetic coupling. Pump for hot water system shall be designed for quiet, trouble-free operation at a minimum of 82 degrees C (180 degrees F) water service and 1,035 kPa (150 psig).
 - 2. Mounting shall be in-line, vertical or horizontal as indicated below
 - 3. Stamped or engraved stainless steel nameplate.
 - 4. Motors: Maximum 40 degrees C (104 degrees F) ambient temperature rise, drip-proof, for operation with current, voltage, phase and cycle shown in schedule on Electrical drawings, conforming to NEMA Type 4. Motors shall be equipped with thermal overload protection. When motor has cooled down it shall re-start automatically if the operating control has been left on and the system requires pump to start.

5. Pump shall operate continuously with on-off switch, or with an HOA switch for automatically controlled pumps, for manual shut down. In the inlet and outlet piping of the pump, shutoff valves shall be installed to permit service to the pump, strainer, and check valve without draining the system.

6. A check valve shall be installed in the pump discharge piping immediately downstream of the pump. A strainer with drain valve and removable strainer screen or basket shall be installed immediately upstream of the pump.

B. Horizontal, Wet-Rotor Circulators:

1. Maintenance free, close-coupled pump and motor with maximum 3,300 rpm rotational speed.

2. Bronze body construction with ceramic shaft, plastic impeller, fluid lubricated bearings, no mechanical seal, and soldered joint connections. Pump shall be capable of pumping the capacity scheduled on drawings .

3. Bearings: Carbon type.

3.1 STARTUP AND TESTING

A. Make tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.

B. System Test: After installation is completed provide an operational test of the completed system including flow rates, pressure compliance, alarms and all control functions.

C. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.

D. The CxA will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and CxA. Contractor shall provide a minimum of 10 working days prior to startup and testing.

3.2 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

Black Hills National Cemetery
Renovate and Expand Administration and Maintenance Buildings
20901 Pleasant Valley Drive
Sturgis, SD 57785

NCA Project # 884CM3015
10/31/22
Bid Documents

- B. Components provided under this section of the specification will be tested as part of a larger system.

3.3 DEMONSTRATION AND TRAINING

- A. Provide services of manufacturer's technical representative for four hours to instruct VA Personnel in operation and maintenance of the system.
- B. Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

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**SECTION 22 13 00
FACILITY SANITARY AND VENT PIPING**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section pertains to sanitary sewer and vent systems, including piping, equipment and all necessary accessories as designated in this section.
- B. A complete listing of all acronyms and abbreviations are included in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

1.2 RELATED WORK

- A. Section 01 00 02, GENERAL REQUIREMENTS (Minor NCA Projects).
- 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.
- I. Section 22 07 11, PLUMBING INSULATION.
- J. Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS: Requirements for commissioning, systems readiness checklist, and training.
- 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.
- B. American Society of Mechanical Engineers (ASME):
 - A13.1-2007Scheme for the Identification of Piping Systems
 - A112.36.2M-1991(R 2012) Cleanouts
 - A112.6.3-2001(R2007) ...Standard for Floor and Trench Drains
 - B1.20.1-2013Pipe Threads, General Purpose (Inch)
 - B16.1-2010Gray Iron Pipe Flanges and Flanged Fittings

- B16.4 2011Standard for Grey Iron Threaded Fittings
Classes 125 and 250
- B16.15-2013Cast Copper Alloy Threaded Fittings, Classes
125 and 250
- B16.18-2012Cast Copper Alloy Solder Joint Pressure
Fittings
- B16.21-2011Nonmetallic Flat Gaskets for Pipe Flanges
- B16.22-2013Wrought Copper and Copper Alloy Solder-Joint
Pressure Fittings
- B16.23-2011Cast Copper Alloy Solder Joint Drainage
Fittings: DWV
- B16.24-2001 (R2006)Cast Copper Alloy Pipe Flanges and Flanged
Fittings
- B16.29-2012Wrought Copper and Wrought Copper Alloy Solder-
Joint Drainage Fittings: DWV
- B16.39-2009Malleable Iron Threaded Pipe Unions Classes
150, 250, and 300
- B18.2.1-2012Square, 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):
 - 1001-2008Performance Requirements for Atmospheric Type
Vacuum Breakers
 - 1018-2001Performance Requirements for Trap Seal Primer
Valves - Potable Water Supplied
 - 1044-2001Performance Requirements for Trap Seal Primer
Devices - Drainage Types and Electronic Design
Types
 - 1079-2012Performance Requirements for Dielectric Pipe
Unions
- D. American Society for Testing and Materials (ASTM):
 - A53/A53M-2012Standard Specification for Pipe, Steel, Black
and Hot-Dipped, Zinc-coated, Welded and
Seamless
 - A74-2013aStandard Specification for Cast Iron Soil Pipe
and Fittings

- A888-2013aStandard Specification for Hubless Cast Iron
Soil Pipe and Fittings for Sanitary and Storm
Drain, Waste, and Vent Piping Applications
- B32-2008Standard Specification for Solder Metal
- B43-2009Standard Specification for Seamless Red Brass
Pipe, Standard Sizes
- B75-2011Standard Specification for Seamless Copper Tube
- B88-2009Standard Specification for Seamless Copper
Water Tube
- B306-2013Standard Specification for Copper Drainage Tube
(DWV)
- B584-2013Standard Specification for Copper Alloy Sand
Castings for General Applications
- B687-1999 (R 2011)Standard Specification for Brass, Copper, and
Chromium-Plated Pipe Nipples
- B813-2010Standard Specification for Liquid and Paste
Fluxes for Soldering of Copper and Copper Alloy
Tube
- B828-2002 (R 2010)Standard Practice for Making Capillary Joints
by Soldering of Copper and Copper Alloy Tube
and Fittings
- C564-2012Standard Specification for Rubber Gaskets for
Cast Iron Soil Pipe and Fittings
- D1785-2012Standard Specification for Poly(Vinyl Chloride)
(PVC) Plastic Pipe, Schedules 40, 80, and 120
- D2321-2011Standard Practice for Underground Installation
of Thermoplastic Pipe for Sewers and Other
Gravity-Flow Applications
- D2564-2012Standard Specification for Solvent Cements for
Poly(Vinyl Chloride) (PVC) Plastic Piping
Systems
- D2665-2012Standard Specification for Poly(Vinyl Chloride)
(PVC) Plastic Drain, Waste, and Vent Pipe and
Fittings

- D2855-1996 (R 2010)Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
- D5926-2011Standard Specification for Poly(Vinyl Chloride) (PVC) Gaskets for Drain, Waste, and Vent (DWV), Sewer, Sanitary, and Storm Plumbing Systems
- F402-2005 (R 2012)Standard Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings
- F477-2010Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
- F1545-1997 (R 2009)Standard Specification for Plastic-Lined Ferrous Metal Pipe, Fittings, and Flanges
- E. Cast Iron Soil Pipe Institute (CISPI):
 - 2006Cast Iron Soil Pipe and Fittings Handbook
 - 301-2012Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
 - 310-2012Specification 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):
 - A4015Copper Tube Handbook
- G. International Code Council (ICC):
 - IPC-2015International Plumbing Code
- H. Manufacturers Standardization Society (MSS):
 - SP-123-2013Non-Ferrous Threaded and Solder-Joint Unions for Use with Copper Water Tube I.
- I. National Fire Protection Association (NFPA):
 - 70-2014National Electrical Code (NEC)
- J. Plumbing and Drainage Institute (PDI):
 - WH-201 (R 2010)Water Hammer Arrestors Standard
- K. Underwriters' Laboratories, Inc. (UL):
 - 508-99 (R2013)Standard for Industrial Control Equipment

1.4 SUBMITTALS

- A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 22 13 00, FACILITY SANITARY AND VENT PIPING", with applicable paragraph identification.
- C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.
 - 1. Piping.
 - 2. Floor Drains.
 - 3. Cleanouts.
 - 4. Trap Seal Protection
 - 5. 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 shall be submitted.

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

1.6 AS-BUILT DOCUMENTATION

- A. The installing contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. As-built drawings are to be provided, and a copy of them on Auto-Cad version 2018 or later 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.

- B. Certification documentation shall be provided prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and a certification that all results of tests were within limits specified.

PART 2 - PRODUCTS

2.1 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.

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. Pipe: The pipe shall meet ASTM B43, regular weight.
 2. Fittings: The fittings shall conform to ASME B16.15
 3. Nipples: Nipples shall conform to ASTM B687, Chromium-plated.
 4. Unions: 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 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 squaretop covers recessed for tile insertion. In the carpeted areas, carpet cleanout markers shall be provided. Two-way cleanouts shall be provided where indicated on drawings 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 is prohibited. Double drainage pattern floor drains shall have integral seepage pan for embedding into floor construction, and weep holes to provide adequate drainage from pan to drain pipe. For drains not installed in connection with a waterproof membrane, a .45 kg (16-ounce) soft copper 1.1 to 1.8 Kg (2.5 to 4 lbs.) flashing membrane, 600 mm (24 inches) square or another approved waterproof membrane shall be provided.
- B. Type 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. Grate shall have vandal-proof screws.
- C. Type W (FD-W) Open Sight Drains (OSDs) for clear water wastes only:
1. 1. OSD's shall be the cast iron open hub type.
 2. 2. A cast iron drain standpipe shall be utilized for equipment with a high rate of discharge.

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 ASSE Standard 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 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 waterproof caulked joint shall be provided at the top hub.

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 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 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 cost to the Government.

3.2 JOINT CONSTRUCTION

- A. Hub and spigot, cast iron piping with gasket joints shall be joined in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Hub and spigot, cast iron piping with calked joints shall be joined in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
- C. Hubless or No-hub, cast iron piping shall be joined in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless piping coupling joints.
- D. For threaded joints, thread pipe with tapered pipe threads according to ASME B1.20.1. The threads shall be cut full and clean using sharp disc cutters. Threaded pipe ends shall be reamed to remove burrs and restored to full pipe inside diameter. Pipe fittings and valves shall be joined as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is required by the pipe service.
 - 2. Pipe sections with damaged threads shall be replaced with new sections of pipe.

- E. Copper tube and fittings with soldered joints shall be joined according to ASTM B828. A water flushable, lead free flux conforming to ASTM B813 and a lead free alloy solder conforming to ASTM B32 shall be used.

3.3 SPECIALTY PIPE FITTINGS

- A. Transition coupling shall be installed at pipe joints with small differences in pipe outside diameters.
- B. Dielectric fittings shall be installed at connections of dissimilar metal piping and tubing.

3.4 PIPE HANGERS, SUPPORTS AND ACCESSORIES

- A. All piping shall be supported according to the International Plumbing Code (IPC), Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, and these specifications. Where conflicts arise between these the code and Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING the most restrictive or the requirement that specifies supports with highest loading or shortest spacing shall apply.
- B. Hangers, supports, rods, inserts and accessories used for pipe supports shall be painted according to Section 09 91 00, PAINTING. Electroplated copper hanger rods, hangers and accessories may be used with copper tubing.
- C. Horizontal piping and tubing shall be supported within 300 mm (12 inches) of each fitting or coupling.
- D. Horizontal cast iron piping shall be supported with the following maximum horizontal spacing and minimum hanger rod diameters:
 - 1. 40 mm or DN40 to 50 mm or DN50 (NPS 1-1/2 inch to NPS 2 inch): 1500 mm (60 inches) with 10 mm (3/8 inch) rod.
 - 2. 75 mm or DN75 (NPS 3 inch): 1500 mm (60 inches) with 15 mm (1/2 inch) rod.
 - 3. 100 mm or DN100 to 125 mm or DN125 (NPS 4 inch to NPS 5 inch): 1500 mm (60 inches) with 18 mm (5/8 inch) rod.
 - 4. 150 mm or DN150 to 200 mm or DN200 (NPS 6 inch to NPS 8 inch): 1500 mm (60 inches) with 20 mm (3/4 inch) rod.
 - 5. 250 mm or DN250 to 300 mm or DN300 (NPS 10 inch to NPS 12 inch): 1500 mm (60 inch) with 23 mm (7/8 inch) rod.
- E. Vertical piping and tubing shall be supported at the base, at each floor, and at intervals no greater than 4.6 m (15 feet).

- F. 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.
- G. 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.
- H. Cast escutcheon with set screw shall be provided at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.
- I. 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.
- J. 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) gage shall be maintained for at least 15 minutes without leakage. A force pump and mercury column gage 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.

Black Hills National Cemetery
Renovate and Expand Administration and Maintenance Buildings
20901 Pleasant Valley Drive
Sturgis, SD 57785

NCA Project # 884CM3015

10/31/22

Bid Documents

B. Components provided under this section of the specification will be tested as part of a larger system.

- - - E N D - - -

**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 02, GENERAL REQUIREMENTS (Minor NCA Projects).
- 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 10 21 13, TOILET COMPARTMENTS: Through bolts.
- H. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- I. Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.
- J. 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. Architectural Barriers Act (ABA) Standards (2015)
- C. The American Society of Mechanical Engineers (ASME):
 - A112.6.1M-1997 (R2012) .Supports for Off-the-Floor Plumbing Fixtures
for Public Use
 - A112.18.1-2011Plumbing supply fittings
 - A112.18.3-(R2012)Backflow Protection Devices and Systems in
Plumbing Fixture Fittings
 - A112.19.1-2013Enameled Cast Iron and Enameled Steel Plumbing
Fixtures
 - A112.19.2-2013Ceramic Plumbing Fixtures

- A112.19.3-2008Stainless Steel Plumbing Fixtures
- A112.19.5-2011Flush Valves and Spuds for Water Closets,
Urinals, and Tanks

D. American Society of Sanitary Engineering (ASSE):

- 1001-2008Atmospheric Type Vacuum Breakers
- 1002-2008Anti-Siphon Fill Valves for Water Closet Tanks
- 1011-2004Hose-Connection Vacuum Breakers
- 1014-2005Backflow Prevention Devices for Hand-Held
Showers
- 1016-2011Automatic Compensating Valves for Individual
Showers and Tub/Shower Combinations
- 1019-2011Wall Hydrant with Backflow Protection and
Freeze Resistance
- 1037-90Pressurized Flushing Devices (Flushometer) for
Plumbing Fixtures

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

- A276-2013aStandard Specification for Stainless Steel Bars
and Shapes
- B584-2008Standard Specification for Copper Alloy Sand
Castings for General Applications

F. CSA Group:

- B45.4-2008 (R2013)Stainless Steel Plumbing Fixtures

G. International Code Council (ICC):

- IPC-2015International Plumbing Code

H. National Association of Architectural Metal Manufacturers (NAAMM):

- AMP 500-2006Metal Finishes Manual

I. NSF International (NSF):

- 14-2013Plastics Piping System Components and Related
Materials
- 61-2013Drinking Water System Components - Health
Effects
- 372-2011Drinking Water System Components - Lead Content

J. Underwriters Laboratories, Inc. (UL):

- 1951-2011Standard for Electric Plumbing Accessories

1.4 SUBMITTALS

- A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 22 40 00, PLUMBING FIXTURES", with applicable paragraph identification.
- C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.
- D. Operating Instructions: Comply with requirements in Section 01 00 00, GENERAL REQUIREMENTS.
- E. 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 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>.
- B. Guaranty: Warranty of Construction, FAR clause 52.246-21.

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-CADD version 2018 or higher provided on compact disk or DVD. Should the installing contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement.
- D. Certification documentation shall be provided to COR 10 working days prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and certification that all results of tests were within limits specified.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Material or equipment containing a weighted average of greater than 0.25 percent lead is prohibited in any potable water system intended for human consumption, and shall be certified in accordance with NSF 61 or NSF 372. Endpoint devices used to dispense water for drinking shall meet the requirements of NSF 61.
- B. Plastic pipe, fittings, and solvent cement shall meet NSF 14 and shall be NSF listed for the service intended.

2.2 STAINLESS STEEL

A. Corrosion-resistant Steel (CRS):

1. Plate, Sheet and Strip: CRS flat products shall conform to chemical composition requirements of any 300 series steel specified in ASTM A276.
2. Finish: Exposed surfaces shall have standard polish (ground and polished) equal to NAAMM finish Number 4.

B. **Die-cast zinc alloy products are prohibited.**

2.3 STOPS

- A. Provide 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 shall be chrome plated copper flexible tubing or flexible stainless steel with inner core of non-toxic polymer.
- D. Supply pipe from wall to valve stop shall be rigid threaded IPS copper alloy pipe, i.e. red brass pipe nipple, chrome plated where exposed.

2.4 ESCUTCHEONS

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

2.5 LAMINAR FLOW CONTROL DEVICE

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

B. Flow Control Restrictor:

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

2.6 CARRIERS

- A. ASME A112.6.1M, with adjustable gasket faceplate chair carriers for wall hung closets with auxiliary anchor foot assembly, hanger rod support feet, and rear anchor tie down.
- B. ASME A112.6.1M, lavatory, concealed arm support. All lavatory chair carriers shall be capable of supporting the lavatory with a 250-pound vertical load applied at the front of the fixture.
- C. Where water closets, lavatories or sinks are installed back-to-back and carriers are specified, provide one carrier to serve both fixtures in lieu of individual carriers. The drainage fitting of the back to back carrier shall be so constructed that it prevents the discharge from one fixture from flowing into the opposite fixture.

2.7 WATER CLOSETS

- A. (P-101) Water Closet (Floor Mounted, ASME A112.19.2, Figure 6)-office and industrial, elongated bowl, siphon jet 6 L (1.6 gallons) per flush, floor outlet. Top of seat shall be 435 mm to 438 mm (17-1/8 inches to 17-1/4 inches) above finished floor.
 1. Seat: Institutional/Industrial, extra heavy duty, chemical resistant, solid plastic, open front less cover for elongated bowls, integrally molded bumpers, concealed check hinge with stainless steel post. Seat shall be posture contoured body design. Color shall be white.
 2. Fittings and Accessories: Floor flange fittings-cast iron; Gasket-wax; bolts with chromium plated cap nuts and washers.

3. Flush valve: Large chloramines resistant diaphragm, semi-red brass valve body, exposed chrome plated, non-hold open ADA approved side oscillating handle, water saver design per flush with maximum 10 percent variance, top spud connection, adjustable tailpiece, one-inch IPS screwdriver back check angle stop with vandal resistant cap, high back pressure vacuum breaker, solid-ring pipe support, and sweat solder adapter with cover tube and cast set screw wall flange. Set centerline of inlet 292 mm (11-1/2 inches) above seat. Seat bumpers shall be integral part of flush valve. Valve body, cover, tailpiece and control stop shall be in conformance with ASTM B584 Alloy classification for semi-red brass.

2.8 URINALS

- A. (P-201) Urinal (Wall Hung, ASME A112.19.2) bowl with integral flush distribution, wall to front of flare 343 mm (13.5 inches) minimum. Wall hung with integral trap, siphon jet flushing action 1.9 L (0.5 gallons) per flush with 50 mm (2 inches) back outlet and 20 mm (3/4 inch) top inlet spud.
 1. Support urinal with chair carrier and install with rim 600 mm (24 inches) above finished floor.
 2. Flushing Device: Large chloramines resistant diaphragm, semi-red brass body, exposed flush valve electronic sensor operated battery powered, active infrared sensor for automatic operation non-hold open, water saver design, solid-ring pipe support, and 20 mm (3/4 inch) capped screwdriver angle stop valve. Set centerline of inlet 292 mm (11-1/2 inches) above urinal. Valve body, cover, tailpiece, and control stop shall be in conformance with ASTM alloy classification for semi-red brass.
- B. (P-202) Urinal (Wheelchair, Wall Hung, ASME A112.19.2) bowl with integral flush distribution, wall to front of flare 343 mm (13.5 inches) minimum. Wall hung with integral trap, siphon jet flushing action // 1.9 L (0.5 gallons) per flush with 50 mm (2 inches) back outlet and 20 mm (3/4 inch) top inlet spud.
 1. Support urinal with chair carrier and install with rim 432 mm (17 inches) maximum above finished floor.

2. Flushing Device: Large chloramines resistant diaphragm, semi-red brass body, exposed flush valve, electronic sensor operated battery powered active infrared sensor for automatic operation non-hold open, water saver design, solid-ring pipe support, and 20 mm (3/4 inch) capped screwdriver angle stop valve. Set centerline of inlet 292 mm (11-1/2 inches) above urinal. Valve body, cover, tailpiece and control stop shall be in conformance with ASTM alloy classification for semi-red brass.

2.9 LAVATORIES

- A. Dimensions for lavatories are specified, Length by width (distance from wall) and depth.
- B. Brass components in contact with water shall contain no more than 0.25 percent lead content by dry weight. Faucet flow rates shall be 3.9 L/m (1.5 gpm) for private lavatories and either 1.9 L/m (0.5 gpm) or 1.0 liter (0.25 gallons) per cycle for public lavatories.
- C. (P-401) Lavatory (Single Lever Handle Control ASME A112.19.2) straight back, approximately 508 mm by 457 mm (20 inches by 18 inches) and a 102 mm (4 inches) maximum apron, first quality vitreous china. Punching for faucet on 102 mm (4 inches) centers. Set with rim 864 mm (34 inches) above finished floor.
 1. Faucet: Solid cast brass construction, vandal resistant, heavy-duty single lever handle, center set. Control shall be washerless ceramic disc cartridge type. Provide laminar flow control device, adjustable hot water limit stop, and vandal proof screws. Flow shall be limited to 1.9 L/m (0.5 gpm)
 2. Drain: Cast or wrought brass with flat grid strainer offset tailpiece, chrome plated. Provide cover per A.D.A 4-19.4.
 3. Stops: Angle type, see paragraph "Stops." Provide cover per A.D.A 4-19.4.
 4. Trap: Cast copper alloy, 38 mm by 32 mm (1 1/2 inches by 1 1/4 inches) P-trap. Adjustable with connected elbow and 1.4 mm thick (17 gauge) tubing extensions to wall. Exposed metal trap surface and connection hardware shall be chrome plated with a smooth bright finish. Set trap parallel to wall. Provide cover per A.D.A 4-19.4.

- D. (P-413) Lavatory (Counter Mounted ASME A112.19.2) vitreous china, self-rimming, approximately 483 mm (19 inches) in diameter with punching for faucet on 203 mm (8 inches) centers. Mount unit in countertop.
1. Faucet: Solid cast brass construction with washerless ceramic disc mixing cartridge type, rigid gooseneck spout with outlet 102 mm to 127 mm (4 inches to 5 inches) above slab with 102 mm (4 inches) wrist blade handles. Provide laminar flow control device. Faucet, wall and floor escutcheons shall be either copper alloy or CRS. Exposed metal parts shall be chrome plated with a smooth bright finish.
 2. Drain: cast or wrought brass with flat grid strainer, offset tailpiece, brass, chrome plated.
 3. Stops: Angle type. See paragraph "Stops."
 4. Trap: Cast copper alloy, 38 mm by 32 mm (1 1/2 inches by 1 1/4 inches) P-trap, adjustable with connected elbow and 1.4mm thick (17 gauge) tubing extension to wall. Exposed metal trap surface and connection hardware shall be chrome plated with a smooth bright finish. Set trap parallel to the wall.
 5. Provide cover for exposed piping, drain, stops and trap per A.D.A.

2.10 SINKS

- A. Dimensions for sinks are specified, length by width (distance from wall) and depth.
- B. (P-501) Service Sink (Regular, ASME A112.19.1) service sink, class 1, single bowl, acid resistant enameled cast iron, approximately 610 mm by 508 mm (24 inches by 20 inches) with a 229 to 305 mm (9 to 12 inches) raised back without faucet holes.
Equip sink with CRS rimguard, and mounted on trap standard. Set sinks rim 711 mm (28 inches) above finished floor.
 1. Faucet: Part B, Type II, 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 shall 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 shall be cast, formed, or drop forged copper alloy. Escutcheons shall be either forged copper alloy or CRS.

Exposed metal parts, including exposed part under valve handle when in open position, shall have a smooth bright finish.

2. Drain: Grid.

3. Trap: Trap standard, painted outside and enameled inside with acid-resistant enamel, drain through adjoining wall.

C. (P-528) Sink (CRS, Single Compartment, Counter Top ASME A112.19.2, Kitchen Sinks) self-rimming, back faucet ledge, approximately 533 mm by 559 mm (21 inches by 22 inches) with single compartment inside dimensions approximately 406 mm by 483 mm by 191 mm (16 inches by 19 inches by 7 1/2 inches) deep. Shall be minimum of 1.3 mm thick (18 gauge) CRS. Corners and edges shall be well rounded:

1. Faucet: Solid brass construction, 8.3 L/m (2.2 gpm) deck mounted combination faucet with Monel or ceramic seats, removable replacement unit containing all parts subject to ware, swivel gooseneck spout with approximately 203 mm (8 inches) reach with spout outlet 152 mm (6 inches above deck and 102 mm (4 inches) wrist blades with hose spray. Faucet shall be polished chrome plated.

2. Drain: Drain plug with cup strainer, stainless steel.

3. Trap: Cast copper alloy 38 mm (1 1/2 inches) P-trap with cleanout plug. Provide wall connection and escutcheon.

4. Provide cover for exposed piping, drain, stops and trap per A.D.A.

2.11 DISPENSER, DRINKING WATER

A. Standard rating conditions: 10 degrees C (50 degrees F) water with 27 degrees C (80 degrees F) inlet water temperature and 32 degrees C (90 degrees F) ambient air temperature.

B. (P-608) Electric Water Cooler (Mechanically Cooled, Wall Hung, Wheelchair, with Glass Filler) bubbler style, air cooled compressor, 15 ml/s (15 gph) minimum capacity, lead free. Top shall be one-piece type 304 CRS anti-splash design. Cabinet, CRS satin finish, approximately 457 mm by 457 mm by 635 mm (18 inches by 18 inches by 25 inches) high with mounting plate. Unit shall be push bar operated with front and side bars, automatic stream regulator, and heavy chrome plated brass push down glass filler with adjustable flow control, and all trim chrome plated. Set bubbler 914 mm (36 inches) above finished floor. Provide with bottle filler option.

2.12 SHOWER BATH FIXTURE

- A. (P-701) Shower Bath Fixture (Detachable, Wall Mounted, Concealed Supplies, Type T/P Combination Valve):
1. Shower Installation: Wall mounted detachable spray assembly, 600 mm (24 inch) wall bar, elevated vacuum breaker, supply elbow and flange and valve. All external trim, chrome plated metal.
 2. Shower Head Assembly: Metallic shower head with flow control to limit discharge to 5.7 l/m (1.5 gpm), 1524 mm (60 inches) length of rubber lined CRS, chrome plated metal flexible, or white vinyl reinforced hose and supply wall elbow. Design showerhead to fit in palm of hand. Provide CRS or chrome plated metal wall bar with an adjustable swivel hanger for showerhead. Fasten wall bar securely to wall for hand support.
 3. Valves: Type T/P combination thermostatic and pressure balancing, with chrome plated metal lever type operating handle adjustable for rough-in variations and chrome plated metal or CRS face plate. Valve body shall be any suitable copper alloy. Internal parts shall be copper, nickel alloy, CRS or thermoplastic material. Valve inlet and outlet shall be 13 mm (1/2 inch) IPS. Provide external screwdriver check stops, vacuum breaker and temperature limit stops. Set stops for a maximum temperature of 50 degrees C (122 degrees F). All exposed fasteners shall be vandal resistant. Valve shall provide a minimum of 5.7 l/m (1.5 gpm) at 310 kPa (45 psig) pressure drop.

2.13 EMERGENCY FIXTURES

- A. (P-709) Emergency Eye and Face Wash (Pedestal Mounted): CRS receptor, recessed, wall mounted, hand operated. Mount eye and face wash spray heads 1067 (42 inches) above finished floor through floor waste connection and P-trap. Paint pedestal same color as room interior. Provide with thermostatic mixing valve to provide tepid water from 30 to 35 degrees C (85 to 95 degrees F). Flow rate shall be 11.4 L/m (3 gpm) .

2.14 HYDRANT, HOSE BIBB AND MISCELLANEOUS DEVICES

- A. (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 shall be cast, formed or drop forged copper alloy. Escutcheons shall be either forged copper alloy or CRS. Exposed metal parts, including exposed part under valve handle when in open position, shall have a bright finish.

3.1 INSTALLATION

- A. Fixture Setting: Opening between fixture and floor and wall finish shall be sealed as specified under Section 07 92 00, JOINT SEALANTS. Bio-based materials shall be utilized when possible.
- B. Supports and Fastening: Secure all fixtures, equipment and trimmings to partitions, walls and related finish surfaces. Exposed heads of bolts and nuts in finished rooms shall be hexagonal, polished chrome plated brass with rounded tops.
- C. Through Bolts: For free standing marble and metal stud partitions refer to Section 10 21 13, TOILET COMPARTMENTS.
- D. Toggle Bolts: For hollow masonry units, finished or unfinished.
- E. Expansion Bolts: For brick or concrete or other solid masonry. Shall be 6 mm (1/4 inch) diameter bolts, and to extend at least 76 mm (3 inches) into masonry and be fitted with loose tubing or sleeves extending into masonry. Wood plugs, fiber plugs, lead or other soft metal shields are prohibited.
- F. Power Set Fasteners: May be used for concrete walls, shall be 6 mm (1/4 inch) threaded studs, and shall extend at least 32 mm (1 1/4 inches) into wall.
- G. Tightly cover and protect fixtures and equipment against dirt, water and chemical or mechanical injury.
- H. Where water closet waste pipe has to be offset due to beam interference, provide correct and additional piping necessary to eliminate relocation of water closet.
- I. Aerators are prohibited on lavatories and sinks.

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

3.2 CLEANING

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

3.3 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

B. Components provided under this section of the specification will be tested as part of a larger system.

3.4 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer's technical representative for four hours to instruct VA Personnel in operation and maintenance of the system.

B. Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

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**SECTION 23 05 11
COMMON WORK RESULTS FOR HVAC**

PART 1 - GENERAL

1.1 DESCRIPTION

A. The requirements of this Section apply to all sections of Division 23.

B. Definitions:

1. Exposed: Piping, ductwork, and equipment exposed to view in finished rooms.

C. Abbreviations/Acronyms:

1. ABS: Acrylonitrile Butadiene Styrene
2. AC: Alternating Current
3. ACR: Air Conditioning and Refrigeration
4. AI: Analog Input
5. AISI: American Iron and Steel Institute
6. AO: Analog Output
7. AWG: American Wire Gage
8. BACnet: Building Automation and Control Network
9. BA_g: Silver-Copper-Zinc Brazing Alloy
10. BAS: Building Automation System
11. BCuP: Silver-Copper-Phosphorus Brazing Alloy
12. BSG: Borosilicate Glass Pipe
13. BTU: British Thermal Unit
14. BTUH: British Thermal Unit Per Hour
15. CDA: Copper Development Association
16. C: Celsius
17. CD: Compact Disk
18. CFM: Cubic Foot Per Minute
19. CLR: Color
20. CO: Carbon Monoxide
21. COR: Contracting Officer's Representative
22. CPVC: Chlorinated Polyvinyl Chloride
23. CRS: Corrosion Resistant Steel
24. CWP: Cold Working Pressure
25. CxA: Commissioning Agent
26. db(A): Decibels (A weighted)
27. DDC: Direct Digital Control
28. DI: Digital Input

- 29. DO: Digital Output
- 30. DVD: Digital Video Disc
- 31. DN: Diameter Nominal
- 32. DWV: Drainage, Waste and Vent
- 33. ECC: Engineering Control Center
- 34. EPDM: Ethylene Propylene Diene Monomer
- 35. EPT: Ethylene Propylene Terpolymer
- 36. ETO: Ethylene Oxide
- 37. F: Fahrenheit
- 38. FAR: Federal Acquisition Regulations
- 39. FD: Floor Drain
- 40. FED: Federal
- 41. FG: Fiberglass
- 42. FNPT: Female National Pipe Thread
- 43. GPM: Gallons Per Minute
- 44. HDPE: High Density Polyethylene
- 45. Hg: Mercury
- 46. HOA: Hands-Off-Automatic
- 47. hp: Horsepower
- 48. ID: Inside Diameter
- 49. in. wc: Inches of Water Column
- 50. IPS: Iron Pipe Size
- 51. Kg: Kilogram
- 52. kPa: Kilopascal
- 53. lb: Pound
- 54. lb/hr: Pounds Per Hour
- 55. L/s: Liters Per Second
- 56. L/min: Liters Per Minute
- 57. MAWP: Maximum Allowable Working Pressure
- 58. MAX: Maximum
- 59. MBH: 1000 BTUH
- 60. MBTU: 1000 BTU
- 61. MED: Medical
- 62. m: Meter
- 63. MFG: Manufacturer
- 64. mg: Milligram
- 65. mg/L: Milligrams Per Liter

- 66. ml: Milliliter
- 67. mm: Millimeter
- 68. MIN: Minimum
- 69. NC: Normally Closed
- 70. NF: Oil Free Dry (Nitrogen)
- 71. NO: Normally Open
- 72. NPTF: National Pipe Thread Female
- 73. NPS: Nominal Pipe Size
- 74. NPT: Nominal Pipe Thread
- 75. OD: Outside Diameter
- 76. OSD: Open Sight Drain
- 77. OS&Y: Outside Stem and Yoke
- 78. PLC: Programmable Logic Controllers
- 79. PP: Polypropylene
- 80. PPM: Parts Per Million
- 81. PSIA: Pounds Per Square Inch Absolute
- 82. PSIG: Pounds Per Square Inch Gage
- 83. PTFE: Polytetrafluoroethylene
- 84. PVC: Polyvinyl Chloride
- 85. PVDF: Polyvinylidene Fluoride
- 86. RAD: Radians
- 87. RO: Reverse Osmosis
- 88. RPM: Revolutions Per Minute
- 89. RTRP: Reinforced Thermosetting Resin Pipe
- 90. SCFM: Standard Cubic Feet Per Minute
- 91. SPEC: Specification
- 92. SPS: Sterile Processing Services
- 93. STD: Standard
- 94. SDR: Standard Dimension Ratio
- 95. SUS: Saybolt Universal Second
- 96. SWP: Steam Working Pressure
- 97. TAB: Testing, Adjusting, and Balancing
- 98. TDH: Total Dynamic Head
- 99. TEFC: Totally Enclosed Fan-Cooled
- 100. TFE: Tetrafluoroethylene
- 101. THERM: 100,000 BTU
- 102. THHN: Thermoplastic High-Heat Resistant Nylon Coated Wire

- 103. THWN: Thermoplastic Heat & Water Resistant Nylon Coated Wire
- 104. T/P: Temperature and Pressure
- 105. USDA: U.S. Department of Agriculture
- 106. V: Volt
- 107. VAC: Vacuum
- 108. VA: Veterans Administration
- 109. VAMC: Veterans Administration Medical Center
- 110. VAC: Voltage in Alternating Current
- 111. WOG: Water, Oil, Gas

1.2 RELATED WORK

- A. Section 01 00 02, GENERAL REQUIREMENTS (Minor NCA Projects).
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Section 01 42 19, REFERENCE STANDARDS.
- D. Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS.
- E. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.
- F. Section 05 31 00, STEEL DECKING.
- G. Section 05 36 00, COMPOSITE METAL DECKING.
- H. Section 05 50 00, METAL FABRICATIONS.
- I. Section 07 60 00, FLASHING AND SHEET METAL: Flashing for Wall and Roof Penetrations.
- J. Section 07 84 00, FIRESTOPPING.
- K. Section 07 92 00, JOINT SEALANTS.
- L. Section 09 91 00, PAINTING.
- M. Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC EQUIPMENT.
- N. Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.
- O. Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.
- P. Section 23 07 11, HVAC INSULATION.
- Q. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.
- R. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- S. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW).
- T. Section 26 29 11, MOTOR STARTERS.
- U. Section 31 20 00, EARTH MOVING: 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.
- B. Air Movement and Control Association (AMCA):
410-1996Recommended Safety Practices for Users and
Installers of Industrial and Commercial Fans
- C. American Society of Mechanical Engineers (ASME):
ASME Boiler and Pressure Vessel Code -
BPVC Section IX-2015 ...Welding, Brazing, and Fusing Qualifications
- D. American Society for Testing and Materials (ASTM):
A36/A36M-2014Standard Specification for Carbon Structural
Steel
A575-1996(2013)e1Standard Specification for Steel Bars, Carbon,
Merchant Quality, M-Grades
- E. Manufacturers Standardization Society (MSS) of the Valve and Fittings Industry, Inc.:
SP-58-2009Pipe Hangers and Supports - Materials, Design,
Manufacture, Selection, Application, and
Installation
SP-127-2014aBracing for Piping Systems: Seismic-Wind-
Dynamic Design, Selection, and Application
- F. National Electrical Manufacturers Association (NEMA):
MG 1-2014Motors and Generators
- G. National Fire Protection Association (NFPA):
70-2014National 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, and with requirements in the individual specification sections.
- B. Submit welder certificates.
- C. Make all necessary field measurements and investigations to ensure that the equipment and assemblies will meet contract requirements.

- D. If equipment is submitted which differs in arrangement from that shown, provide drawings that show the rearrangement of all associated systems. Approval will be given only if all features of the equipment and associated systems, including accessibility, are equivalent to that required by the contract.
- E. Prior to submitting shop drawings for approval, 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 as to provide a complete and efficient installation.
- F. Coordination Drawings: Indicate the proposed locations of equipment, ductwork, piping, and materials by preparing floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations. The sheet metal drawing shall be the Base Sheet. Other drawings produced shall be coordination drawing overlays, so interferences can be detected. Prepare coordination drawings to a scale of 1/4" = 1'-0" or larger clearly indicating the following:
1. Clearances for servicing and maintaining equipment, including tube removal, filter removal, and space for equipment disassembly required for periodic maintenance.
 2. Clearances for installing and maintaining insulation.
 3. Clearances for installing and maintaining valves, dampers, and their actuators.
 4. Equipment connections and support details.
 5. Exterior wall and foundation penetrations.
 6. Fire-rated wall and floor penetrations.
 7. Sizes and location of required concrete pads and bases.
 8. Indicate locations where space is limited for installation and maintenance.
 9. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
 10. Indicate location of existing utilities, ducts, piping and equipment that are to remain.
 11. Prepare reflected ceiling plans to coordinate and integrate installations, air outlets and inlets, light fixtures, communication systems components, sprinklers, and other ceiling-mounted items.

- G. Upon request by COR, provide lists of previous installations for selected items of equipment. Include contact persons who will serve as references, with telephone numbers and e-mail addresses.
- H. Submittals and shop drawings for interdependent items, containing applicable descriptive information, shall be furnished together and complete in a group. Coordinate and properly integrate materials and equipment in each group as to provide a completely compatible and efficient installation. Final review and approvals will be made only by groups.
- I. Manufacturer's Literature and Data: Submit under the pertinent section rather than under this section.
 - 1. Belt drive with the driven equipment.
 - 2. 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.
 - 6. Wall, floor, and ceiling plates.
- J. HVAC Maintenance Data and Operating Instructions: Maintenance and operating manuals in accordance with Section 01 00 02, GENERAL REQUIREMENTS (Minor NCA Projects), paragraph, INSTRUCTIONS, for systems and equipment.
- K. Provide copies of approved HVAC equipment submittals to the testing, adjusting, and balancing subcontractor.

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 institutional HVAC construction.
- B. Contractor to ensure the flow rate tolerance for HVAC equipment is consistent with 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 be re-balanced on site, as necessary.
2. After HVAC air balance work is completed and permanent drive sheaves are in place, perform field mechanical balancing and adjustments required to meet the specified vibration tolerance.

D. Products Criteria:

1. Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 3 years. The design, model, and size of each item shall have been in satisfactory and efficient operation on at least three installations for at least three years. However, digital electronics devices, software, and systems such as controls, instruments, and computer work stations shall be the current generation of technology and basic design that has a proven satisfactory service record of at least three years. See other specification sections for any exceptions.
2. All items furnished shall be free from defects that would adversely affect the performance, maintainability, and appearance of individual components and overall assembly.
3. Conform to codes and standards as required by the specifications. Conform to local codes, if required by local authorities such as the natural gas supplier, if the local codes are more stringent than those specified. Refer any conflicts to the COR.
4. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.
5. Assembled Units: Ensure manufacturers of equipment assemblies, which use components made by others, that the manufacturer will assume complete responsibility for the final assembled unit.
6. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.
7. Do not use asbestos containing products, equipment, or materials.

- E. HVAC Equipment Service Organizations: Products and systems shall be supported by service organizations that maintain a complete inventory of repair parts and are located reasonably close to the site.
- F. HVAC Mechanical Systems Welding: Before any welding is performed, submit a certificate certifying that welders comply with the following requirements:
1. Qualify welding processes and operators for piping according to ASME BPVX Section IX.
 2. Certify that each welder has passed American Welding Society (AWS) qualification tests for the welding processes involved, and that certification is current.
- G. Execution (Installation, Construction) Quality:
1. Apply and install all items in accordance with manufacturer's written instructions. Refer conflicts between the manufacturer's instructions and the contract drawings and specifications to the COR for resolution. Provide written hard copies or computer files of manufacturer's installation instructions to the COR at least two weeks prior to commencing installation of any item. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations is a cause for rejection of the material.
 2. All items that require access, such as for operating, cleaning, servicing, maintenance, and calibration, shall be easily and safely accessible by persons standing at floor level, or standing on permanent platforms, without the use of portable ladders. Examples of these items include, but are not limited to, all types of valves, filters and strainers, transmitters, and control devices. Prior to commencing installation work, refer conflicts between this requirement and contract drawings to the COR for resolution.
 3. Provide complete layout drawings required by Paragraph, SUBMITTALS. Do not commence construction work on any system until the layout drawings have been approved.

1.6 DELIVERY, STORAGE AND HANDLING

A. Protection of Equipment:

1. Equipment and material placed on the job site shall remain in the custody of the Contractor until phased acceptance, whether or not the Government has reimbursed the Contractor for the equipment and material. The Contractor is solely responsible for the protection of such equipment and material against any damage.
2. Place damaged equipment in new operating condition; or, replace same as determined and directed by the COR. Such repair or replacement shall be at no additional cost to the Government.
3. Protect interiors of new equipment and piping systems against entry of foreign matter. Clean both inside and outside before painting or placing equipment in operation.
4. Existing equipment and piping being worked on by the Contractor shall be under the custody and responsibility of the Contractor and shall be protected as required for new work.

B. Cleanliness of Piping and Equipment Systems:

1. Exercise care in storage and handling of equipment and piping material to be incorporated in the work. Remove debris arising from cutting, threading, and welding of piping.
2. Piping systems shall be flushed, blown, or pigged as necessary to deliver clean systems.
3. Clean interior of all tanks prior to delivery for beneficial use by the Government.
4. Contractor is fully responsible for all costs, damage, and delay arising from failure to provide clean systems.

PART 2 - PRODUCTS

2.1 FACTORY-ASSEMBLED PRODUCTS

- A. Provide maximum standardization of components.
- B. Ensure manufacturers of equipment assemblies, which use components made by others, that the manufacturer assumes complete responsibility for the final assembled unit.
 1. All components of an assembled unit need not be products of same manufacturer.
 2. Constituent parts that are alike shall be products of a single manufacturer.

3. Components shall be compatible with each other and with the total assembly for intended service.
 4. Guarantee performance of assemblies of components, and repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.
- C. Components of equipment shall bear manufacturer's name and trademark, model number, serial number, and performance data on a name plate securely affixed in a conspicuous place, or cast integral with, stamped, or otherwise permanently marked upon the components of the equipment.
- D. Major items of equipment, which serve the same function, shall be the same make and model. Exceptions will be permitted only with the approval of the COR and if performance requirements are met.

2.2 COMPATIBILITY OF RELATED EQUIPMENT

- A. Equipment and materials installed shall be compatible with other items being furnished and with existing items so that the result will be a complete and fully operational plant that conforms to contract requirements.

2.3 BELT DRIVES

- A. Drive Types:
1. Provide adjustable-pitch or fixed-pitch drive as follows:
 - a. Fan speeds up to 1800 RPM: 7.5 kW (10 horsepower) and smaller.
 - b. Fan speeds over 1800 RPM: 2.2 kW (3 horsepower) and smaller.
 2. Provide fixed-pitch drives for drives larger than those listed above.
 3. The final fan speeds required to meet the system CFM and pressure requirements, without throttling, shall be determined by adjustment of a temporary adjustable-pitch motor sheave, or by fan law calculation if a fixed-pitch drive is used initially.

2.4 DRIVE GUARDS

- A. For machinery and equipment, provide guards as shown in AMCA 410 for belts, chains, couplings, pulleys, sheaves, shafts, gears, and other moving parts regardless of height above the floor as to prevent damage to equipment and injury to personnel. Drive guards may be excluded where motors and drives are inside factory-fabricated air handling unit casings.

- B. Pump shafts and couplings shall be fully guarded by a sheet steel guard, covering coupling and shaft but not bearings. Material shall be minimum 16 gage sheet steel; ends shall be braked and drilled and attached to pump base with minimum of four 6 mm (1/4 inch) bolts. Reinforce guard as necessary to prevent side play forcing guard onto couplings.

2.5 LIFTING ATTACHMENTS

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

2.6 ELECTRIC MOTORS

- A. All material and equipment furnished and installation methods shall conform to the requirements of Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC EQUIPMENT; Section 26 29 11, MOTOR STARTERS; and, Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW). Provide all electrical wiring, conduit, and devices necessary for the proper connection, protection, and operation of the systems. Provide special energy efficient motors as scheduled. Unless otherwise specified for a particular application, use electric motors with the following requirements.
- B. Single-phase Motors: Capacitor-start type for hard starting applications. Motors for centrifugal fans and pumps may be permanent split capacitor (PSC).
- C. Poly-phase Motors: NEMA Design B, Squirrel cage, induction type.
- D. Electronically Commutated Motors: Brushless DC motors. Provide with equipment where indicated on drawings. Provide with 6 mH inductor on line side of motor.
- E. Rating: Continuous duty at 100 percent capacity in an ambient temperature of 40 degrees C (104 degrees F) and sea level; minimum horsepower as shown on drawings; when operating maximum horsepower, not to exceed nameplate rating without service factor.

F. Special Requirements:

1. Where motor power requirements of equipment furnished deviate from power shown on plans, provide electrical service designed under the requirements of NFPA 70 without additional time or cost to the Government.
2. Assemblies of motors, starters, controls, and interlocks on factory assembled and wired devices shall be in accordance with the requirements of this specification.
3. Wire and cable materials specified in the electrical division of the specifications shall be modified as follows:
 - a. 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 and fans shall be sized for non-overloading at all points on the pump and fan performance curves.
5. Motors utilized with variable frequency drives shall be rated "inverter-ready" per NEMA MG 1. Provide motor shaft grounding apparatus that will protect bearings from damage from stray currents.

G. Motor Efficiency and Power Factor: All motors, when specified as "high efficiency" by the project specifications on driven equipment, shall conform to efficiency and power factor requirements in Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC 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 of 1992 (EPACT). Motors not specified as "high efficiency" shall comply with EPACT.

H. Insulation Resistance: Not less than one-half meg-ohm between stator conductors and frame, to be determined at the time of final inspection.

2.7 VARIABLE SPEED MOTOR CONTROLLERS

- A. Refer to Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS and Section 26 29 11, MOTOR STARTERS for specifications.

- B. The combination of controller and motor shall be provided by the manufacturer of the driven equipment, such as pumps and fans, and shall be rated for 100 percent output performance. Multiple units of the same class of equipment, i.e. air handlers, fans, pumps, shall be the products of a single manufacturer.
- C. Motors shall be energy efficient type and be approved by the motor controller manufacturer. The controller-motor combination shall be guaranteed to provide full motor nameplate horsepower in variable frequency operation. Both driving and driven motor/fan sheaves shall be fixed pitch.
- D. Controller shall not add any current or voltage transients to the input AC power distribution system, DDC controls, etc., nor shall be affected from other devices on the AC power system.

2.8 EQUIPMENT AND MATERIALS IDENTIFICATION

- A. Use symbols, nomenclature, and equipment numbers specified, shown on the drawings, and shown in the maintenance manuals. Identification for piping is specified in Section 09 91 00, PAINTING.
- B. Interior (Indoor) Equipment: Engraved nameplates, with letters not less than 4.8 mm (1-7/8 inches) high of brass with black-filled letters, or rigid black plastic with white letters as 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 4.8 mm (1-7/8 inches) high, riveted or bolted to the equipment.
- D. Control Items: Label all temperature and humidity sensors, controllers, and control dampers. Identify and label each item as they appear on the control diagrams.
- E. Valve Tags and Lists:
 - 1. Valve tags: Engraved black-filled numbers and letters not less than 15 mm (1/2 inch) high for number designation, and not less than 6 mm (1/4 inch) for service designation on 19 gage 40 mm (1-1/2 inches) round brass disc, attached with brass "S" hook or brass chain.
 - 2. Valve lists: Typed or printed plastic coated card(s), sized 215 mm (8-1/2 inches) by 275 mm (11 inches) showing tag number, valve function, and area of control for each service or system. Punch sheets for a 3-ring notebook.

2.9 FIRESTOPPING

- A. Section 07 84 00, FIRESTOPPING specifies an effective barrier against the spread of fire, smoke, and gases where penetrations occur for piping and ductwork. Refer to Section 23 07 11, HVAC INSULATION, for firestop pipe and duct insulation.

2.10 GALVANIZED REPAIR COMPOUND

- A. Green Seal Standard GC-03, paint form.

2.11 HVAC PIPE AND EQUIPMENT SUPPORTS AND RESTRAINTS

- A. Vibration Isolators: Refer to Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.
- B. Supports for Roof Mounted Items:
1. Equipment: Equipment rails shall be galvanized steel, minimum 1.3 mm (18 gage), with integral baseplate, continuous welded corner seams, factory installed 50 mm by 100 mm (2 inch by 4 inch) treated wood nailer, 1.3 mm (18 gage) galvanized steel counter flashing cap with screws, built-in cant strip (except for gypsum or tectum deck), with minimum height 275 mm (11 inches). For surface insulated roof deck, provide raised cant strip starting 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 may be used for individual copper tubing up to 23 mm (7/8 inch) outside diameter.
- F. Attachment to Wood Construction: Wood screws or lag bolts.
- G. Hanger Rods: Hot-rolled steel, ASTM A36/36M or ASTM A575 for allowable load listed in MSS SP-58. For piping, provide adjustment means for controlling level or slope. Types 13 or 15 turn-buckles shall provide 40 mm (1-1/2 inches) minimum of adjustment and incorporate locknuts. All-thread rods are acceptable.
- H. Hangers Supporting Multiple Pipes (Trapeze Hangers): Galvanized, cold formed, lipped steel channel horizontal member, not less than 41 mm by 41 mm (1-5/8 inches by 1-5/8 inches), 2.7 mm (12 gage), designed to accept special spring held, hardened steel nuts.
1. Allowable hanger load: Manufacturers rating less 91 kg (200 pounds).
 2. Guide individual pipes on the horizontal member of every other trapeze hanger with 6 mm (1/4 inch) U-bolt fabricated from steel rod. Provide Type 40 insulation shield, secured by two 15 mm (1/2 inch) galvanized steel bands, or pre-insulated calcium silicate shield for insulated piping at each hanger.
- I. Supports for Piping Systems: Select hangers sized to encircle insulation on insulated piping. Refer to Section 23 07 11, HVAC INSULATION, for insulation thickness. To protect insulation, provide Type 39 saddles for roller type supports or pre-insulated calcium silicate shields. Provide Type 40 insulation shield or pre-insulated calcium silicate shield at all other types of supports and hangers, including those for pre-insulated piping.

2.12 PIPE PENETRATIONS

- A. Install sleeves during construction.
- B. Penetrations are prohibited through beams or ribs, but may be installed in concrete beam flanges. Any deviation from these requirements shall be made only after receipt of prior approval from the COR.
- C. 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.

- D. 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.
- E. 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.
- F. Brass Pipe Sleeves: Provide for pipe passing through quarry tile, terrazzo, or ceramic tile floors. Connect sleeve with floor plate.
- G. Sleeves are not required for wall hydrants for fire department connections or in drywall construction.
- H. 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.
- I. Sealant and Adhesives: Shall be as specified in Section 07 92 00, JOINT SEALANTS.

2.13 SPECIAL TOOLS AND LUBRICANTS

- A. Furnish, and turn over to the COR, special tools not readily available commercially, that are required for disassembly or adjustment of equipment and machinery furnished.

2.14 WALL, FLOOR AND CEILING PLATES

- A. Material and Type: Chrome-plated brass or chrome-plated steel, one piece or split type with concealed hinge, with set screw for fastening to pipe or sleeve. Use plates that fit tight around pipes, cover openings around pipes, and cover the entire pipe sleeve projection.
- B. Thickness: Not less than 2.4 mm (3/32 inch) for floor plates. For wall and ceiling plates, not less than 0.64 mm (0.025 inch) for up to 75 mm (3 inch) pipe, 0.89 mm (0.035 inch) for larger pipe.
- C. Locations: Use where pipe penetrates floors, walls, and ceilings in exposed locations, in finished areas only. Use also where insulation ends on exposed water supply pipe drop from overhead. Provide a watertight joint in spaces where brass or steel pipe sleeves are specified.

2.15 ASBESTOS

- A. Materials containing asbestos are prohibited.

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.

3.2 ARRANGEMENT AND INSTALLATION OF EQUIPMENT AND PIPING

- A. Coordinate location of piping, sleeves, inserts, hangers, ductwork, and equipment. Locate piping, sleeves, inserts, hangers, ductwork, and equipment clear of windows, doors, openings, light outlets, and other services and utilities. Prepare equipment layout drawings to coordinate proper location and personnel access to all facilities. Submit the drawings for review as required by Part 1. Follow manufacturer's published recommendations for installation methods not otherwise specified.
- B. Operating Personnel Access and Observation Provisions: Select and arrange all equipment and systems to provide clear view and easy access, without use of portable ladders, for maintenance and operation of all devices including, but not limited to, all equipment items, valves, filters, strainers, transmitters, sensors, and control devices. All gages and indicators shall be clearly visible by personnel standing on the floor or on permanent platforms. Do not reduce or change maintenance and operating space and access provisions that are shown on the drawings.
- C. Equipment and Piping Support: Coordinate structural systems necessary for pipe and equipment support with pipe and equipment locations to permit proper installation.
- D. Location of pipe sleeves, trenches, and chases shall be accurately coordinated with equipment and piping locations.
- E. Cutting Holes:
 - 1. Cut holes through concrete and masonry by rotary core drill. Pneumatic hammer, impact electric, and hand or manual hammer type drill is prohibited, except as permitted by the COR where working area space is limited.

2. Locate holes to avoid interference with structural members such as beams or grade beams. Holes shall be laid out in advance and drilling done only after approval by COR. If the Contractor considers it necessary to drill through structural members, refer to the COR for approval.
 3. Do not penetrate membrane waterproofing.
- F. Interconnection of Instrumentation or Control Devices: Generally, electrical and pneumatic interconnections are not shown but shall be provided.
- G. Minor Piping: Generally, small diameter pipe runs from drips and drains, water cooling, and other service are not shown but shall be provided.
- H. Electrical Interconnection of Controls and Instruments: Generally, not shown but shall be provided. This includes interconnections of sensors, transmitters, transducers, control devices, control and instrumentation panels, instruments, and computer workstations. Comply with NFPA 70.
- I. Protection and Cleaning:
1. Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations, and as approved by the 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.
- J. Concrete and Grout: Use concrete and shrink compensating grout 21 MPa (3000 psig) minimum.
- K. Install gages, thermometers, valves, and other devices with due regard for ease in reading or operating and maintaining devices. Locate and position thermometers and gages to be easily read by operator or staff standing on floor or on walkway provided. Servicing shall not require dismantling adjacent equipment or pipe work.

L. Work in Existing Building:

1. Perform as specified in paragraphs, OPERATIONS AND STORAGE AREAS, ALTERATIONS, and RESTORATION of Section 01 00 01, GENERAL REQUIREMENTS (Major NCA Projects) for relocation of existing equipment, alterations and restoration of existing building(s).
2. As specified in paragraph, OPERATIONS AND STORAGE AREAS of Section 01 00 01, GENERAL REQUIREMENTS (Major NCA Projects) make alterations to existing service piping at times that will least interfere with normal operation of the facility.
3. Cut required openings through existing masonry and reinforced concrete using diamond core drills. Use of pneumatic hammer type drills, impact type electric drills, and hand or manual hammer type drills will be permitted only with approval of the COR. Locate openings that will least effect structural slabs, columns, ribs, or beams. Refer to the COR for determination of proper design for openings through structural sections and for opening layouts approval prior to cutting or drilling into structures. After COR's approval, carefully cut opening through construction no larger than necessary for the required installation.

M. Switchgear Drip Protection: Every effort shall be made to eliminate the installation of pipe above electrical and telephone switchgear. If this is not possible, encase pipe in a second pipe with a minimum of joints.

N. Inaccessible Equipment:

1. Where the Government determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled or remedial action performed as directed at no additional cost to the Government.
2. The term "conveniently accessible" is defined as capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as motors, fans, pumps, belt guards, transformers, high voltage lines, piping, and ductwork.

3.3 TEMPORARY PIPING AND EQUIPMENT

A. Continuity of operation of existing facilities will generally require temporary installation or relocation of equipment and piping.

- B. 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.

3.4 RIGGING

- A. Alternative methods of equipment delivery may be offered by Contractor and will be considered by Government if allowed under specified restrictions of phasing and maintenance of service as well as structural integrity of the building.
- B. 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.
- C. 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 responsibility. Upon request, the Government will check structure adequacy and advise Contractor of recommended restrictions.
- D. Check all clearances, weight limitations, and provide a rigging plan designed by a Registered Professional Engineer. All modifications to structures, including reinforcement, shall be at Contractor's cost, time, and responsibility.
- E. Rigging plan and methods shall be referred to COR for evaluation prior to actual work.
- F. 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 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, wire, or strap hangers; wood for blocking, stays, and bracing; or, hangers suspended from piping above is prohibited. Replace or thoroughly clean rusty products and paint with zinc primer.

- C. Use hanger rods that are straight and vertical. Turnbuckles for vertical adjustments may be omitted where limited space prevents use. Provide a minimum of 15 mm (1/2 inch) clearance between pipe or piping covering and adjacent work.
- D. HVAC Horizontal Pipe Support Spacing: Refer to MSS SP-58. Provide additional supports at valves, strainers, in-line pumps, and other heavy components. Provide a support within one foot of each elbow.
- 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.
- F. Floor Supports:
 - 1. Provide concrete bases, concrete anchor blocks and pedestals, and structural steel systems for support of equipment and piping. Anchor and dowel concrete bases and structural systems to resist forces under operating and seismic conditions without excessive displacement or structural failure.
 - 2. Do not locate or install bases and supports until equipment mounted thereon has been approved. Size bases to match equipment mounted thereon plus 50 mm (2 inch) excess on all edges. Refer to structural drawings. Bases shall be neatly finished and smoothed, shall have chamfered edges at the top, and shall be suitable for painting.
 - 3. 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 on the drawings, 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 occupied building or an operating plant, provide approved protection from dust and debris at all times for the safety of personnel, maintenance of operation, and environment of the facility.

- B. In an occupied building, maintain the operation, cleanliness, and safety. Government personnel will be carrying on their normal duties or normal duties of operating, cleaning, maintaining equipment, and building operation. Confine the work to the immediate area concerned; maintain cleanliness and wet down demolished materials to eliminate dust. Allowing debris to accumulate in the area to the detriment of operations is prohibited. Perform all flame cutting to maintain the fire safety integrity of the building and occupants. 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 Cemetery, and Contractor shall follow all directives of the COR with regard to rigging, safety, fire safety, and maintenance of operations.
- C. Completely remove all piping, wiring, conduit, and other devices associated with the equipment not to be re-used in the new work. This includes all pipe, valves, fittings, insulation, and all hangers including the top connection and any fastenings to building structural systems. Seal all openings, after removal of equipment, pipes, ducts, and other penetrations in roof, walls, and floors in an approved manner and in accordance with plans and specifications where specifically covered. Structural integrity of the building system shall be maintained. Reference shall also be made to the drawings and specifications of the other disciplines in the project for additional facilities to be demolished or handled.
- D. All valves including gate, globe, ball, butterfly, and check, and all pressure gages and thermometers with wells shall remain Government property and shall be removed, delivered to COR, and stored as directed. Remove all other material and equipment, devices, and demolition debris under these plans and specifications. Such material shall be removed from Government property expeditiously and is prohibited to accumulate.

3.7 CLEANING AND PAINTING

- A. Prior to final inspection and acceptance of the equipment rooms and facilities for beneficial use by the Government, the facilities, equipment, and systems shall be thoroughly cleaned and painted. Refer to Section 09 91 00, PAINTING. Use cleaning materials and methods recommended by the manufacturers for the specific tasks.

Remove all rust prior to painting and from surfaces to remain unpainted. Repair scratches, scuffs, and abrasions prior to applying prime and finish coats.

B. In addition, the following special conditions apply:

1. Material and Equipment Not to Be Painted Includes:

- a. Motors, controllers, control switches, and safety switches.
- b. Control and interlock devices.
- c. Regulators.
- d. Pressure reducing valves.
- e. Control valves and thermostatic elements.
- f. Lubrication devices and grease fittings.
- g. Copper, brass, aluminum, stainless steel, and bronze surfaces.
- h. Valve stems and rotating shafts.
- i. Pressure gages and thermometers.
- j. Glass.
- k. Name plates.

2. Control and instrument panels shall be cleaned, damaged surfaces repaired, and touched-up with matching paint obtained from panel manufacturer.

3. Pumps, fans, motors, steel and cast-iron bases, and coupling guards shall be cleaned, and touched-up with the same color as utilized by the pump and fan manufacturer

4. Final result shall be smooth, even-colored, even-textured factory finish on all items. Completely repaint the entire piece of equipment if necessary.

3.8 IDENTIFICATION SIGNS

A. Factory Built Equipment: Metal plate, securely attached, with name and address of manufacturer, serial number, model number, size, and performance.

B. Pipe Identification: Refer to Section 09 91 00, PAINTING.

3.9 MOTOR AND DRIVE ALIGNMENT

A. Belt Drive: Set driving and driven shafts parallel, and align so that the corresponding grooves are in the same plane.

B. Direct-connect Drive: Securely mount motor in accurate alignment so that shafts are free from both angular and parallel misalignments when both motor and driven machine are operating at normal temperatures.

3.10 LUBRICATION

- A. Lubricate all devices requiring lubrication prior to initial operation, and field-check all devices for proper lubrication.
- B. Equip all devices with required lubrication fittings or devices.
- C. All lubrication points shall be accessible without disassembling equipment, except to remove access plates.

3.11 STARTUP AND TEMPORARY OPERATION

- A. Startup equipment per manufacturer's instructions. Verify that vibration is within specified tolerance prior to extended operation. Temporary use of equipment is specified in Section 01 00 02, GENERAL REQUIREMENTS (Minor NCA Projects), 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 02, GENERAL REQUIREMENTS (Minor NCA Projects), paragraph, 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 system occurs at a time when final control settings and adjustments cannot be properly made to make performance tests, then make performance tests for heating systems and for cooling systems respectively during first actual seasonal use of respective systems following completion of work.

- - - E N D - - -

**SECTION 23 05 12
GENERAL MOTOR REQUIREMENTS FOR HVAC EQUIPMENT**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installation and connection of motors for HVAC 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 02, GENERAL REQUIREMENTS (Minor NCA Projects).
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Section 01 42 19, REFERENCE STANDARDS.
- D. Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS.
- E. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.
- F. Section 23 05 11, COMMON WORK RESULTS FOR HVAC: General mechanical requirements and items which are common to more than one section of Division 23.
- G. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.
- H. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements that are common to more than one Section of Division 26.
- I. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 Volts and Below).
- J. Section 26 29 11, MOTOR STARTERS: Starters, control and protection for motors.

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. National Electrical Manufacturers Association (NEMA):
 - MG 1-2014Motors and Generators
 - MG 2-2014Safety Standard for Construction and Guide for Selection, Installation and Use of Electric Motors and Generators
- C. National Fire Protection Association (NFPA):
 - 70-2014National 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 EQUIPMENT", with applicable paragraph identification.
- C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.
- D. Shop Drawings:
 - 1. Include clearly presented information that is sufficient to demonstrate compliance with contract documents.
 - 2. Include electrical ratings, dimensions, mounting details, materials, horsepower, RPM, enclosure, starting characteristics, torque characteristics, code letter, full load and locked rotor current, service factor, and lubrication method.
- E. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replacement parts, and troubleshooting guide:
 - 1. Include complete list indicating all components of the systems.
 - 2. Include complete diagrams of the internal wiring for each item of equipment.
 - 3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.
- F. Certification: Two weeks prior to final inspection, unless otherwise noted, submit to the COR 4 copies of certification that the motors have been properly applied, installed, adjusted, lubricated, and tested.
- G. 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.
- H. 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. 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 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. As-built drawings are to be provided, and a copy of them in Auto-CAD version 2018 or later provided on CD 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 MOTORS

- A. For alternating current, fractional and integral horsepower motors, NEMA MG 1 and NEMA MG 2 shall apply.

- B. All material and equipment furnished and installation methods shall conform to the requirements of Section 26 29 11, MOTOR STARTERS; and Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 Volts and Below). Provide all electrical wiring, conduit, and devices necessary for the proper connection, protection, and operation of the systems. Provide premium efficiency type motors as scheduled. Unless otherwise specified for a particular application, use electric motors with the following requirements.
- C. Single-phase Motors: Motors for centrifugal fans and pumps may be split phase or permanent split capacitor (PSC) type. Provide capacitor-start type for hard starting applications.
1. Contractor's Option - Electrically Commutated motor (EC Type): Motor shall be brushless DC type specifically designed for applications, with heavy duty ball bearings and electronic commutation. The motor shall be speed controllable down to 20 percent of full speed and shall be at least 85 percent efficient at all speeds.
- D. 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.
- E. 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: 230/460 volts, dual connection.
- F. 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), may be single phase provided the manufacturer of the proposed assemblies cannot supply the assemblies with three phase motors.
- G. 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.
- H. Motor designs, as indicated by the NEMA code letters, shall be coordinated with the connected loads to assure adequate starting and running torque.
- I. Motor Enclosures:
 - 1. Shall be the NEMA types shown on the drawings for the motors.
 - 2. Where the types of motor enclosures are not shown on the drawings, shall be the NEMA types, which are most suitable for the environmental conditions where the motors are being installed.
 - 3. Shall be primed and finish coated at the factory with manufacturer's prime coat and standard finish.
- J. Additional requirements for specific motors, as indicated in other sections, shall also apply.
- K. Energy-Efficient Motors (Motor Efficiencies): All permanently wired polyphase motors of 746 Watts (1 HP) or more shall meet the full-load efficiencies as indicated in table MG 12-12, reproduced in part below, and as specified in this specification. Motors of 746 Watts (1 HP) or more with open, drip-proof or totally enclosed fan-cooled 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.

| Nominal Efficiencies Open Drip-Proof | | | | Nominal Efficiencies Totally Enclosed Fan-Cooled | | | |
|---|-------------|-------------|----------|---|-------------|-------------|-------------|
| 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% |

- L. Minimum Power Factor at Full Load and Rated Voltage: 90 percent at 1200 RPM, 1800 RPM and 3600 RPM.
- M. Premium efficiency motors shall be used where energy cost/kW x (hours use/year) > 50.

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 motors in accordance with manufacturer's recommendations, the NEC, NEMA, as shown on the drawings, and as required by other sections of these specifications.

3.2 STARTUP AND TESTING

- A. Megger all motors after installation, before start-up. All motors shall test free from grounds.
- B. Make tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements.

Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.

C. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.

D. The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and Commissioning Agent. Provide a minimum notice of 10 working days prior to startup and testing.

3.3 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.

- - - E N D - - -

SECTION 23 05 93
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Testing, adjusting, and balancing (TAB) of heating, ventilating and air conditioning (HVAC) systems and plumbing water recirculation. TAB includes the following:
1. Planning TAB procedures.
 2. Reviewing Contract Documents for producing and submitting a report.
 3. Producing and submitting a report summarizing observations from the Contract Documents review.
 4. Producing and submitting a Systems Inspection report.
 5. Producing and submitting a Duct Air Leakage Test Report.
 6. Producing and submitting a Systems Readiness Report.
 7. Balancing and adjusting air and water distribution systems to provide design performance; and testing performance of equipment and automatic controls for the following systems:
 - a. Air Systems
 - b. Hydronic Systems
 - c. Plumbing recirculation systems.
 8. Recording and reporting vibration and sound measurements.
 9. Control Systems verification.
- B. A complete listing of common acronyms and abbreviations are included in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- C. Definitions:
1. Basic TAB used in this Section: Testing, Adjusting, and Balancing Chapter of ASHRAE Handbook-HVAC Applications.
 2. TAB: Testing, Adjusting, and Balancing; the process of checking and adjusting HVAC systems to meet design objectives and recording and reporting measurements.
 3. AABC: Associated Air Balance Council.
 4. NEBB: National Environmental Balancing Bureau.
 5. SMACNA: Sheet Metal and Air Conditioning Contractors National Association.
 6. TABB: Testing, Adjusting and Balancing Bureau.
 7. Hydronic Systems: Includes ground source heat pump condenser 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.
10. Out-of-tolerance data: When applied to TAB work this phrase means "a measurement which does not fall within the prescribed range for a specific parameter."
11. Season of maximum heating load: The time of year when the outdoor temperature at the project site remains within plus or minus 20 degrees F of the project site's winter outdoor design temperature, throughout the period of TAB data recording.
12. Season of maximum cooling load: The time of year when the outdoor temperature at the project site remains within plus or minus 5 degrees F of the project site's summer outdoor design temperature through the period of TAB data recording.
13. Season 1, Season 2: Depending upon when the project HVAC is completed and ready for TAB, Season 1 is defined, thereby defining Season 2. Season 1 could be the season of maximum heating load, or the season of maximum cooling load.

1.2 RELATED WORK

- A. Section 01 00 02, GENERAL REQUIREMENTS (Minor NCA Projects).
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Section 01 42 19, REFERENCE STANDARDS.
- D. Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS.
- E. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.
- F. Section 23 05 11, COMMON WORK RESULTS FOR HVAC: General mechanical requirements and items which are common to more than one section of Division 23.
- G. Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT: Noise and Vibration Requirements.
- H. Section 23 07 11, HVAC INSULATION: Piping and Equipment Insulation.
- I. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.
- J. Section 23 31 00, HVAC DUCTS AND CASINGS: Duct Leakage.
- K. Section 23 36 00, AIR TERMINAL UNITS: Terminal Units Performance.
- L. Section 23 81 00, UNITARY HVAC EQUIPMENT.

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. Air Movement and Control Association (AMCA):
 - 201-2012Fans and Systems
- C. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE):
 - Latest EditionASHRAE Handbook-HVAC Applications, Testing, Adjusting, and Balancing Chapter and Noise and Vibration Control Chapter
 - 62.1-2016Ventilation for Acceptable Indoor Air Quality
 - 90.1-2013Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings
- D. Associated Air Balance Council (AABC):
 - 2015National Standards for Total System Balance, 7th Edition
- E. National Environmental Balancing Bureau (NEBB):
 - 2015Procedural Standard for Testing, Adjusting and Balancing of Environmental Systems, 8th Edition
 - 2015Procedural Standard for Measurement of Sound and Vibration, 3rd Edition
 - 2014Procedural Standards for Whole Building Systems Technical Commissioning for New Construction, 4th Edition
- F. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):
 - 2002HVAC Systems Testing, Adjusting and Balancing, 3rd Edition
 - 2006HVAC Systems Duct Design, 4th Edition
- G. Testing, Adjusting and Balancing Bureau (TABB):
 -Quality Assurance Program

1.4 SUBMITTALS

- A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

- B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC", 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. TAB Report Forms: Use standard TAB contractor's forms approved by Architect.
- E. 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.
- F. For use by the Contracting Officer's Representative (COR) staff, submit one complete set of applicable AABC, NEBB, or TABB/SMACNA publications that will be the basis of TAB work.
- G. Submit the following for Review and Approval:
 - 1. Contract Documents Review Report within 45days for conventional design projects after the system layout on air, and water 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 Certified TAB reports including 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. Strategies and Procedures Plan: Within 60 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in paragraph, PREPARATION in Part 3.
 - 8. Sample report forms.
- H. Prior to request for Final Inspection, submit completed Test and Balance report for the area.
- I. Instrument calibration reports, to include the following:
 - 1. Instrument type and make.

2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

J. 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.

1.5 QUALITY ASSURANCE

- A. Refer to paragraphs QUALITY ASSURANCE and SUBMITTALS in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, "Air Balancing."
- C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, "System Balancing."
- D. 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.

The TAB agency shall be either a certified member of AABC or certified by the NEBB, SMACNA, or TABB to perform TAB service for HVAC, water balancing, and vibration and sound testing of equipment. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the agency loses subject certification during this period, the General Contractor shall immediately notify the COR and submit another TAB firm for approval. Any agency that has been the subject of disciplinary action by either the AABC, NEBB, or TABB within the five years preceding Contract Award shall not be eligible to perform any work related to the TAB. All work performed in this Section and in other related Sections by the TAB agency shall be considered invalid if the TAB agency loses its certification prior to Contract completion, and the successor agency's review shows unsatisfactory work performed by the predecessor agency.

2. TAB Specialist: The TAB specialist shall be either a member of AABC or an experienced technician of the agency certified by NEBB or TABB.

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, NEBB, or TABB within the five years preceding Contract Award shall not be eligible to perform any duties related to the HVAC systems, including TAB. All work specified in this Section and in other related Sections performed by the TAB specialist shall be considered invalid if the TAB Specialist loses its certification prior to Contract completion and must be performed by an approved successor.

3. TAB Specialist shall be identified by the General Contractor within 60 days after the notice to proceed. The TAB specialist will be coordinating, scheduling and reporting all TAB work and related activities and will provide necessary information as required by the COR. The responsibilities would specifically include:
 - a. Directly supervising all TAB work.
 - b. Signing 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, NEBB, or TABB.
 - c. Following all TAB work through its satisfactory completion.
 - d. Providing final markings of settings of all HVAC adjustment devices.
 - e. Permanently marking location of duct test ports.
4. All TAB technicians performing TAB work shall be experienced and must have done satisfactory work on a minimum of 3 projects comparable in size and complexity to this project. Qualifications must be certified by the TAB agency in writing.
- E. Test Equipment Criteria: The instrumentation shall meet the accuracy and calibration requirements established by AABC National Standards, TABB/SMACNA International Standards, or by NEBB Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems and instrument manufacturer. Provide calibration history of the instruments to be used for test and balance purpose.

F. TAB Criteria:

1. One or more of the applicable AABC, NEBB, or SMACNA publications, supplemented by ASHRAE Handbook-HVAC Applications, Testing, Adjusting, and Balancing Chapter, and requirements stated herein shall be the basis for planning, procedures, and reports.
 2. Flow rate tolerance: Following tolerances are allowed. For tolerances not mentioned herein follow ASHRAE Handbook-HVAC Applications, Testing, Adjusting, and Balancing Chapter, as a guideline. Air Filter resistance during tests, artificially imposed if necessary, shall be at least 90 percent of final values for all filters.
 - a. Air handling unit and all other fans, cubic meters/min (cubic feet per minute): Minus 0 percent to plus 10 percent.
 - b. Air terminal units (maximum values): Minus 2 percent to plus 10 percent.
 - c. Outside air: 0 percent to plus 10 percent.
 - d. Exhaust air: 0 to 10 percent more than design.
 - e. Individual room air outlets and inlets, and air flow rates not mentioned above: Minus 2 percent to plus 10 percent except if the air to a space is 100 CFM or less the tolerance would be 0 to plus 5 percent.
 - f. Condenser water pumps: 0 percent to plus 5 percent.
 3. Systems shall be adjusted for energy efficient operation as described in PART 3.
 4. When field TAB work begins typical TAB procedures and results shall be demonstrated to the COR for one air distribution system (including all fans, three terminal units and three rooms) and one hydronic system (pumps and three coils).
- G. TAB Conference: Meet with Commissioning Authority on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Require the participation of the TAB field supervisor and technicians. Provide seven days' advance notice of scheduled meeting time and location. The following shall be the agenda items for the TAB conference:
1. The Contract Documents examination report.
 2. The TAB plan.
 3. Coordination and cooperation of trades and subcontractors.

4. Coordination of documentation and communication flow.

1.6 PROJECT CONDITIONS

- A. Full Occupancy: Site and existing building will be occupied during entire TAB period. Cooperate with Government during TAB operations to minimize conflicts with operations.
- B. Partial Occupancy: Completed areas of building may be occupied before Substantial Completion. Cooperate with Government during TAB operations to minimize conflicts with operations.

1.7 COORDINATION

- A. Notice: Provide ten calendar days' advance notice to COR for each test. Include scheduled test dates and times.
- B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

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 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 CONTRACT DOCUMENTS REVIEW REPORT

- A. The TAB Specialist shall review the Contract Plans and specifications and advise the COR of any design deficiencies that would preclude proper TAB of systems and equipment or 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 EXAMINATION

- A. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.
- B. Coordinate with the COR the examination of ceiling plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as scheduled on drawings and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
- C. Examine equipment performance data including fan and pump curves.
 - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
 - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201 or in SMACNA's "HVAC Systems Duct Design." Compare results with the design data and installed conditions.
- D. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- E. Examine test reports specified in individual system and equipment Sections.
- F. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- G. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- H. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.
- I. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- J. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

- K. Examine system pumps to ensure absence of entrained air in the suction piping.
- L. Examine operating safety interlocks and controls on HVAC equipment.
- M. Report deficiencies discovered before and during performance of TAB procedures to COR. Record default set points.

3.4 SYSTEMS INSPECTION REPORT

- A. Inspect equipment and installation for conformance with design.
- B. The inspection and report is to be done after air distribution equipment is on site and duct installation has begun, but well in advance of performance testing and balancing work. The purpose of the inspection is to identify and report deviations from design and ensure that systems will be ready for TAB at the appropriate time.
- C. Reports: Follow check list format developed by AABC, NEBB, TABB, or SMACNA, supplemented by narrative comments, with emphasis on air handling units and fans. Check for conformance with submittals. Verify that diffuser and register sizes are correct. Check air terminal unit installation including their duct sizes and routing.

3.5 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system-readiness checks and prepare reports. Verify the following:
 - 1. Permanent electrical-power wiring is complete.
 - 2. Hydronic systems are filled, clean, and free of air.
 - 3. Automatic temperature-control systems are operational.
 - 4. Equipment and duct access doors are securely closed.
 - 5. Balance, smoke and fire dampers are open.
 - 6. Isolating and balancing valves are open to the proper setpoint and control valves are operational.
 - 7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 - 8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.6 DUCT AIR LEAKAGE TEST REPORT

- A. See paragraph DUCT LEAKAGE TESTS AND REPAIR in Section 23 31 00, HVAC DUCTS AND CASINGS for TAB agency's role and responsibilities in witnessing, recording and reporting of deficiencies.
- B. Inspect each System to ensure that it is complete including installation and operation of controls.
- C. Verify that all items such as ductwork piping, ports, terminals, connectors, etc., that is required for TAB are installed. Provide a report to the COR.

3.7 PRELIMINARY TAB REPORTS

- A. Submit an intermediate report for minimum of 50 percent of systems and equipment tested and balanced to establish satisfactory test results.
- B. The TAB contractor shall provide raw data immediately in writing to the COR if there is a problem in achieving intended results before submitting a formal report.
- C. If over 20 percent of readings in the intermediate report fall outside the acceptable range, the TAB report shall be considered invalid and all contract TAB work shall be repeated and re-submitted for approval.
- D. Do not proceed with the remaining systems until intermediate report is approved by the COR.

3.8 FINAL TAB REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
 - 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 - 2. Include a list of instruments used for procedures, along with proof of calibration.
- B. Final Report Contents: In addition to certified field report data, include the following:
 - 1. Pump curves.
 - 2. Fan curves.
 - 3. Manufacturers' test data.
 - 4. Field test reports prepared by system and equipment installers.
 - 5. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB contractor.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:
 - a. Design or indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outdoor-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Settings for supply-air, static-pressure controller.
 - g. Other system operating conditions that affect performance.

D. Coil Measurements:

1. Entering and leaving dry bulb and wet bulb temperatures shall be determined using a minimum of 9 measurements taken in a grid pattern and in accordance with AABC.

2. Along with the TAB report, submit part-load coil performance data from the coil manufacturer and use the data to verify performance in compliance with AABC.
- E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
 2. Water and steam flow rates.
 3. Duct, outlet, and inlet sizes.
 4. Pipe and valve sizes and locations.
 5. Terminal units.
 6. Balancing stations.
 7. Position of balancing devices.
- F. Ambient Temperatures: On each TAB report form, record the outdoor and space's indoor ambient wet bulb and dry bulb temperature ranges.
- G. Air Handling Unit and Energy Recovery Unit Test Reports: For air handling units and energy recovery units with coils and/or heat exchangers, include the following:
1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Unit arrangement and class.
 - g. Discharge arrangement.
 - h. Sheave make, size in mm (inches), and bore.
 - i. Center-to-center dimensions of sheave, and amount of adjustments in mm (inches).
 - j. Number, make, and size of belts.
 - k. Number, type, and size of filters.
 2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in mm (inches), and bore.

- f. Center-to-center dimensions of sheave, and amount of adjustments in mm (inches).
3. Test Data (Indicated and Actual Measured Values):
- a. Total supply air flow rate in L/s (cfm).
 - b. Total system static pressure in Pa (inch WG).
 - c. Fan rpm.
 - d. Discharge static pressure in Pa (inch WG).
 - e. Filter static-pressure differential in Pa (inch WG).
 - f. Preheat-coil static-pressure differential in Pa (inch WG).
 - g. Cooling-coil static-pressure differential in Pa (inch WG).
 - h. Heating-coil static-pressure differential in Pa (inch WG).
 - i. Outdoor airflow in L/s (cfm).
 - j. Return airflow in L/s (cfm).
 - k. Outdoor-air damper position.
 - l. Return-air damper position.
 - m. Vortex damper position.
- H. Gas- and Oil-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:
1. Unit Data:
- a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Fuel type in input data.
 - g. Output capacity in kW (Btu/h).
 - h. Ignition type.
 - i. Burner-control types.
 - j. Motor horsepower and rpm.
 - k. Motor volts, phase, and hertz.
 - l. Motor full-load amperage and service factor.
 - m. Sheave make, size in mm (inches), and bore, for each sheave.
 - n. Center-to-center dimensions of sheaves, and amount of adjustments in mm (inches).
2. Test Data (Indicated and Actual Measured Values):
- a. Total air flow rate in L/s (cfm).

- b. Entering-air temperature in degrees C (degrees F) for each stage of heating or if modulating then at a minimum of full load and a minimum of two part load points.
 - c. Leaving-air temperature in degrees C (degrees F) for each stage of heating or if modulating then at a minimum of full load and a minimum of two part load points.
 - d. Entering-air static pressure in Pa (inch WG).
 - e. Leaving-air static pressure in Pa (inch WG).
 - f. Air static-pressure differential in Pa (inch WG).
 - g. Low-fire fuel input in kW (Btu/h) or fire input at each stage if multi-stage or if modulating then at a minimum of full load and two part load points
 - h. High-fire fuel input in kW (Btu/h).
 - i. Manifold pressure in kPa (psig).
 - j. High-temperature-limit setting in degrees C (degrees F).
 - k. Operating set point in kW (Btu/h).
 - l. Motor voltage at each connection.
 - m. Motor amperage for each phase.
 - n. Heating value of fuel in kW (Btu/h).
3. Test Data (Indicated and Actual Measured Values):
- a. Heat output in kW (Btu/h).
 - b. Air flow rate in L/s (cfm).
 - c. Air velocity in m/s (fpm).
 - d. Entering-air temperature in degrees C (degrees F) for each stage of heating or if modulating then at a minimum of full load and a minimum of two part load points.
 - e. Leaving-air temperature in degrees C (degrees F) for each stage of heating or if modulating then at a minimum of full load and a minimum of two part load points.
 - f. Voltage at each connection.
 - g. Amperage for each phase.
- I. Fan Test Reports: For supply, return, and exhaust fans, include the following:
- 1. Fan Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.

- d. Model number and size.
 - e. Manufacturer's serial number.
 - f. Arrangement and class.
 - g. Sheave make, size in mm (inches), and bore for each sheave.
 - h. Center-to-center dimensions of sheaves, and amount of adjustments in mm (inches).
2. Motor Data:
- a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in mm (inches), and bore.
 - f. Center-to-center dimensions of sheaves, and amount of adjustments in mm (inches).
 - g. Number, make, and size of belts.
3. Test Data (Indicated and Actual Measured Values):
- a. Total airflow rate in L/s (cfm).
 - b. Total system static pressure in Pa (inch WG).
 - c. Fan rpm.
 - d. Discharge static pressure in Pa (inch WG).
 - e. Suction static pressure in Pa (inch WG).
- J. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
1. Report Data:
 - a. System and air handling unit number.
 - b. Location and zone.
 - c. Traverse air temperature in degrees C (degrees F).
 - d. Duct static pressure in Pa (inch WG).
 - e. Duct width in mm (inches).
 - f. Duct height in mm (inches).
 - g. Indicated air flow rate in L/s (cfm).
 - h. Indicated velocity in m/s (fpm).
 - i. Actual measured air flow rate in L/s (cfm).
 - j. Actual measured average velocity in m/s (fpm).
 - k. Barometric pressure in psig (Pa).

K. Air Terminal Device Reports:

1. Unit Data:

- a. System and air handling unit identification.
- b. Location and zone.
- c. Apparatus used for test.
- d. Area served.
- e. Make.
- f. Number or mark from system diagram.
- g. Type and model number.
- h. Size.
- i. Effective area of air path in sq. m (sq. ft.).
- j. Effective area of coil in sq. m (sq. ft.).

2. Test Data (Indicated and Actual Measured Values):

- a. Air flow rate in L/s (cfm).
- b. Air velocity in m/s (fpm).
- c. As needed, preliminary air flow rate in L/s (cfm).
- d. As needed, preliminary velocity in m/s (fpm).
- e. Final air flow rate in L/s (cfm).
- f. Final velocity in m/s (fpm).
- g. Space temperature in degrees C (degrees F).

L. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data:

- a. System and air handling unit identification.
- b. Location and zone.
- c. Room or riser served.
- d. Coil make and size.
- e. Flowmeter type.

2. Test Data (Indicated and Actual Measured Values):

- a. Air flow rate in L/s (cfm).
- b. Entering-water temperature in degrees C (degrees F).
- c. Leaving-water temperature in degrees C (degrees F).
- d. Water pressure drop in feet of head or kPa (psig).
- e. Entering-air temperature in degrees C (degrees F).
- f. Leaving-air temperature in degrees C (degrees F) degrees C (degrees F).

M. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:

1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Service.
 - d. Make and size.
 - e. Model number and serial number.
 - f. Water flow rate in L/s (gpm).
 - g. Water pressure differential in feet of head or kPa (psig).
 - h. Required net positive suction head in feet of head or kPa (psig).
 - i. Pump rpm.
 - j. Impeller diameter in mm (inches) from shop drawing submittal or name plate.
 - k. Motor make and frame size.
 - l. Motor horsepower and rpm.
 - m. Voltage at each connection.
 - n. Amperage for each phase.
 - o. Full-load amperage and service factor.
 - p. Seal type.
2. Test Data (Indicated and Actual Measured Values):
 - a. Static head in feet of head or kPa (psig).
 - b. Pump shutoff pressure in feet of head or kPa (psig).
 - c. Calculated impeller size in mm (inches).
 - d. Full-open flow rate in L/s (gpm).
 - e. Full-open pressure in feet of head or kPa (psig).
 - f. Final discharge pressure in feet of head or kPa (psig).
 - g. Final suction pressure in feet of head or kPa (psig).
 - h. Final total pressure in feet of head or kPa (psig).
 - i. Final water flow rate in L/s (gpm).
 - j. Voltage at each connection.
 - k. Amperage for each phase.

3.9 TAB PROCEDURES

- A. TAB shall be performed in accordance with the requirement of the Standard under which TAB agency is certified by either AABC or NEBB.

- 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 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.
- D. Allow sufficient time in construction schedule for TAB and submission of all reports for an organized and timely correction of deficiencies.
- E. Timing of TAB work:
 - 1. Season 1 TAB Field Work: When the ambient temperature is within Season 1 limits, accomplish Season 1 TAB field work.
 - 2. Prerequisite HVAC Work Check Out List For Season 2 and Advanced Notice For Season 2 TAB Field Work: Within 150 calendar days after date of the commencement of the Season 1 TAB field work, submit the Season 2 prerequisite HVAC work check out list certified as complete and submit advance notice of commencement of Season 2 TAB field work.
 - 3. Season 2 TAB Field Work: Within 180 calendar days after date of commencement of the Season 2 limits, accomplish Season 2 TAB field work.
- F. Air Balance and Equipment Test: Include air handling units, fans, terminal units, fan coil units, room diffusers/outlets/inlets.
 - 1. Make all measurements under conditions that will be present when system is in use. Make rest room exhaust airflow measurements after system has been in operation and doors have been closed for 10 minutes.
 - 2. Check condensate drains for proper connections and functioning.
 - 3. Check for proper sealing of air handling unit components.
 - 4. Verify that air duct system is sealed as specified.
 - 5. Artificially load air filters by partial blanking to produce air static pressure drop of at least 90 percent of the design final pressure drop. If no dirty filter drop is specified allow 1-inch WG.

6. 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.
 7. 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.
 8. Record final measurements for air handling equipment performance data sheets.
 9. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- G. Water Balance and Equipment Test: Include circulating pumps and coils:
1. Check liquid level in expansion tank.
 2. Check makeup water-station pressure gage for adequate pressure for highest vent and at highest point of system.
 3. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
 4. Check air vents for a forceful liquid flow exiting from vents when manually operated.
 5. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size. Include information in report.
 - a. If impeller sizes must be adjusted to achieve pump performance, obtain approval from COR and comply with requirements in Section 23 21 23, HYDRONIC PUMPS.
 6. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual measured amperage exceeds motor nameplate amperage.
 7. Adjust flow rates for equipment. Set coils to values on equipment submittals, if different from values on contract drawings.

8. Record final measurements for hydronic equipment on performance data sheets. Include entering and leaving water temperatures for coils. Include entering and leaving air temperatures (DB/WB for cooling coils) for air handling units and reheat coils. Make air and water temperature measurements at the same time.

3.10 VERIFICATION AND ALTERNATE SEASON TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods:
 1. If initial TAB procedures were performed during season of maximum heating load or season of maximum cooling load, perform additional TAB during Season 2, season of maximum heating load or season of maximum cooling load as specified in this section.
 2. If initial TAB procedures were not performed during season of maximum heating load and season of maximum cooling load, perform additional TAB during season of maximum heating load and season of maximum cooling load.

3.11 MARKING OF SETTINGS

- A. Following approval of Final TAB 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.

3.12 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.

3.13 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.

- - - E N D - - -

SECTION 23 07 11
HVAC INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Field applied insulation for thermal efficiency and condensation control for HVAC piping, ductwork, and equipment.
- B. A complete listing of common acronyms and abbreviations are included in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- C. 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 15 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 15 degrees C (60 degrees F); HVAC equipment or piping handling media above 40.5 degrees C (105 degrees F)
 - 8. Density: kg/m^3 - kilograms per cubic meter (pcf - pounds per cubic foot).
 - 9. Perm: Metric measure of water vapor transmission in units of 1 grain of water vapor per hour, per square meter, per millimeter of mercury. US measure of water vapor transmission in units of 1 grain of water vapor per hour, per square foot, per inch of mercury.
 - 10. Runouts: Branch pipe connections up to 25 mm (1 inch) nominal size to fan coil units or reheat coils for terminal units.

11. 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).
12. Thermal Conductivity (k): Watt per meter, per degree C (BTU per inch thickness, per hour, per square foot, per degree F temperature difference).
13. PVDC: Polyvinylidene chloride vapor retarder jacketing, white.

1.2 RELATED WORK

- A. Section 01 00 02, GENERAL REQUIREMENTS (Minor NCA Projects).
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Section 01 42 19, REFERENCE STANDARDS.
- D. Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS.
- E. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.
- F. Section 07 84 00, FIRESTOPPING: Mineral fiber and bond breaker behind sealant.
- G. Section 23 05 11, COMMON WORK RESULTS FOR HVAC: General mechanical requirements and items which are common to more than one section of Division 23.
- H. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.
- I. Section 23 21 13, HYDRONIC PIPING
- J. Section 23 23 00, REFRIGERANT PIPING: Requirements for refrigerant piping and fittings.
- K. Section 23 31 00, HVAC DUCTS AND CASINGS: Ductwork and fittings.

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 Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE):
90.1-2013Energy Efficient Design of New Buildings Except
Low-Rise Residential Buildings

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

- A240/A240M-2015bStandard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
- B209-2014Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
- C411-2011Standard test Method for Hot-Surface Performance of High-Temperature Thermal Insulation
- C449-2007 (R2013)Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement
- C518-2015Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
- C534/C534M-2014Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
- C547-2015Standard Specification for Mineral Fiber Pipe Insulation
- C553-2013Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
- C591-2015Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
- C612-2014Standard Specification for Mineral Fiber Block and Board Thermal Insulation
- C795-2008 (R2013)Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel
- C871-2011e1Standard Test Methods for Chemical Analysis of Thermal Insulation Materials for Leachable Chloride, Fluoride, Silicate, and Sodium Ions

- C921-2010 (R2015)Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation
- C1136-2012Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation
- C1290-2011Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts
- C1393-2014Standard Specification for Perpendicularly Oriented Mineral Fiber Roll and Sheet Thermal Insulation for Pipes and Tanks
- D1644-2001 (R2012)Standard Test Methods for Nonvolatile Content of Varnishes
- D1668/D1668M-1997a (R2014)e1 Standard Specification for Glass Fabrics (Woven and Treated) for Roofing and Waterproofing
- D1784-2011Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
- E84-2015bStandard Test Method for Surface Burning Characteristics of Building Materials
- E96/E96M-2015Standard Test Methods for Water Vapor Transmission of Materials
- F1249-2013Standard Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor
- D. Federal Specifications (Fed. Spec.):
 - L-P-535E-2012Plastic Sheet (Sheeting): Plastic Strip; Poly (Vinyl Chloride) and Poly (Vinyl Chloride - Vinyl Acetate), Rigid
- E. Military Specifications (Mil. Spec.):
 - MIL-A-24179A (1)-1987 ..Adhesive, Flexible Unicellular-Plastic Thermal Insulation
 - MIL-A-3316C (2)-1990 ...Adhesives, Fire-Resistant, Thermal Insulation
 - MIL-C-20079H-87Cloth, Glass; Tape, Textile Glass; and Thread, Glass and Wire-Reinforced Glass

MIL-PRF-19565C (1)-1988 Coating Compounds, Thermal Insulation, Fire,
and Water-Resistant, Vapor-Barrier

F. National Fire Protection Association (NFPA):

- 90A-2015Standard for the Installation of Air-
Conditioning and Ventilating Systems
- 90B-2015Standard for the Installation of Warm Air
Heating and Air-Conditioning Systems
- 251-2006Standard Methods of Tests of Fire Resistance of
Building Construction Materials
- 255-2006Standard Method of Test of Surface Burning
Characteristics of Building Materials
- 262-2015Standard Method of Test for Flame Travel and
Smoke of Wires and Cables for Use in Air-
Handling Spaces

G. Underwriters Laboratories, Inc. (UL):

- 181-2013Standard for Factory-Made Air Ducts and Air
Connectors
- 181A-2013Standard for Closure Systems for User with
Rigid Air Ducts
- 181B-2013Standard for Closure Systems for Use with
Flexible Air Ducts and Air Connectors
- 723-2008 (R2013)Standard for Test for Surface Burning
Characteristics of Building Materials
- 1820-2004 (R2013)Standard for Fire Test of Pneumatic Tubing for
Flame and Smoke Characteristics

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 07 11, HVAC 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 shall be included as to be able to clearly determine compliance with contract documents, ASTM standards, and federal and military specifications. For each type of product indicated, include thermal conductivity, water-vapor permeance thickness, and jackets (both factory-applied and field-applied if any).
 - a. Insulation materials: Specify each type used and state surface burning and smoke developed characteristics.
 - b. Insulation facings and jackets: Each type used. White finish shall 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.
- E. 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.

1.5 QUALITY ASSURANCE

- A. Refer to paragraph QUALITY ASSURANCE, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- B. Criteria:
 - 1. Comply with NFPA 90A.
 - a. For installation indoors 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 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 or ASTM E84.

- b. For installations outdoors the maximum flame spread index is 75 and the maximum smoke developed index is 150 for insulation and covering materials that do not penetrate a wall or roof, and do not create an exposure hazard.
- c. Where 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.
- d. 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
- e. 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 C411 at the temperature to which they are exposed in service.
- f. In no case shall the test temperature be below 121 degrees C (250 degrees F).
- g. 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.
- h. Air duct linings shall be interrupted at fire dampers to prevent interference with the operation of devices.
- i. Air duct coverings shall not be installed so as to conceal or prevent the use of any service opening.
- j. 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.

- k. 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 feet) 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.
 - l. Supplementary materials for air distribution systems shall comply with the provisions of air distribution materials.
 - m. 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 mm (1 inch) average clearance on all sides
 - 2) Filled solid with an approved material capable of preventing the passage of flame and hot gases as specified in NFPA 251.
 2. Test methods: ASTM E84, UL 723, or NFPA 255.
 3. Specified k-values are in accordance with ASTM test methods including ASTM C518 and ASTM C411 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.

1.6 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.
- B. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Do not use materials containing asbestos, lead, mercury, or mercury compounds.
- B. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C871.
- C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C795.
- D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

2.2 MINERAL FIBER BOARD OR BLOCK, BLANKET, AND PREFORMED PIPE INSULATION

- A. ASTM C612, Type 1A or Type 1B. Board or block insulation with mineral or glass fibers bonded with thermosetting resin. Density 48 kg/m³ (3.0 pcf), labeled thickness thermal conductivity (k-value) 0.23 Btu x inches / Hr x sq. ft. x deg. F (0.042 W/m x K) or less at 24 degrees C (75 degrees F), and maximum temperature 93 degrees C (200 degrees F) or greater.
- B. ASTM C553, Type II, or ASTM C1290, Type III with factory Foil-Scrim-Kraft jacket. Flexible blanket insulation with mineral or glass fibers bonded with thermosetting resin. Density 12 kg/m³ (0.75 pcf), labeled thickness thermal conductivity (k-value) 0.29 Btu x inches / Hr x sq. ft. x deg. F (0.033 W/m x K) or less at 24 degrees C (75 degrees F), and maximum temperature 93 degrees C (200 degrees F) or greater.

- C. ASTM C547, Type I, Grade A, with factory-applied ASJ jacket. Preformed pipe insulation with glass fibers bonded with a thermosetting resin. Jacket complying with ASTM C1136, Type I with polyvinyl chloride pre-molded fitting covers. Labeled thickness thermal conductivity (k-value) 0.23 Btu x inches / Hr x sq. ft. x deg. F (0.034 W/m x K) or less at 24 degrees C (75 degrees F), and minimum temperature minus 18 degrees C (0 degrees F) or less, and maximum temperature 454 degrees C (850 degrees F) or greater.

2.3 MINERAL WOOL OR REFRACTORY FIBER FOR INSULATION

- A. Comply with ASTM C612 for board and block insulation, Type 1A-III, maximum temperature 454 degrees C (850 degrees F).
- B. Comply with ASTM C1393 for pipe insulation.

2.4 POLYISOCYANURATE CLOSED-CELL RIGID PREFORMED PIPE AND EQUIPMENT INSULATION

- A. ASTM C591, Grade 2, Type I. Preformed pipe insulation. Thermal conductivity (k-value) 0.19 Btu x inches / Hr x sq. ft. x deg. F (0.027 W/m x K) or less at 24 degrees C (75 degrees F), and minimum temperature minus 18 degrees C (0 degrees F) or less, and maximum temperature 149 degrees C (300 degrees F) or greater. With factory applied PVDC or all service jacket vapor retarder with polyvinyl chloride pre-molded fitting covers.
- B. Equipment insulation, ASTM C591, Type IV. Thermal conductivity (k-value) 0.19 Btu x inches / Hr x sq. ft. x deg. F (0.027 W/m x K) or less at 24 degrees C (75 degrees F), and minimum temperature minus 18 degrees C (0 degrees F) or less, and maximum temperature 149 degrees C (300 degrees F) or greater. With PVDC or all service jacket vapor retarder jacket.

2.5 FLEXIBLE ELASTOMERIC CELLULAR THERMAL PREFORMED PIPE AND EQUIPMENT INSULATION

- A. ASTM C534/C534M, Grade I for tube and sheet materials. Thermal conductivity (k-value) 0.21 Btu x inches / Hr x sq. ft. x deg. F (0.030 W/m x K) or less at 24 degrees C (75 degrees F), and minimum temperature minus 18 degrees C (0 degrees F) or less, and maximum temperature 104 degrees C (220 degrees F) or greater. No jacket required.

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 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. Comply with ASTM C1136, Type I. Beach puncture 50 Beach Units (1.5 Joules) minimum. Suitable for painting without sizing. Jackets shall have minimum 40 mm (1-1/2 inch) lap on longitudinal joints and minimum 100 mm (4 inch) butt strip on end joints. Butt strip material shall be same as the jacket. Lap and butt strips shall be self-sealing type with factory-applied pressure sensitive adhesive.
- C. Vapor retarder medium strength with low water vapor permeance of 0.132 metric perm (0.02 or less perm rating). Beach puncture 25 units: Foil-Scrim-Kraft (FSK) or PVDC vapor retarder jacketing type for concealed ductwork and equipment.
- D. Glass Cloth Jackets: Presized, minimum 0.18 kg per square meter (7.8 ounces per square yard), 2070 kPa (300 psi) bursting strength with integral vapor retarder where required or specified. Weather proof if utilized for outside service.
- E. Factory composite materials may be used provided that they have been tested and certified by the manufacturer.
- F. Pipe fitting insulation covering (jackets): Fitting covering shall be premolded to match shape of fitting and shall be polyvinyl chloride (PVC) conforming to FedSpec L-P-565E, composition A, Type II Grade GU, and Type III, minimum thickness 0.7 mm (0.03 inches). Provide color matching vapor retarder pressure sensitive tape.
- G. Aluminum jacket piping systems and circular breeching and stacks: ASTM B209, 3003 alloy, H-14 temper, 0.6 mm (0.024 inch) minimum thickness with locking longitudinal joints. Jackets for elbows, tees and other fittings shall be factory-fabricated to match shape of fitting and of 0.6 mm (0.024) inch minimum thickness aluminum. Fittings shall be of same construction as straight run jackets but need not be of the same alloy. Factory-fabricated stainless steel bands shall be installed on all circumferential joints.

Bands shall be 20 mm (3/4 inch) wide on 450 mm (18 inch) centers.
System shall be weatherproof if utilized for outside service.

- H. Aluminum jacket rectangular breaching: 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 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 |

- 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. 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).

2.8 ADHESIVE, MASTIC, CEMENT

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Mil. Spec. MIL-A-3316C, Class 1: Jacket and lap adhesive and protective finish coating for insulation.
- C. Mil. Spec. MIL-A-3316C, Class 2: Adhesive for laps and for adhering insulation to metal surfaces.
- D. Mil. Spec. MIL-A-24179A, Type II Class 1: Adhesive for installing flexible unicellular insulation and for laps and general use.
- E. Mil. Spec. MIL-PRF-19565C, Type I: Protective finish for outdoor use.
- F. Mil. Spec. MIL-PRF-19565C, Type I or Type II: Vapor barrier compound for indoor use.

G. ASTM C449: Mineral fiber hydraulic-setting thermal insulating and finishing cement.

H. Other: Insulation manufacturers' published recommendations.

2.9 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.

1. Water-Vapor Permeance: ASTM E96/E96M, Procedure B, 0.013 perm (0.009 metric perm) at 43 mil (1.09 mm) dry film thickness.

2. Service Temperature Range: Minus 29 to plus 82 degrees C (Minus 20 to plus 180 degrees F).

3. Solids Content: ASTM D1644, 58 percent by volume and 70 percent by weight.

4. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.

1. Water-Vapor Permeance: ASTM F1249, 0.05 perm (0.03 metric perm) at 35 mil (0.9 mm) dry film thickness.

2. Service Temperature Range: Minus 18 to plus 82 degrees C (0 to 180 degrees F).

3. Solids Content: ASTM D1644, 44 percent by volume and 62 percent by weight.

4. Color: White.

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.

1. Water-Vapor Permeance: ASTM F1249, 0.05 perm (0.033 metric perm) at 30 mil (0.8 mm) dry film thickness.

2. Service Temperature Range: Minus 46 to plus 104 degrees C (Minus 50 to plus 220 degrees F).

3. Solids Content: ASTM D1644, 33 percent by volume and 46 percent by weight.

4. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Water-Vapor Permeance: ASTM F1249, 1.8 perms (1.2 metric perms) at 1.6 mm (0.0625 inch) dry film thickness.

2. Service Temperature Range: Minus 29 to plus 82 degrees C (Minus 20 to plus 180 degrees F).
3. Solids Content: 60 percent by volume and 66 percent by weight.
4. Color: White.

2.10 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 121 degrees C (Minus 40 to plus 250 degrees F).
4. Color: Aluminum.

B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 121 degrees C (Minus 40 to plus 250 degrees F).
4. Color: White.

2.11 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.
4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C1136, Type II.
5. Vinyl Jacket: White vinyl with a permeance of 1.3 perms (0.86 metric perm) when tested according to ASTM E96/E96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.12 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. Self-Adhesive Outdoor Jacket: 1.5 mm (60 mil) thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with white aluminum-foil facing.

2.13 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
 - 1. Width: 75 mm (3 inches).
 - 2. Thickness: 0.29 mm (11.5 mils).
 - 3. Adhesion: 1.0 N/mm (90 ounces force/inch) in width.
 - 4. Elongation: 2 percent.
 - 5. Tensile Strength: 7.2 N/mm (40 lbf/inch) in width.
 - 6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.
 - 1. Width: 75 mm (3 inches).
 - 2. Thickness: 0.16 mm (6.5 mils).
 - 3. Adhesion: 1.0 N/mm (90 ounces force/inch) in width.
 - 4. Elongation: 2 percent.
 - 5. Tensile Strength: 7.2 N/mm (40 lbf/inch) in width.
 - 6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
 - 1. Width: 50 mm (2 inches).
 - 2. Thickness: 0.15 mm (6 mils).
 - 3. Adhesion: 0.7 N/mm (64 ounces force/inch) in width.
 - 4. Elongation: 500 percent.
 - 5. Tensile Strength: 3.3 N/mm (18 lbf/inch) in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
 - 1. Width: 50 mm (2 inches).
 - 2. Thickness: 0.093 mm (3.7 mils).

3. Adhesion: 1.1 N/mm (100 ounces force/inch) in width.
4. Elongation: 5 percent.
5. Tensile Strength: 6.2 N/mm (34 lbf/inch) in width.

2.14 MECHANICAL FASTENERS

- A. Pins, anchors: Welded pins, or metal or nylon anchors with tin-coated or fiber washer, or clips. Pin diameter shall be as recommended by the insulation manufacturer.
- B. Staples: Outward clinching monel or stainless steel.
- C. Wire: 1.3 mm (18 gage) thick soft annealed galvanized or 1.9 mm (14 gage) copper clad steel or nickel copper alloy.
- D. Bands: 20 mm (3/4 inch) nominal width, brass, galvanized steel, aluminum or stainless steel.

2.15 REINFORCEMENT AND FINISHES

- A. Glass fabric, open weave: ASTM D1668/D1668M, Type III (resin treated) and Type I (asphalt treated).
- B. Glass fiber fitting tape: Mil. Spec MIL-C-20079H, Type II, Class 1.
- C. Tape for Flexible Elastomeric Cellular Thermal Insulation: As recommended by the insulation manufacturer.
- D. Corner angles: 50 mm by 50 mm (2 inch by 2 inch), 0.55 mm (26 gage) thick galvanized steel; or, 25 mm by 25 mm (1 inch by 1 inch), 0.47 mm (28 gage) thick aluminum angle adhered to 50 mm by 50 mm (2 inch by 2 inch) Kraft paper, or PVC Corner Angles: 30 mils (0.76 mm)
- E. 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 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.

2.16 FIRESTOPPING MATERIAL

- A. Other than pipe and duct insulation, refer to Section 07 84 00, FIRESTOPPING.

2.17 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 QUALITY ASSURANCE.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- 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. Required pressure tests of duct and 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.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 1. Draw jacket tight and smooth.
 2. Cover circumferential joints with 75 mm (3 inch) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 100 mm (4 inches) on center.
 3. Overlap jacket longitudinal seams at least 40 mm (1-1/2 inches). Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 50 mm (2 inches) on center.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 100 mm (4 inches) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above-ambient services, do not install insulation to the following:
 1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Manholes.
 5. Handholes.
 6. Cleanouts.
- Q. 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.

- R. 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 in accordance with NFPA 90A. 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).
- S. Install vapor stops at all insulation terminations on either side of valves, pumps and equipment and particularly in straight lengths of pipe insulation.
- T. Construct insulation on parts of equipment such as 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 (20 gage) thick 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.
- U. 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.
- V. 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.
- W. HVAC work not to be insulated:
 - 1. Internally insulated ductwork and air handling units.
 - 2. Exhaust air ducts and ventilation exhaust air shafts.
 - 3. Equipment: Expansion tanks and hot water pumps.
- X. Apply insulation materials subject to the manufacturer's recommended temperature limits. Apply adhesives, mastic and coatings at the manufacturer's recommended minimum coverage.

- Y. 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.
- Z. 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
- AA. 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 16 square feet per gallon) over the entire fabric surface.
- B. Flexible Mineral Fiber Blanket: Adhere insulation to metal with 100 mm (4 inch) wide strips of insulation bonding adhesive at 200 mm (8 inches) on center all around duct. Additionally secure insulation to bottom of ducts exceeding 600 mm (24 inches) in width with pins welded or adhered on 450 mm (18 inch) centers. Secure washers on pins. Butt insulation edges and seal joints with laps and butt strips. Staples may be used to assist in securing insulation. Seal all vapor retarder penetrations with mastic. Sagging duct insulation will not be acceptable. Install firestop duct insulation where required.
- 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, 15 degrees C (59 degrees F) or less, vapor seal with a layer of glass fitting tape imbedded between two 1.6 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).

D. Polyisocyanurate Closed-Cell Rigid Insulation:

- 1. Polyisocyanurate closed-cell rigid insulation (PIR) may be provided for piping, equipment and ductwork for temperature up to 149 degree C (300 degree F) provided insulation thickness requirement does not exceed 40 mm (1-1/2 inches).
- 2. Install insulation, vapor retarder and jacketing per manufacturer's recommendations. Particular attention should be paid to recommendations for joint staggering, adhesive application, external hanger design, expansion/contraction joint design and spacing and vapor retarder integrity.
- 3. Install insulation with all joints tightly butted (except expansion joints in hot applications).
- 4. If insulation thickness exceeds 65 mm (2-1/2 inches), install as a double layer system with longitudinal (lap) and butt joint staggering as recommended by manufacturer.
- 5. For cold applications, vapor retarder shall be installed in a continuous manner. No staples, rivets, screws or any other attachment device capable of penetrating the vapor retarder shall be used to attach the vapor retarder or jacketing.
No wire ties capable of penetrating the vapor retarder shall be used to hold the insulation in place. Banding shall be used to attach PVC or metal jacketing.
- 6. Elbows, flanges and other fittings shall be insulated with the same material as is used on the pipe straights. The elbow/ fitting insulation shall be field-fabricated, mitered or factory prefabricated to the necessary size and shape to fit on the elbow/

- fitting. Use of polyurethane spray-foam to fill PVC elbow jacket is prohibited on cold applications.
7. For cold applications, the vapor retarder on elbows/fittings shall be either mastic-fabric-mastic or 0.05 mm (2 mils) thick PVDC vapor retarder adhesive tape.
 8. All PVC and metal jacketing shall be installed so as to naturally shed water. Joints shall point down and shall be sealed with either adhesive or caulking (except for periodic slip joints).
 9. Note the NFPA 90A burning characteristic requirements of 25/50. Refer to paragraph GENERAL REQUIREMENTS for items not to be insulated.
 10. HVAC Condensation Control Insulation: Minimum 20 mm (3/4 inch) thick for all pipe sizes. Cooling coil condensation piping to waste piping fixture or drain inlet. Omit insulation on plastic piping in mechanical rooms.
- 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.
 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.

3.3 INSULATION APPLICATION - DUCTWORK

- A. Supply Air Ductwork transporting air that may sometimes may be colder than surrounding ambient or room temperature.
 - 1. Concealed in conditioned locations:
 - a. Round ductwork: 1-1/2-inch thick mineral fiber blanket with factory applied FSK
 - b. Rectangular ductwork: 1-inch thick mineral fiber board with factory applied FSK or 1-1/2-inch thick mineral fiber blanket with factory applied FSK
 - 2. Exposed in conditioned locations:
 - a. Round ductwork: 1-1/2-inch thick mineral fiber blanket with factory applied FSK or 1-inch thick elastomeric.
 - b. Rectangular ductwork: 1-inch thick mineral fiber board with factory applied FSK or 1-1/2-inch thick mineral fiber blanket with factory applied FSK
 - 3. Concealed in unconditioned locations (attic):
 - a. Round ductwork: 2-inch thick mineral fiber blanket with factory applied FSK or 1-1/2-inch thick elastomeric.
 - b. Rectangular ductwork: 2-inch thick mineral fiber board with factory applied FSK or 2-inch thick mineral fiber blanket with factory applied FSK elastomeric.
 - 4. Exposed in unconditioned locations:
 - a. Round ductwork: 2-inch thick mineral fiber blanket with factory applied FSK or 2-inch thick elastomeric.
 - b. Rectangular ductwork: 2-inch thick mineral fiber board with factory applied FSK or 2-inch thick mineral fiber blanket with factory applied FSK
- B. Outdoor Air Ductwork transporting air that has not been heated or cooled.
 - 1. Concealed in conditioned locations:
 - a. Round ductwork: 2-inch thick mineral fiber blanket with factory applied FSK or 1-1/2-inch thick elastomeric.
 - b. Rectangular ductwork: 2-inch thick mineral fiber board with factory applied FSK or 2-inch thick mineral fiber blanket with factory applied FSK.

2. Exposed in conditioned locations:
 - a. Round ductwork: 2-inch thick mineral fiber blanket with factory applied FSK or 1-1/2-inch thick elastomeric.
 - b. Rectangular ductwork: 2-inch thick mineral fiber board with factory applied FSK or 2-inch thick mineral fiber blanket with factory applied FSK.
 3. Concealed in unconditioned locations:
 - a. Round ductwork: None
 - b. Rectangular ductwork: None
 4. Exposed in unconditioned locations:
 - a. Round ductwork: 2-inch thick mineral fiber blanket with factory applied FSK or 1-1/2-inch thick elastomeric.
 - b. Rectangular ductwork: 2-inch thick mineral fiber board with factory applied FSK or 2-inch thick mineral fiber blanket with factory applied FSK.
- C. Return and Transfer Air Ductwork.
1. Concealed in conditioned locations:
 - a. Round ductwork: None
 - b. Rectangular ductwork: None
 2. Exposed in conditioned locations:
 - a. Round ductwork: None
 - b. Rectangular ductwork: None
 3. Concealed in unconditioned locations (attic):
 - a. Round ductwork: 1-1/2-inch thick mineral fiber blanket with factory applied FSK or 1-inch thick elastomeric.
 - b. Rectangular ductwork: 1-inch thick mineral fiber board with factory applied FSK or 1-1/2-inch thick mineral fiber blanket with factory applied FSK.
 4. Exposed in unconditioned locations:
 - a. Round ductwork: 2-inch thick mineral fiber blanket with factory applied FSK or 1-1/2-inch thick elastomeric.
 - b. Rectangular ductwork: 2-inch thick mineral fiber board with factory applied FSK or 2-inch thick mineral fiber blanket with factory applied FSK.

- D. Relief Air and HVAC Exhaust Air Ductwork - between spaces and an exterior wall or roof of the building.
1. Concealed in conditioned locations:
 - a. Round ductwork: None
 - b. Rectangular ductwork: None
 2. Exposed in conditioned locations:
 - a. Round ductwork: None
 - b. Rectangular ductwork: None
 3. Concealed in unconditioned locations:
 - a. Round ductwork: None
 - b. Rectangular ductwork: None
 4. Exposed in unconditioned locations:
 - a. Round ductwork: None
 - b. Rectangular ductwork: None

3.4 INSULATION APPLICATION - PIPING

| PIPE INSULATION TYPE AND THICKNESS SCHEDULE | | |
|--|-------------------------|----------------------------|
| INSULATION | PIPE SIZE (NOM. DIA.) | |
| | LESS THAN 1-1/2-INCH | GREATER THAN 1-1/2-INCH |
| COOLING COIL CONDENSATE DRAIN LINES MADE OF COPPER | | |
| Mineral Fiber k = 0.27 | 1/2 | 1/2 |
| Flexible Elastomeric maximum k=0.28 | 1/2 | 1/2 |
| Phenolic maximum k=0.168 | 1/2 | 1/2 |
| Polyisocyanurate maximum k=0.168 | 1/2 | 1/2 |
| REFRIGERANT | | |
| Flexible Elastomeric maximum k=0.28 | 2 | 2 |
| Phenolic maximum k=0.168 | 1 | 1 |
| Polyisocyanurate maximum k=0.168 | 1 | 1 |

3.5 COMMISSIONING

- A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.
- B. Components provided under this section of the specification will be tested as part of a larger system.

- - - E N D - - -

**SECTION 23 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 REQUIREMENTS. A Commissioning Agent (CxA) appointed by the VA will manage the commissioning process.

1.2 RELATED WORK

- A. Section 01 00 02 GENERAL REQUIREMENTS (MINOR NCA PROJECTS).
- 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 exterior closure, 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 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 and of Division 23, 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 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 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. The Contractor shall complete the checklists. Completed checklists shall be submitted to the VA and to the Commissioning Agent for review. The Commissioning Agent may spot check a sample of completed checklists. If the Commissioning Agent determines that the information provided on the checklist is not accurate, the Commissioning Agent will return the marked-up checklist to the Contractor for correction and resubmission. If the Commissioning Agent determines that a significant number of completed checklists for similar equipment are not accurate, the Commissioning Agent will select a broader sample of checklists for review.

If the Commissioning Agent determines that a significant number of the broader sample of checklists is also inaccurate, all the checklists for

the type of equipment will be returned to the Contractor for correction and resubmission. Refer to SECTION 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for Pre-Functional Checklists, Equipment Startup Reports, and other commissioning documents.

3.3 CONTRACTORS TESTS

- A. Contractor tests as required by other sections of Division 23 shall be scheduled and documented in accordance with Section 01 00 00 GENERAL REQUIREMENTS. All testing shall be incorporated into the project schedule. Contractor shall provide no less than 7 calendar days' notice of testing. The Commissioning Agent will witness selected Contractor tests at the sole discretion of the Commissioning Agent. Contractor tests shall be completed prior to scheduling Systems Functional Performance Testing.

3.4 SYSTEMS FUNCTIONAL PERFORMANCE TESTING:

- A. The Commissioning Process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions. The Commissioning Agent will prepare detailed Systems Functional Performance Test procedures for review and approval by the Resident Engineer. The Contractor shall review and comment on the tests prior to approval. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The Commissioning Agent will witness and document the testing. The Contractor shall sign the test reports to verify tests were performed. See Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS, for additional details.

3.5 TRAINING OF VA PERSONNEL

- A. Training of the VA operation and maintenance personnel is required in cooperation with the Resident Engineer and Commissioning Agent. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. Contractor shall submit training agendas and trainer resumes in accordance with the requirements of Section 01 91 00.

The instruction shall be scheduled in coordination with the VA Resident Engineer after submission and approval of formal training plans. Refer

Black Hills National Cemetery
Renovate and Expand Administration and Maintenance Buildings
20901 Pleasant Valley Drive
Sturgis, SD 57785

NCA Project # 884CM3015

10/31/22

Bid Documents

to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS and Division 23
Sections for additional Contractor training requirements.

----- END -----

SECTION 23 09 23
DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The control system(s) shall be as indicated on the project documents, point list, drawings, and described in these specifications. Include in this scope of work a complete and working system including all controls and installation materials, installation labor, commissioning and start-up.
- B. Supply as required, all necessary hardware equipment and software packages to interface between any existing and new system Unitary Control Units (UCU) as part of this contract. Number of controllers required is dependent on the type and quantity of devices, hardware and software points provided.
- C. The control systems is designed such that each mechanical system operates under stand-alone mode. Provide controllers for each mechanical system.
- D. Do not run power wiring in conduit with communications trunk wiring, signal, or control wiring operating at 100 volts or less.
- E. A complete listing of common acronyms and abbreviations are included in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- F. Definitions:
 - 1. 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.
 - 2. Analog: A continuously varying signal value (e.g., temperature, current, velocity etc).
 - 3. BAC: Building Automation Control.
 - 4. BAS: Building Automation System.
 - 5. 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).

6. 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.
7. BMP or bmp: Bitmap, 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.
8. Control Unit (CU): Generic term for any controlling unit, stand-alone, microprocessor based, digital controller.
9. Deadband: A temperature range over which no heating or cooling is supplied, i.e., 22 to 25 degrees C (72 to 77 degrees F), as opposed to a single point change over or overlap).
10. 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.
11. 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.
12. 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.
13. DXF: An AutoCAD 2-D graphics file format. Many CAD systems import and export the DXF format for graphics interchange.
14. 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.
15. 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.
16. Ethernet: Physical and data link layer technology system for exchanging messages between computers on a LAN using coaxial, fiber optic, or twisted-pair cables.

17. Firmware: Firmware is software programmed into read only memory (ROM) chips. Software may not be changed without physically altering the chip.
18. GIF: Abbreviation of Graphic interchange format.
19. 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.
20. Operating system (OS): Software, which controls the execution of computer application programs.
21. 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.
22. Peripheral: Different components that make the control system function as one unit. Peripherals include monitor, printer, and I/O unit.
23. PICS: Protocol Implementation Conformance Statement.
24. UCU: Unitary Control Unit, digital controller, dedicated to a specific piece of equipment, such as: air handling unit, heat pump, chiller, heat exchanger etc.

1.2 RELATED WORK

- A. Section 01 00 02, GENERAL REQUIREMENTS (Minor NCA Projects).
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Section 01 42 19, REFERENCE STANDARDS.
- D. Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS.
- E. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.
- F. Section 23 05 11, COMMON WORK RESULTS FOR HVAC: General mechanical requirements and items which are common to more than one section of Division 23.
- G. Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.
- H. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.
- I. Section 23 31 00, HVAC DUCTS AND CASINGS.
- J. Section 23 36 00, AIR TERMINAL UNITS.
- K. Section 23 81 00, UNITARY HVAC EQUIPMENT.

- L. Section 23 81 43, AIR-SOURCE UNITARY HEAT PUMPS.
- M. Section 23 81 46, WATER-SOURCE UNITARY HEAT PUMPS.
- N. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.
- O. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW).
- P. Section 27 10 00, NETWORK CABLING.

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 Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
 - 90.1-2013Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings
 - 135-2012BACnet - A Data Communication Protocol for Building Automation and Control Networks
- C. Federal Communication Commission (FCC):
 - Rules and Regulations Title 47 Chapter 1-2001 Part 15, Radio Frequency Devices.
- D. National Fire Protection Association (NFPA):
 - 70-2014National Electric Code (nec)
- E. Underwriter Laboratories Inc (UL):
 - 508A-2013 (R2014)Standard for Industrial Control Panels
 - 916-2015Standard for Energy Management 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 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC", 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. A wiring diagram for each type of input device and output device including DDC controllers, etc. Ensure diagram shows 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 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 schedule, including the size and pressure drop.
4. Installation instructions for smoke dampers, if furnished.
5. Catalog cut sheets of all equipment used. This includes, but is not limited to DDC controllers, panels, peripherals, 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, highlight the data specifically applicable to the project. Each submitted piece of literature and drawings should clearly reference the specification and/or drawings that it supposed to represent and provided in both hardcopy and electronic formats.
6. Provide sequence of operations for each HVAC system and the associated control diagrams. Ensure equipment and control labels correspond to those shown on the drawings. Ensure all control diagrams shown on drawings are represented accurately by graphics on the system. Generic graphics lacking some components or have components not in the project are not acceptable.
7. Color prints of proposed graphics with a list of points for display.
8. Furnish PICS (protocol implementation conformance statement) for each device.

D. Product Certificates: Compliance with paragraph, QUALITY ASSURANCE.

- E. As Built Control Drawings:
 - 1. Furnish three (3) copies of as-built drawings for each control system. Ensure the documents are submitted for approval prior to final completion.
 - 2. Furnish one (1) CD-ROM in PDF format for the drawings noted in subparagraphs above.
- 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 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.
- 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. Criteria:
 - 1. Single Source Responsibility of Contractor: Ensure that the controls contractor obtain hardware and software specified under this Section and that the controls contractor also installs the system. Ensure the controls contractor is responsible for the complete design, installation, and commissioning of the system. Ensure the controls contractor is in the business of design, installation and service of such building automation control systems similar in size and complexity.
 - 2. Equipment and Materials: Ensure equipment and materials are cataloged products of manufacturers regularly engaged in production and installation of HVAC control systems. Ensure products are manufacturer's latest standard design and have been tested and proven in actual use.
- B. Codes and Standards:
 - 1. Ensure all work conforms to the applicable Codes and Standards.

2. Ensure electronic equipment conforms to the requirements of FCC Regulation, Part 15, Governing Radio Frequency Electromagnetic Interference, and be so labeled.
3. Ensure unitary controllers conform to the requirements of UL 916, Category PAZX.
4. UL 508A for auxiliary fabricated control panels.
5. Ensure all controllers provided be UL tested and labeled.
6. System provided to comply with ASHRAE 135 and be UL tested, certified and labeled.
7. Ventilation Sequence of control to comply with ASHRAE 90.1.

1.6 PERFORMANCE

- A. Ensure the system conforms to the following:
 1. Object Command: Ensure the maximum time between the command of a binary object by the operator and the reaction by the device be 10 seconds. Ensure analog objects start to adjust within 3 seconds.
 2. Object Scan: Ensure all changes of state and change of analog values are to 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 10 seconds.
 3. Alarm Response Time: Ensure the maximum time from when an object goes into alarm to when it is annunciated at the workstation not exceed 10 seconds.
 4. Program Execution Frequency: Ensure custom and standard applications are capable of running as often as once every 5 seconds. Ensure that the controls contractor select execution times consistent with the mechanical process under control.
 5. Performance: Ensure programmable controllers are able to execute DDC PID control loops at a selectable frequency from at least once every 5 seconds. Ensure the controller scans and updates the process value and output generated by this calculation at this same frequency.

6. Reporting Accuracy: Listed below are minimum acceptable reporting 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 | ±1.0 degrees C (±2 degrees F) |
| Outdoor air temperature | ±1.0 degrees C (±2 degrees F) |

1.7 INSTRUCTIONS

- A. Instructions to VA operations personnel: Perform in accordance with paragraph, INSTRUCTIONS, in Section 01 00 01, GENERAL REQUIREMENTS (Major NCA Projects) and as noted below.

1.8 PROJECT CONDITIONS (ENVIRONMENTAL CONDITIONS OF OPERATION)

- A. Ensure the CUs and associated equipment used in controlled environment are mounted in NEMA 1 enclosures for operation at 0 to 50 degrees C (32 to 122 degrees F) at a relative humidity of 10 to 90 percent non-condensing.
- B. Ensure the CUs used outdoors are mounted in NEMA 4 waterproof enclosures, and are rated for operation at minus 40 to plus 65 degrees C (minus 40 to plus 150 degrees F).
- C. Ensure all electronic equipment operates properly with power fluctuations of plus 10 percent to minus 15 percent of nominal supply voltage.
- D. Ensure sensors and controlling devices are designed to operate in the environment, which they are sensing or controlling.

1.9 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 CD or DVD inserted into a three ring binder. All aspects of system operation and maintenance procedures, including applicable piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations.

Notes on all special systems or devices shall be included. A List of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.

- C. The installing contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. As-built drawings are to be provided, and a copy of them in Auto-CAD version 2018 or later provided on CD 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 CONTROLS SYSTEM ARCHITECTURE

- A. General: Provide licenses for all software residing on and used by the Controls Systems and transfer these licenses to the Government prior to completion.
- B. The Specifications for the individual elements and component subsystems are the minimum requirements and 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. Third Party Interfaces: Ensure the Controls Systems include necessary hardware, equipment and software to allow data communications between the Controls Systems and building systems supplied by other trades.
 - 1. The contractor shall ensure the other manufacturers and subcontractors supplying other associated systems and equipment will provide the necessary hardware, software, and start-up and will cooperate fully with the controls contractor in a timely manner to ensure complete functional integration.

2.2 DIRECT DIGITAL CONTROLLERS

- A. Ensure Unitary Control Units (UCUs) are microprocessor-based. Ensure they are capable of stand-alone operation, continuing to provide stable control functions if communication is lost with the rest of the system.
 - 1. Ensure the each UCU have sufficient memory to support its own operating system, including data sharing.
 - 2. Ensure all UCUs are provided with LCD type annunciation to continually display its operational mode, power and communications.
 - 3. In the event of loss of normal power, ensure the orderly shut down of the controllers to prevent the loss of database or software programming. When power is restored flash memory, battery backup, or super capacitor will be automatically loaded into non-volatile flash memory and incorporated for all programming data.
- B. Provide I/O module that connects sensors and actuators onto the field bus network for use by the direct digital controllers. Ensure I/O devices support the communication technology specified for each controller.
 - 1. Ensure analog input allow the monitoring of low voltage (0-10 VDC), current (4-20 ma), or resistance signals (thermistor, RTD). Ensure analog input be compatible with, and field configurable to commonly available sensing devices. Ensure that analog output provide a modulating signal for these control devices.
 - 2. Ensure binary inputs allow the monitoring of on/off signals from remote devices. Ensure that binary inputs provide a wetting current of at least 12 milliamps to be compatible with commonly available control devices. Ensure that binary outputs provide on/off operation, or a pulsed low voltage signal for pulse width modulation control. Ensure outputs be selectable for either normally open or normally closed operation.
 - 3. Ensure binary outputs on remote and auxiliary controllers have 3-position (on/off/auto) override switches and status lights. Ensure analog outputs on remote and auxiliary controllers have status lights and a 2-position (auto/manual) switch and manually adjustable potentiometer for manual override.
 - 4. Ensure each output point be provided with a light emitting diode (LED) to indicate status of outputs.

2.3 DIRECT DIGITAL CONTROLLER SOFTWARE

- A. Ensure the software programs specified in this section are commercially available, concurrent, multi-tasking operating system and support the use of software application that operates under DOS or Microsoft Windows.
- B. Ensure all points are to be identified by up to 30-character point name and 16-character point descriptor.
- C. Ensure all control functions execute within the stand-alone control units via DDC algorithms.
- D. Ensure all CU's are capable of being programmed to utilize stored default values for assured fail-safe operation of critical processes. Ensure default values 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. Ensure individual application software packages are structured to assume a fail-safe condition upon loss of input sensors.
- E. Ensure all DDC control loops are able to utilize any of the following control modes:
 - 1. Two position (on-off, slow-fast) control.
 - 2. Proportional control.
 - 3. Proportional plus integral (PI) control.
 - 4. Proportional plus integral plus derivative (PID) control. Ensure all PID programs automatically invoke integral wind up prevention routines whenever the controlled unit is off, under manual control of an automation system or time initiated program.
 - 5. Automatic tuning of control loops.
- F. System Security: Ensure operator access be secured using individual password and operator's name. Ensure passwords restrict the operator to the level of object, applications, and system functions assigned to him. Provide a minimum of six (6) levels of security for operator access.
- G. Application Software: Ensure the CUs provide the following programs as a minimum for the purpose of optimizing energy consumption while maintaining comfortable environment for occupants. Ensure all application software reside and run in the system digital controllers.
 - 1. Power Demand Limiting (PDL): Ensure power demand limiting program monitor the building power consumption and limit the consumption of electricity to prevent peak demand charges.

- Ensure PDL continuously tracks the electricity consumption from a pulse input generated at the kilowatt-hour/demand electric meter. Ensure PDL samples the meter data to continuously forecast the electric demand likely to be used during successive time intervals. If the forecast demand indicates that electricity usage will likely exceed a user preset maximum allowable level, then PDL shall automatically shed electrical loads. Once the demand load has met, restore and return to normal mode all loads that have been shed. Ensure control system is capable of demand limiting by resetting the HVAC system set points to reduce load while maintaining indoor air quality.
2. Night Setback/Morning Warm up Control: Ensure the system provides the ability to automatically adjust set points for this mode of operation.
 3. Optimum Start/Stop (OSS): Ensure optimum start/stop program automatically coordinates with event scheduling. Ensure the OSS program starts HVAC equipment at the latest possible time that will allow the equipment to achieve the desired zone condition by the time of occupancy, and also shut down HVAC equipment at the earliest possible time before the end of the occupancy period and still maintain desired comfort conditions. Ensure the OSS program considers both outside weather conditions and inside zone conditions. Ensure the program automatically assigns longer lead times for weekend and holiday shutdowns. Ensure the program polls all zones served by the associated air handling unit and selects the warmest and coolest zones. Use these in the start time calculation. Ensure the possibility to assign occupancy start times on a per air handler unit basis. Ensure the program meets the local code requirements for minimum outdoor air while the building is occupied.
 4. 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. Ensure this program provides the capability to individually command a point or group of points. When points are assigned to one common load group, ensure the possibility to assign variable time advances/delays between each successive start or stop within that group. Ensure scheduling be calendar based and advance schedules may be defined up to one year in advance.

Ensure advance schedule overrides the day-to-day schedule. Ensure the operator is able to define the following information:

- a. Time, day.
 - b. Commands such as on, off, auto.
 - c. Time delays between successive commands.
 - d. Manual overriding of each schedule.
 - e. Allow operator intervention.
5. Alarm Reporting: Ensure the system is able to start programs, log the event, and display the messages.
6. Maintenance Management (PM): Ensure the system monitors equipment status and generate maintenance messages based upon the operators defined equipment run time, starts, and/or calendar date limits. Ensure a preventative maintenance alarm is displayed indicating maintenance requirements based on pre-defined run time. Ensure each preventive message include point description, limit criteria, and preventative maintenance instruction assigned to that limit. Ensure a minimum of 480-character PM be provided for each component of units such as air handling units.

2.4 SENSORS (AIR AND WATER)

A. Temperature Sensors:

1. Electronic Sensors: Provide all remote sensors as required for the systems. Ensure all sensors are vibration and corrosion resistant for wall, and/or duct mounting.
 - a. Temperature Sensors: Thermistor type for terminal units and Resistance Temperature Device (RTD) with an integral transmitter type for all other sensors.
 - 1) Ensure duct sensors are rigid or averaging type as shown on drawings. Ensure averaging sensor is a minimum of 1 linear foot of sensing element for each square foot of cooling coil face area.
 - 2) Ensure space sensors are equipped with set-point adjustment, override switch, display, and/or communication port as shown on the drawings. Match room thermostats, locking cover.
 - 3) Ensure outdoor air temperature sensors have watertight inlet fittings and be shielded from direct sunlight.
 - 4) Ensure room security sensors have stainless steel cover plate with insulated back and security screws.

- 5) Wire: Twisted, shielded-pair cable.
- 6) Output Signal: 4-20 ma.

B. Current Switches: Ensure current operated switches are self-powered, solid state with adjustable trip current as well as status, power, and relay command status LED indication. Ensure the switches are selected to match the current of the application and output requirements of the DDC systems.

2.5 CONTROL CABLES

- A. As specified in Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW).
- B. As specified in Section 27 10 00, NETWORK CABLING.

2.6 THERMOSTATS

- A. Ensure room thermostats controlling heating and cooling devices have three modes of operation (heating - null or dead band - cooling). Ensure wall mounted thermostats have manufacturer's recommendation finish, setpoint range and temperature display and external adjustment:
 - 1. Electronic Thermostats: Solid-state, microprocessor based, programmable to daily, weekend, and holiday schedules.
 - a. Public Space Thermostat: Ensure public space thermostat is a platinum sensor and not have a visible means of set point adjustment. Ensure adjustment be via the digital controller to which it is connected.
- B. Ensure strap-on thermostats are enclosed in a dirt and moisture proof housing with fixed temperature switching point and single pole, double throw switch.

2.7 FINAL CONTROL ELEMENTS AND OPERATORS

- A. Fail Safe Operation: Ensure control valves and dampers 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. Ensure all modulating dampers are opposed blade type and gasketed. Ensure blades for two-position, duct-mounted dampers are the parallel, airfoil (streamlined) type for minimum noise generation and pressure drop.
1. Leakage: Ensure maximum leakage in closed position not to exceed 4cfm/sq.ft. at 1.0 inch WG differential pressure.
 2. Ensure frame is galvanized steel channel with seals as required to meet leakage criteria.
 3. Ensure blades are galvanized steel or aluminum, 200 mm (8 inch) maximum width, with edges sealed as required.
 4. Ensure bearing is nylon, bronze sleeve or ball type.
 5. Ensure hardware is zinc-plated steel. Ensure connected rods and linkage be non-slip. Ensure working parts of joints are brass, bronze, nylon or stainless steel.
 6. Ensure metal parts are aluminum, mill finish galvanized steel, or zinc plated steel or stainless steel.
 7. Maximum air velocity and pressure drop through free area of the dampers:
 - a. Smoke damper in air handling unit: 210 meter per minute (688 fpm).
 - b. Duct mounted damper: 600 meter per minute (1968 fpm).
 - c. Maximum static pressure loss: 50 Pascal (0.20 inches water gage).
- D. Ensure operators are electric type. See drawings for required control operation.
- E. 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.
- F. Damper Operators and Relays:
1. Ensure electric damper operator provides full modulating control of dampers. Ensure a linkage and pushrod be furnished for mounting the actuator on the damper frame internally in the duct or externally in the duct or externally on the duct wall, or be furnished with a direct-coupled design.

2. Electronic Damper Operators: Ensure VAV Box actuator to be mounted on the damper axle or be of the air valve design, and provide complete modulating control of the damper. Ensure the motor has a closure torque of 35-inch pounds minimum with full torque applied at close off to attain minimum leakage.

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. 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 wiring /conduit parallel to or at right angles to building lines.
 3. Install all equipment 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 equipment.
 6. Run tubing and wire connecting devices on or in control cabinets parallel with the sides of the cabinet neatly racked to permit tracing.
 7. Install equipment level and plum.
- C. Electrical Wiring Installation:
 1. Install conduits and wiring in accordance with Specification Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.
 2. Install signal and communication cables in accordance with Specification Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW).

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. Ensure all wiring is installed in conduits.
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 power is required, provide suitable transformers.
5. Install all system components in accordance with local Building Code and National Electric Code.
 - a. Splices: Ensure splices in shielded and coaxial cables consist of terminations and the use of shielded cable couplers. Ensure terminations are in accessible locations. Ensure cables are 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. Ensure equipment for fiber optics system is rack mounted, as applicable, in ventilated, self-supporting, code gage steel enclosure. Ensure cables are 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 along with the name and address of the point. 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.

9. Ensure fabricated control panels built to support auxiliary devices such as power supplies, relays, controllers, and control devices are certified to UL 508A.

D. Install Sensors and Controls:

1. Temperature Sensors:

- a. Install all sensors and instrumentation according to manufacturer's written instructions. Ensure temperature sensor locations are 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. Ensure use of sensors are 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. Ensure sensors are mounted at 1.5 meter (5.0 feet) above the finished floor.
 - e. Mount sensors rigidly and adequately for the environment within which the sensor operates.
 - f. Ensure sensors used in mixing plenum, and hot and cold decks are of the averaging type. Ensure averaging sensors are installed in a serpentine manner horizontally across duct. Ensure each bend is supported with a capillary clip.
 - g. Ensure all pipe mounted temperature sensors are installed in wells.
 - h. Ensure all wires attached to sensors are 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. 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.

3.2 STARTUP AND TESTING

- A. Make tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.
- B. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.
- C. The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and Commissioning Agent. Provide a minimum notice of 10 working days prior to startup and testing.

3.3 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 8 hours to instruct each VA personnel responsible in the 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.
- C. Demonstration:
 - 1. System operation and calibration to be demonstrated by the Installer in the presence of the Government's representative
 - 2. Demonstrate to authorities that systems are fully functional and complete.
 - 3. Make accessible, personnel to provide necessary adjustments and corrections to systems as directed by balancing agency.

Black Hills National Cemetery
Renovate and Expand Administration and Maintenance
20901 Pleasant Valley Drive
Sturgis, SD 57785

NCA Project # 884CM3015
10/31/22
Bid Documents

4. Include the following witnessed demonstrations of field control equipment:
 - a. Observe HVAC systems in shut down condition. Check dampers and valves for normal position.
 - b. 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.

----- END -----

**SECTION 23 11 23
FACILITY NATURAL-GAS PIPING**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Fuel gas 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 23 05 11, COMMON WORK RESULTS FOR HVAC.

1.2 RELATED WORK

- A. Section 01 00 02, GENERAL REQUIREMENTS (Minor NCA Projects).
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Section 01 42 19, REFERENCE STANDARDS.
- D. Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS.
- E. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.
- F. Section 07 84 00, FIRESTOPPING: Penetrations in rated enclosures.
- G. Section 07 92 00, JOINT SEALANTS.
- H. Section 09 91 00, PAINTING: Preparation and finish painting and identification of piping systems.
- I. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- J. Section 22 05 23, GENERAL-DUTY VALVES FOR PLUMBING PIPING.
- K. Section 23 08 00, COMMISSIONING OF HVAC 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 for Civil Engineers (ASCE):
25-2006Earthquake-Actuated Automatic Gas Shutoff
Devices
- C. American Society of Mechanical Engineers (ASME): (Copyrighted Society)
B16.3-2011Malleable Iron Threaded Fittings: Classes 150
and 300
B16.9-2012Factory-Made Wrought Steel Buttwelding Fittings
B16.11-2011Forged Fittings, Socket-Welding and Threaded
B16.15-2013Cast Copper Alloy Threaded Fittings: Classes
125 and 250

- B31.8-2014Gas Transmission and Distribution Piping
Systems
- D. American Society for Testing and Materials (ASTM):
 - A47/A47M-1999 (R2014) ..Standard Specification for Ferritic Malleable
Iron Castings
 - A53/A53M-2012Standard Specification for Pipe, Steel, Black
And Hot-Dipped, Zinc-coated, Welded and
Seamless
 - A536-1984 (R2014)Standard Specification for Ductile Iron
Castings
 - A733-2015Standard Specification for Welded and Seamless
Carbon Steel and Austenitic Stainless Steel
Pipe Nipples
 - B43-2015Standard Specification for Seamless Red Brass
Pipe, Standard Sizes
 - B687-1999 (R2011)Standard Specification for Brass, Copper, and
Chromium-Plated Pipe Nipples
 - STP534-1973Manual of Industrial Corrosion Standards and
Control
- E. American Water works Association (AWWA):
 - C203-2015Coal-Tar Protective Coatings and Linings for
Steel Water Pipes
- F. International Code Council:
 - IFGC-2015International Fuel Gas Code
- G. Manufacturers Standardization Society of the Valve and Fittings
Industry, Inc. (MSS):
 - SP-72-2010aBall Valves With Flanged or Butt-Welding For
General Purpose
 - SP-110-2010Ball Valves Threaded, Socket-Welding, Solder
Joint, Grooved and Flared Ends
- H. NACE International (NACE):
 - SP0274-2011High-Voltage Electrical Inspection of Pipeline
Coatings
 - SP0490-2007Holiday Detection of Fusion-Bonded Epoxy
External Pipeline Coating of 250 to 760 μm (10
to 30 mil)

I. National Fire Protection Association (NFPA):

54-2015National Fuel Gas Code

SPEC WRITER NOTE: Make material requirements agree with applicable requirements specified in the referenced Applicable Publications. Update and specify only that which applies to the project.

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 11 23, FACILITY NATURAL-GAS 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. Strainers.
 - 3. All items listed in Part 2 - Products.
- 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 replacement parts, and troubleshooting guide:
 - 1. Include complete list indicating all components of the systems.
 - 2. Include complete diagrams of the internal wiring for each item of equipment.
 - 3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.
- F. Completed System Readiness Checklist provided by the 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.
- G. 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. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.
- B. Submit operation and maintenance data updated to include submittal review comments, substitutions and construction revisions shall be inserted into a three ring binder. All aspects of system operation and maintenance procedures, including 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. As-built drawings are to be provided, and a copy of them in Auto-CAD version 2018 or later provided on CD 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 FUEL GAS SERVICE CONNECTIONS TO BUILDING

- A. From inside face of exterior wall to a distance of approximately 1.5 m (5 feet) outside of building, use coated piping.

- B. Pipe: Black steel, ASTM A53/A53M, Schedule 40. Shop-applied pipe coating shall be one of the following types:
1. Coal Tar Enamel Coating: Exterior of pipe and fittings shall be cleaned, primed with Type B primer, and coated with hot-applied coal tar enamel with bonded layer of felt wrap in accordance with AWWA C203. Asbestos felt is prohibited. Felt material shall be fibrous glass mat as specified in AWWA C203.
 2. Adhesive-thermoplastic Resin Coating: ASTM STP534, Type I.
 3. Thermosetting Epoxy Coating: Fed. ASTM STP534, Type II.
 4. Field-applied plastic tape material used on pipe joints and for repairing damaged areas of shop-applied coatings, ASTM STP534, Type I, 10 mils nominal thickness for pipe joints, and Type II, 20 mils nominal thickness for coating repairs.
- C. Holiday Inspections:
1. Procedures for Holiday Inspection: Holiday inspection shall be conducted on all coatings to determine the presence and number of discontinuities in those coatings. Holiday inspection shall be performed in a manner spelled out in the Tinker & Rasor operating instructions and at a voltage level recommended by the coating manufacturer or applicable standard such as NACE SP0274 or NACE SP0490 in the case thermosetting epoxy coating.
 2. Holiday Detectors shall be calibrated and supplied with a certificate of calibration from the factory. A calibration of the Holiday Detector shall be performed once every 6 months to verify output voltages are true and correct.
- D. Fittings:
1. Butt weld fittings, wrought steel, ASME B16.9.
 2. Socket weld and threaded fittings forged steel, ASME B16.11.
 3. Grooved End: Ductile iron (ASTM A536, Grade 65-45-12), malleable iron (ASTM A47/A47M, Grade 32510), or steel (ASTM A53/A53M, Type F or Type E or S, Grade B).
- E. Joints: Welded, ASME B31.8.

2.2 FUEL GAS PIPING

- A. Pipe: Black steel, ASTM A53/A53M, Schedule 40.
B. Nipples: Steel, ASTM A733, Schedule 40.

C. Fittings:

1. Steel Welded: Schedule 40.
 - a. Smaller than 50 mm (2 inches), ASME B16.3, threaded malleable iron.
 - b. 50 mm to 100 mm (2 inches to 4 inches), ASME B16.11, socket welded.
 - c. Over 100 mm (4 inches), ASME B16.9, butt welded.
2. Grooved End: Ductile iron (ASTM A536, Grade 65-45-12), malleable iron (ASTM A47/A47M, Grade 32510), or steel (ASTM A53/A53M, Type F or Type E or S, Grade B).

D. Joints: Provide welded or threaded joints.

2.3 EXPOSED FUEL GAS PIPING

- A. Finished Room: Use full iron pipe size chrome-plated brass piping for exposed fuel gas piping connecting fixtures, casework, cabinets, equipment, and reagent racks when not concealed by apron including those furnished by the Government or specified in other sections.
1. Pipe: ASTM B43, standard weight
 2. Fittings: ASME B16.15 cast bronze threaded fittings with chrome finish, (125 and 250).
 3. Nipples: ASTM B687, Chromium-plated.
 4. Unions: 50 mm (2 inches) and smaller MSS SP-72, MSS SP-110, brass or bronze, threaded with chrome finish. Unions 65 mm (2-1/2 inches) and greater shall be flange type with approved gaskets.
 5. Valves: MSS SP-72, MSS SP-110, brass or bronze, with chrome finish.
- B. Unfinished Rooms and Mechanical Rooms: Chrome-plated brass piping is not required. Paint piping systems as specified in Section 09 91 00, PAINTING.

2.4 VALVES

- A. Ball Valve: Bronze body, rated for 1034 kPa at 185 degrees C (150 psig at 365 degrees F), 1724 kPa at 121 degrees C (250 psig at 250 degrees F), reinforced TFE seat, stem seal, and thrust washer; end entry, threaded ends, UL listed for natural or LP gas shut off service when used on those services.
- B. Gas Vent Cocks: Type 701, bronze body, tee handle, rated for 207 kPa at 38 degrees C (30 psig at 100 degrees F), ground plug, rated for tight shut-off on fuel gas service.

2.5 WATERPROOFING

- A. Provide at points where pipes pass through membrane waterproofed floors or walls in contact with earth.
- B. Floors: Provide cast iron stack sleeve with flashing device and an underdeck clamp. After stack is passed through sleeve, provide a waterproofed caulked joint at top hub.
- C. Walls: Provide cast iron sleeve with flashing device and a mechanical link seal. After pipe is passed through sleeve, provide a waterproofed caulked joint at inside wall face and escutcheon.

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. Gas Lines: "Y" type with removable mesh lined brass strainer sleeve.
- C. Body: Smaller than 75 mm (3 inches), brass or bronze; greater than 75 mm (3 inches), cast iron or semi-steel.

2.7 DIELECTRIC FITTINGS

- A. Provide dielectric couplings or unions between ferrous and non-ferrous pipe.

2.8 GAS EQUIPMENT CONNECTORS

- A. Flexible connectors with Teflon core, interlocked galvanized steel protective casing, AGA certified design.

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. General: Comply with the ICC IFGC and the following:
 - 1. Install branch piping for fuel gas 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 shall be reamed to full size after cutting.
 - 3. All pipe runs shall be laid out to avoid interference with other work.

4. Install valves with stem in horizontal position whenever possible.
All valves shall be easily accessible.
5. Install union and shut-off valve on pressure piping at connections to equipment.
6. Pipe Hangers, Supports, and Accessories:
 - a. All piping shall be supported per ICC IFGC.
 - b. Shop Painting and Plating: Hangers, supports, rods, inserts, and accessories used for Pipe supports shall be shop coated with red lead or zinc Chromate primer paint. Electroplated copper hanger rods, hangers, and accessories may be used with copper tubing. Painting shall comply with Section 09 91 00, PAINTING.
 - c. Floor, Wall and Ceiling Plates, Supports, Hangers:
 - 1) Solid or split unplated cast iron, chrome-plated in finished areas.
 - 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) Riser Clamps: Malleable iron or steel.
 - 8) Rollers: Cast iron.
 - 9) Self-drilling type expansion shields shall be "Phillips" type, with case hardened steel expander plugs.
 - 10) Miscellaneous Materials: As specified, required, directed, or as noted in the contract documents for proper installation of hangers, supports, and accessories.
7. Install chrome-plated cast escutcheon with set screw at each wall, floor, and ceiling penetration in exposed finished locations and within cabinets and millwork.

8. Penetrations:

- a. Fire Stopping: 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 fire stopping 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.

C. Fuel Gas Piping shall conform to the following:

1. Entire fuel gas piping installation shall be in accordance with requirements of NFPA 54 and ICC IFGC.
2. Install fuel gas piping with plugged drip pockets at low points.

3.2 CLEANING OF SYSTEM AFTER INSTALLATION

- A. Clean all piping systems to remove all dirt, coatings and debris.

3.3 STARTUP AND TESTING

- A. Make tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.
- B. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.
- C. Test system either in its entirety or in sections. Test shall be made in accordance with the ICC IFGC. The system shall be tested at a minimum of 1.5 times maximum working pressure, but not less than 21 kPa (3 psig)).
- D. The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and Commissioning Agent. Provide a minimum notice of 10 working days prior to startup and testing.

3.4 COMMISSIONING

- A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.
- B. Components provided under this section of the specification will be tested as part of a larger system.

Black Hills National Cemetery
Renovate and Expand Administration and Maintenance Buildings
20901 Pleasant Valley Drive
Sturgis, SD 57785

NCA Project # 884CM3015

10/31/22

Bid Documents

3.5 DEMONSTRATION AND TRAINING

- A. Provide services of manufacturer's technical representative for four hours to instruct each VA personnel responsible in the 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.

- - - E N D - - -

SECTION 23 23 00
REFRIGERANT PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Field refrigerant piping for direct expansion HVAC 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. Refrigeration 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 refrigeration system subjected to evaporator pressure.
 - b. High side means the parts of a refrigeration 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 450 degrees C (842 degrees F) but less than the melting temperatures of the joined parts.

1.2 RELATED WORK

- A. Section 01 00 02, GENERAL REQUIREMENTS (Minor NCA Projects).
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Section 01 42 19, REFERENCE STANDARDS.
- D. Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS
- E. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS
- F. Section 23 05 11, COMMON WORK RESULTS FOR HVAC: General mechanical requirements and items which are common to more than one section of Division 23.
- G. Section 23 07 11, HVAC INSULATION: Requirements for piping insulation.
- H. Section 23 08 00, COMMISSIONING OF HVAC 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. Air Conditioning, Heating, and Refrigeration Institute (AHRI):
 - 730-2013Flow Capacity Rating of Suction-Line Filters
and Suction-Line Filter-Driers
 - 750-2007Performance Rating of Thermostatic Refrigerant
Expansion Valves
 - 760-2014Performance Rating of Solenoid Valves for Use
with Volatile Refrigerants
- C. American National Standards Institute (ANSI):
 - Z535.1-2006 (R2011)Safety Colors
- D. American Society of Heating, Refrigerating and Air-Conditioning
Engineers, Inc. (ASHRAE):
 - 15-2013Safety Standard for Refrigeration Systems
 - 17-2008Method of Testing Capacity of Thermostatic
Refrigerant Expansion Valves
 - 34-2013Designation and Safety Classification of
Refrigerants
 - 63.1-1995 (RA 2001)Method of Testing Liquid Line Refrigerant
Driers
- E. American Society of Mechanical Engineers (ASME):
 - A13.1-2015Scheme for the Identification of Piping Systems
 - B16.22-2013Wrought Copper and Copper Alloy Solder-Joint
Pressure Fittings
 - B16.24-2011Cast Copper Alloy Pipe Flanges and Flanged
Fittings, Class 150, 300, 600, 900, 1500, and
2500
 - B31.5-2013Refrigeration Piping and Heat Transfer
Components
 - B40.100-2013Pressure Gauges and Gauge Attachments
 - B40.200-2008Thermometers, Direct Reading and Remote Reading
- F. American Society for Testing and Materials (ASTM)
 - A126-2004 (R2014)Standard Specification for Gray Iron Castings
for Valves, Flanges, and Pipe Fittings
 - B32-2008 (R2014)Standard Specification for Solder Metal
 - B280-2013Standard Specification for Seamless Copper Tube
for Air Conditioning and Refrigeration Field
Service

G. American Welding Society, Inc. (AWS):

BRH-2007Braze Handbook, 5th Edition

A5.8/A5.8M-2011Specification for Filler Metals for Brazing and
Braze Welding

H. Underwriters Laboratories (UL):

207-2009 (R2014)Standard for Refrigerant-Containing Components
and Accessories, Nonelectrical

429-2013Standard 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, REFRIGERANT 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.

D. Shop Drawings:

1. Sufficient information including valves and refrigerant piping accessories shall be included as to be able to clearly determine compliance with 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. Gages
- j. Pipe and equipment supports
- k. Refrigerant and oil
- l. Pipe/conduit roof penetration cover
- m. Soldering and brazing materials

- E. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replacement parts, and troubleshooting guide:
 - 1. Include complete list indicating all components of the systems.
 - 2. Include complete diagrams of the internal wiring for each item of equipment.
 - 3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.
- F. Completed System Readiness Checklist provided by the 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.
- 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. Refer to paragraph QUALITY ASSURANCE, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- B. Comply with ASHRAE 15, Safety Standard for Refrigeration Systems (ANSI Approved), and ASHRAE 34, Designation and Classification of Refrigerants. The application of this Code is intended to assure the safe design, construction, installation, operation, and inspection of every refrigeration system employing a fluid which normally is vaporized and liquefied in its refrigeration cycle.
- C. Comply with ASME B31.5: Refrigerant Piping and Heat Transfer Components.
- D. Products shall comply with UL 207 and/or UL 429.

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 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. As-built drawings are to be provided, and a copy of them in Auto-CAD version 2018 or later provided on CD or DVD. Should the installing contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement.
- D. Certification documentation shall be provided to COR 10 working days prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and certification that all results of tests were within limits specified.

PART 2 - PRODUCTS

2.1 PIPING AND FITTINGS

- A. Refrigerant Piping: Copper refrigerant tube, ASTM B280, cleaned, dehydrated and sealed, marked ACR on hard temper straight lengths. Provide coils tagged ASTM B280 by the manufacturer.
- B. Fittings, Valves and Accessories:
 - 1. Solder joints: Wrought copper fittings, ASME B16.22.
 - a. Solder, refrigerant tubing: Cadmium free, AWS A5.8/A5.8M, 45 percent silver brazing alloy, Class BAg-5.
 - b. Solder, water, and drain: 95-5 tin-antimony, ASTM B32 (95TA).
 - 2. Flanges and flanged fittings: ASME B16.24.
 - 3. Refrigeration Valves:
 - a. Stop Valves: Brass or bronze alloy, packless, or packed type with gas tight cap, frost proof, backseating.

- 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 15.
 - c. Solenoid Valves: Comply with AHRI 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 normally open coil.
 - d. Thermostatic Expansion Valves: Comply with AHRI 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 17.
 - e. 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. Provide direction of flow indicator legibly and permanently on the valve body.
4. 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.

5. 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.
6. Refrigerant Filter-Dryers: UL listed, angle or in-line type, as shown on drawings. Conform to AHRI 730 and ASHRAE 63.1. Heavy gage 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. Provide filter driers with replaceable filters with one spare element of each type and size.
7. 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 GAGES

- A. Temperature Gages: Comply with ASME B40.200. Industrial-duty type and in required temperature range for service in which installed. Gages shall have Celsius scale in 1-degree (Fahrenheit scale in 2-degree) graduations and with black number on a white face. Provide adjustable pointers. Provide rigid stem type temperature gages in thermal wells located within 1500 mm (5 feet) of the finished floor. Utilize universal adjustable angle type or remote element type temperature gages in thermal wells located 1500 to 2100 mm (5 to 7 feet) above the finished floor. Provide remote element type temperature gages in thermal wells located 2100 mm (7 feet) above the finished floor.
- B. Vacuum and Pressure Gages: Comply with ASME B40.100 and provide with throttling type needle valve or a pulsation dampener and shut-off valve. Gage shall be a minimum of 90 mm (3-1/2 inches) in diameter with a range from 0 kPa (0 psig) to approximately 1.5 times the maximum system working pressure. Select each gage range so that at normal operating pressure, the needle is within the middle-third of the range.
 1. Suction: 101 kPa (30 inches Hg) vacuum to 1724 kPa (250 psig).
 2. Discharge: 0 to 3447 kPa (0 to 500 psig).

2.3 PIPE SUPPORTS

- A. Refer to specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

2.4 REFRIGERANTS AND OIL

- A. Provide required refrigerant and oil for proper system operation.

2.5 PIPE/CONDUIT ROOF PENETRATION COVER

- A. Prefabricated Roof Curb: Galvanized steel or extruded aluminum 300 mm (12 inches) overall height, continuous welded corner seams, treated wood nailer, 40 mm (1-1/2 inch) thick, 48 kg/cu. m (3 lb/cu. ft.) density rigid mineral fiberboard insulation with metal liner, built-in cant strip (except for gypsum or tectum decks). For surface insulated roof deck, provide raised cant strip (recessed mounting flange) to start at the upper surface of the insulation. Curbs constructed for pitched roof or ridge mounting as required to keep top of curb level.
- B. Penetration Cover: Galvanized sheet metal with flanged removable top. Provide 40 mm (1-1/2 inch) thick mineral fiber board insulation.
- C. Flashing Sleeves: Provide sheet metal sleeves for conduit and pipe penetrations of the penetration cover. Seal watertight penetrations.

2.6 PIPE INSULATION FOR DX HVAC SYSTEMS

- A. Refer to specification Section 23 07 11, HVAC INSULATION.

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 refrigerant piping and refrigerant containing parts in accordance with ASHRAE 15 and ASME B31.5.
 - 1. Install piping as short as possible, with a minimum number of joints, elbows, and fittings.
 - 2. Install piping with adequate clearance between pipe and adjacent walls and hangers as to allow for service and inspection. Space piping, including insulation, to provide 25 mm (1 inch) minimum clearance between adjacent piping or other surfaces. 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 on the drawing.

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.

C. 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.

D. Protect refrigeration 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.

E. Pipe relief valve discharge to outdoors for systems containing more than 45 kg (100 lbs) of refrigerant.

F. 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 INSULATION.

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. For each refrigeration system erected on the premises provide an easily legible permanent sign securely attached and easily accessible, indicating 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. For systems containing more than 50 kg (110 lb) of refrigerant provide with durable signs, in accordance with ASME A13.1 and ANSI Z535.1, having letters not less than 15 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.

3.5 FIELD TESTS

- A. After completion of piping installation and prior to initial operation, conduct tests 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 gages, control mechanisms, and systems that are factory tested, shall be tested and proved tight after complete installation, and before operation.

2. Test the high and low side of each system and prove 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.
- B. Test Medium: Use a suitable dry gas such as nitrogen 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 gage 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.

3.6 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 69 kPa (10 psig). 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 refrigeration system by the triplicate evacuation method with a vacuum pump equipped with an electronic gage reading in mPa (microns). Pull the system down to 665 mPa (500 microns) and hold for four hours then break the vacuum with dry nitrogen (or refrigerant). Repeat the evacuation two more times breaking the third vacuum with the refrigerant to be charged and charge with the proper volume of refrigerant.

3.7 STARTUP AND TESTING

- A. Make tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements.

Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.

- B. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.
- C. The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and Commissioning Agent. Provide a minimum notice of 10 working days prior to startup and testing.

3.8 COMMISSIONING

- A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.
- B. Components provided under this section of the specification will be tested as part of a larger system.

- - - E N D - - -

**SECTION 23 31 00
HVAC DUCTS AND CASINGS**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Ductwork and accessories for HVAC including supply air, return air, outside air, exhaust, roof hoods, goosenecks, and relief 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. SMACNA Standards as used in this specification means the HVAC Duct Construction Standards, Metal and Flexible.
 - 2. Seal or Sealing: Use of liquid or mastic sealant, with or without compatible tape overlay, or gasketing of flanged joints, to keep air leakage at duct joints, seams, and connections to an acceptable minimum.
 - 3. Duct Pressure Classification: SMACNA HVAC Duct Construction Standards, Metal and Flexible.
 - 4. Exposed Duct: Exposed to view in a finished room.

1.2 RELATED WORK

- A. Section 01 00 02, GENERAL REQUIREMENTS (Minor NCA Projects).
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Section 01 42 19, REFERENCE STANDARDS.
- D. Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS.
- E. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.
- F. Section 07 84 00, FIRESTOPPING: Fire Stopping Material.
- G. Section 08 90 00, LOUVERS AND VENTS: Outdoor and Exhaust Louvers.
- H. Section 23 05 11, COMMON WORK RESULTS FOR HVAC: General mechanical requirements and items which are common to more than one section of Division 23.
- I. Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT: Noise Level Requirements.
- J. Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC: Testing and Balancing of Air Flows.
- K. Section 23 07 11, HVAC INSULATION: Duct Insulation
- L. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

- M. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC: Duct Mounted Instrumentation.
- N. Section 23 34 00, HVAC FANS: Return Air and Exhaust Air Fans.
- O. Section 23 36 00, AIR TERMINAL UNITS: Air Flow Control Valves and Terminal Units.
- P. Section 23 40 00, HVAC AIR CLEANING DEVICES: Air Filters and Filters' Efficiencies.
- Q. Section 23 82 16, AIR COILS: Duct Mounted Coils.
- R. Section 28 31 00, FIRE DETECTION AND ALARM: Smoke Detectors.

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. Air Movement and Control Association (AMCA):
512-2009AMCA Listing Label Program
- C. American Society of Civil Engineers (ASCE):
ASCE/SEI 7-2010Minimum Design Loads for Buildings and Other Structures
- D. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE):
62.1-2016Ventilation for Acceptable Indoor Air Quality
90.1-2013Energy Standard for Buildings Except Low-Rise Residential Buildings
- E. American Society for Testing and Materials (ASTM):
A653/A653M-2015e1Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
B209-2014Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
C916-2014Standard Specification for Adhesives for Duct Thermal Insulation
C1071-2012Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)
E84-2015bStandard Test Method for Surface Burning Characteristics of Building Materials

- F. Environmental Protection Agency (EPA):
 - CFR 40, PART 59, Subpart D, EPA Method 24
- G. National Fire Protection Association (NFPA):
 - 90A-2015Standard for the Installation of Air Conditioning and Ventilating Systems
 - 90B-2015Standard for the Installation of Warm Air Heating and Air-Conditioning Systems
 - 96-2014Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations
- H. North American Insulation Manufacturers Association (NAIMA):
 - AH124-2002Fibrous Glass Duct Liner Standard, 3rd Edition
- I. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):
 - 2005HVAC Duct Construction Standards, Metal and Flexible, 3rd Edition
 - 2012HVAC Air Duct Leakage Test Manual, 2nd Edition
 - 2008IAQ Guidelines for Occupied Buildings Under Construction, 2nd Edition
- J. Underwriters Laboratories, Inc. (UL):
 - 33-2010 (R2015)Standard for Heat Responsive Links for Fire-Protection Service
 - 181-2013Standard for Factory-Made Air Ducts and Connectors
 - 555-2006 (R2013)Standard for Fire Dampers
 - 555S-2014Standard for Smoke Dampers
 - 1978-2010 (R2013)Standard for Grease Ducts

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 31 00, DUCTS AND CASINGS", 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, gage, and reinforcement.
- b. Duct liner.
- c. Sealants and gaskets.
- d. Access doors.

2. Round:

- a. Manufacturer's details for duct fittings and joints.
- b. Duct liner.
- c. Sealants and gaskets.
- d. Access sections.
- e. Installation instructions.

3. Volume dampers, control dampers, and back draft dampers.

4. Hanger attachments.

5. Fire dampers, fire doors, and smoke dampers with installation instructions.

6. Turning Vanes.

7. Sound attenuators, including pressure drop and acoustic performance.

8. Flexible ducts and clamps, with manufacturer's installation instructions.

9. Flexible connections.

10. Instrument test fittings.

11. 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 replacement parts, and troubleshooting guide:

1. Include complete list indicating all components of the systems.
2. Include complete diagrams of the internal wiring for each item of equipment.

3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

- F. Completed System Readiness Checklist provided by the 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.
- 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. Refer to paragraph, QUALITY ASSURANCE, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- B. Fire Safety Code: Comply with NFPA 90A.
- C. Duct System Construction and Installation: Referenced SMACNA Standards are the minimum acceptable quality.
- D. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- E. Duct Sealing, Air Leakage Criteria, and Air Leakage Tests: Ducts shall be sealed as per duct sealing requirements of SMACNA Standards for duct pressure classes shown on the drawings.
- 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 the duct or provide at least the same level of corrosion resistance.
- G. ASHRAE Compliance: Applicable requirements in ASHRAE 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."
- H. Sealants and Adhesives: Comply with NFPA 90A and with ASTM C916.
 - 1. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

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 inserted into a three ring binder. All aspects of system operation and maintenance procedures, including applicable piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices shall be included. A List of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.
- C. The installing contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. As-built drawings are to be provided, and a copy of them in Auto-CAD version 2018 or later provided on CD 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 DUCT MATERIALS AND SEALANTS

- A. General: Except for systems specified otherwise, construct ducts and accessories of galvanized sheet steel, ASTM A653/A653M, coating G90; or, aluminum sheet, ASTM B209, alloy 1100, 3003, or 5052.
- B. Joint Sealing:
 - 1. Sealant: Elastomeric compound, gun or brush grade, maximum 25 flame spread and 50 smoke developed (dry state) compounded specifically for sealing ductwork as recommended by the manufacturer.

Generally provide liquid sealant, with or without compatible tape, for low clearance slip joints and heavy, permanently elastic, mastic type where clearances are larger. Oil base caulking and glazing compounds are not acceptable because they do not retain elasticity and bond.

2. Tape: Use only tape specifically designated by the sealant manufacturer and apply only over wet sealant. Pressure sensitive tape shall not be used except as designated by sealant manufacturer.
3. Gaskets for Flanged Joints: Soft neoprene.

C. Approved factory made joints such as DUCTMATE SYSTEM may be used.

2.2 DUCT CONSTRUCTION AND INSTALLATION

- A. Follow SMACNA HVAC Duct Construction Standards.
- B. Duct Pressure Class: 500 Pa (2 inch WG)
- C. Seal Class: As shown on the drawings and in accordance with SMACNA Standards.
- D. Round Ducts: Furnish duct and fittings made by the same manufacturer to ensure good fit of joints. When submitted and approved in advance, round ducting, with size converted on the basis of equal pressure drop may be furnished in lieu of rectangular duct design shown on the drawings.
 1. Elbows: Diameters 150 mm through 200 mm (6 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.
- E. Volume Dampers: Single blade, opposed blade, or multi-blade type as detailed in SMACNA Standards.
- F. Duct Hangers and Supports: Refer to SMACNA Standards. Do not use trapeze hangers for round duct.

2.3 DUCT LINER (WHERE INDICATED ON DRAWINGS)

- A. Duct sizes shown on drawings for lined duct are clear opening inside lining.

- B. Rectangular Duct Liner: ASTM C1071, Type I (flexible), or Type II (board), 25 mm (one inch) minimum thickness, applied with mechanical fasteners and 100 percent coverage of adhesive in conformance with SMACNA HVAC Duct Construction Standards.

2.4 DUCT ACCESS DOORS, PANELS AND SECTIONS

- A. Install access doors with swing against duct static pressure.
- B. Provide access doors, sized and located for maintenance work, in the following locations:
 - 1. Upstream and downstream of each duct mounted coil.
 - 2. Each fire damper (for link service), smoke damper, and automatic control damper.
 - 3. Each duct mounted smoke detector.
 - 4. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
 - 5. Upstream from turning vanes.
 - 6. Upstream or downstream from duct silencers.
 - 7. Control devices requiring inspection.
- C. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2 (7-2M), "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."
 - 1. Door:
 - a. Double wall, rectangular.
 - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
 - c. Hinges and Latches: 25 by 25 mm (1 by 1 inch) butt or piano hinge and cam latches.
 - d. Fabricate doors airtight and suitable for duct pressure class.
 - 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
 - 3. Number of Hinges and Locks:
 - a. Access Doors Less Than 300 mm (12 inches) Square: No hinges and two sash locks.
 - b. Access Doors up to 450 mm (18 inches) Square: Continuous and two sash locks.
 - c. Access Doors up to 600 by 1200 mm (24 by 48 inches): Continuous and two compression latches.

- D. Access Doors Greater Than 600 by 1200 mm (24 by 48 inches): Continuous and two compression latches with outside and inside handles, labeled according to UL 1978 by an NRTL.
- E. Panel and Frame: Minimum thickness 1.3 mm (0.05 inch) carbon steel.
- F. Fasteners: Carbon steel. Panel fasteners shall not penetrate duct wall.
- G. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 1093 degrees C (2000 degrees F).
- H. Minimum Pressure Rating: 2500 Pa (10-inch WG), positive or negative.
- I. Openings shall be as large as feasible in small ducts, 300 mm by 300 mm (12 inch by 12 inch) minimum where possible. Access sections in insulated ducts shall be double-wall, insulated.
 - 1. Refer to SMACNA HVAC Duct Construction Standards.

2.5 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
 - 1. Standard leakage rating, with linkage outside airstream.
 - 2. Suitable for horizontal or vertical applications.
 - 3. Frames:
 - a. Frame: Hat-shaped, 2.4 mm (3/32 inch) thick, galvanized sheet steel
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
 - 4. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Galvanized -steel, 1.62 mm (0.064 inch) thick.
 - 5. Blade Axles: Galvanized steel
 - 6. Bearings:
 - a. Oil-impregnated bronze.
 - b. Dampers in ducts with pressure classes of 750 Pa (3-inch WG) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 - 7. Tie Bars and Brackets: Galvanized steel.
- B. Standard, Aluminum, Manual Volume Dampers:
 - 1. Standard leakage rating, with linkage outside airstream.
 - 2. Suitable for horizontal or vertical applications.

3. Frames: Hat-shaped, 2.5 mm (0.10 inch) thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
4. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Roll-Formed Aluminum Blades: 2.5 mm (0.10 inch) thick aluminum sheet.
 - e. Extruded-Aluminum Blades: 1.3 mm (0.050 inch) thick extruded aluminum.
5. Blade Axles: Galvanized steel.
6. Bearings:
 - a. Oil-impregnated bronze sleeve.
 - b. Dampers in ducts with pressure classes of 750 Pa (3-inch WG) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
7. Tie Bars and Brackets: Aluminum.

2.6 FLEXIBLE AIR DUCT

- A. General: Factory fabricated, complying with NFPA 90A for connectors not passing through floors or 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 flexible 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 200 mm (8 inches) in diameter shall be Class 1. Ducts 200 mm (8 inches) in diameter and smaller may be Class 1 or Class 2.
- C. Insulated Flexible Air Duct: Factory made including mineral fiber insulation with maximum C factor of 0.25 at 24 degrees C (75 degrees F) mean temperature, encased with a low permeability moisture barrier outer jacket, having a puncture resistance of not less than 50 Beach Units. Acoustic insertion loss shall not be less than 3 dB per 300 mm (1 foot) of straight duct, at 500 Hz, based on 150 mm (6 inch) duct, of 750 m/min (2500 fpm).

D. Application Criteria:

1. Temperature range: minus 18 to 93 degrees C (0 to 200 degrees F) internal.
2. Maximum working velocity: 1200 m/min (4000 fpm).
3. Minimum working pressure: 2500 Pa (10-inch WG) positive, 500 Pa (2-inch WG) negative.

E. Duct Clamps: 100 percent nylon strap, 80 kg (175 pounds) minimum loop tensile strength manufactured for this purpose or stainless-steel strap with cadmium plated worm gear tightening device. Apply clamps with sealant and as approved for UL 181, Class 1 installation.

2.7 FLEXIBLE CONNECTIONS

A. Where duct connections are made to fans and air handling units, install a non-combustible flexible connection of 822 g (29 ounce) neoprene coated fiberglass fabric, approximately 150 mm (6 inches) wide.

B. Coatings and Adhesives: Comply with UL 181, Class 1. For connections exposed to sun and weather provide hypalon coating in lieu of neoprene. Burning characteristics shall conform to NFPA 90A.

1. Tensile Strength: 84 N/mm (480 lbf/inch) in the warp and 63 N/mm (360 lbf/inch) in the filling.
2. Service Temperature: Minus 40 to plus 93 degrees C (Minus 40 to plus 200 degrees F)

C. 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 TURNING VANES

A. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

B. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vaness and Vane Runners," and 4-4, "Vane Support in Elbows."

C. Vane Construction: Single wall.

D. Vane Construction: Single wall for ducts up to 1200 mm (48 inches) wide and double wall for larger dimensions.

2.9 FIRESTOPPING MATERIAL

- A. Refer to Section 07 84 00, FIRESTOPPING.

2.10 THERMOMETER (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 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. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and aluminum accessories in aluminum ducts.
- D. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan, unless otherwise indicated.
- E. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner and terminate liner with nosing at hat channel.
 - 1. Install steel volume dampers in steel ducts.
 - 2. Install aluminum volume dampers in aluminum ducts.
- F. Access Door Sizes:
 - 1. One-Hand or Inspection Access: 200 mm by 125 mm (8 inches by 5 inches).
 - 2. Two-Hand Access: 300 mm by 150 mm (12 inches by 6 inches).
 - 3. Head and Hand Access: 450 mm by 250 mm (18 inches by 10 inches).

4. Head and Shoulders Access: 533 mm by 356 mm (21 inches by 14 inches).
5. Body Access: 635 mm by 356 mm (25 inches by 14 inches).
6. Body plus Ladder Access: 635 mm by 432 mm (25 inches by 17 inches).
- G. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- H. Install ducts with fewest possible joints.
- I. Install factory- or shop-fabricated fittings for changes in direction, size, shape, and for branch connections.
- J. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- K. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- L. Install ducts with a clearance of 25 mm (1 inch), plus allowance for insulation thickness.

Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- M. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 40 mm (1-1/2 inches).
- N. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA IAQ Guidelines for Occupied Buildings Under Construction, Appendix G, "Duct Cleanliness for New Construction Guidelines."
- O. Fabricate and install ductwork and accessories in accordance with referenced SMACNA Standards:
 1. Drawings show the general layout of ductwork and accessories but do not show all required fittings and offsets that may be necessary to connect ducts to equipment, boxes, diffusers, grilles, etc., and to coordinate with other trades. Fabricate ductwork based on field measurements. Provide all necessary fittings and offsets at no additional cost to the government. Coordinate with other trades for space available and relative location of HVAC equipment and accessories on ceiling grid. Duct sizes on the drawings are inside dimensions which shall be altered by Contractor to other dimensions

- with the same air handling characteristics where necessary to avoid interferences and clearance difficulties.
2. Provide duct transitions, offsets and connections to dampers, coils, and other equipment in accordance with SMACNA HVAC Duct Construction 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 HVAC Duct Construction Standards.
- P. Install duct hangers and supports in accordance with SMACNA HVAC Duct Construction Standards.
- Q. Install fire dampers and smoke dampers in accordance with the manufacturer's instructions to conform to the installation used for the rating test.
- R. Seal openings around duct penetrations of floors and fire rated partitions with fire stop material as required by NFPA 90A.
- S. Flexible duct installation: Refer to SMACNA HVAC Duct Construction Standards. Ducts shall be continuous, single pieces not over 1.5 m (5 feet) long, as straight and short as feasible, adequately supported. Centerline radius of bends shall be not less than 2 duct diameters. Make connections with clamps as recommended by SMACNA Standards. Clamp per SMACNA Standards 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 1-hour or 2-hour. Support flexible ducts per SMACNA HVAC Duct Construction Standards.
- T. 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. Install all damper control/adjustment devices on stand-offs to allow complete coverage of insulation.
- U. Low Pressure Duct Liner: Install in accordance with SMACNA HVAC Duct Construction Standards.
- V. Protection and Cleaning: Adequately protect equipment and materials against physical damage. Place equipment in first-class operating condition, or return to source of supply for repair or replacement, as

determined by COR. Protect equipment and ducts during construction against entry of foreign matter to the inside and clean both inside and outside before operation and painting. When new ducts are connected to existing ductwork, clean both new and existing ductwork by mopping and vacuum cleaning inside and outside before operation.

3.2 DUCT LEAKAGE TESTS AND REPAIR

- A. Leak testing company shall be independent of the sheet metal company employed by General Contractor.
- B. Ductwork leak test shall be performed for the entire air distribution supply, return, exhaust system section-by-section including fans, coils, and filter section designated as static pressure class 750 Pa (3-inch WG) and above. All supply ductwork less than 500 Pa (2-inch WG) shall also be tested where there is no air terminal unit employed in the system.
- C. Test procedure, apparatus, and report shall conform to SMACNA HVAC Air Duct Leakage Test Manual. The maximum leakage rate allowed is 4 percent of the design air flow rate.
- D. All ductwork shall be leak tested first before enclosed in a shaft or covered in other inaccessible areas.
- E. All tests shall be performed in the presence of the COR and the Test and Balance agency. The Test and Balance agency shall measure and record duct leakage and report to the COR and identify leakage source with excessive leakage.
- F. If any portion of the duct system tested fails to meet the permissible leakage level, rectify sealing of ductwork to bring it into compliance and retest until acceptable leakage is demonstrated to the COR.
- G. All tests and necessary repairs shall be completed prior to insulation or concealment of ductwork.
- H. Make sure all openings used for testing flow and temperatures by TAB contractor are sealed properly.

3.3 TESTING, ADJUSTING, AND BALANCING (TAB)

- A. Refer to Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.

3.4 STARTUP AND TESTING

- A. Make tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements.

Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.

- B. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.
- C. The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and Commissioning Agent. Provide a minimum notice of 10 working days prior to startup and testing.

3.5 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.

3.6 DEMONSTRATION AND TRAINING

- A. Provide services of manufacturer's technical representative for four hours to instruct each VA personnel responsible in the 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.

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**SECTION 23 34 00
HVAC FANS**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Fans for heating, ventilating and air conditioning.
- B. A complete listing of common acronyms and abbreviations are included in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- C. Product Definitions: AMCA 99 Standards Handbook, Definitions.

1.2 RELATED WORK

- A. Section 01 00 02 GENERAL REQUIREMENTS (Minor NCA Projects)
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Section 01 42 19, REFERENCE STANDARDS.
- D. Section 01 81 11 SUSTAINABLE DESIGN REQUIREMENTS.
- E. Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.
- F. Section 23 05 11, COMMON WORK RESULTS FOR HVAC: General mechanical requirements and items which are common to more than one section of Division 23.
- G. Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC EQUIPMENT.
- H. Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.
- I. Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.
- J. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.
- K. Section 26 29 11, MOTOR STARTERS.

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. Air Movement and Control Association International, Inc. (AMCA):
 - 99-2010Standards Handbook
 - 210-2007Laboratory Methods of Testing Fans for
Certified Aerodynamic Performance Rating
 - 300-2014Reverberant Room Method for Sound Testing of
Fans
- C. American Society for Testing and Materials (ASTM):
 - B117-2011Standard Practice for Operating Salt Spray
(Fog) Apparatus

D1735-2014Standard Practice for Testing Water Resistance
of Coatings Using Water Fog Apparatus

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 34 00, HVAC FANS", 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. Fan sections, motors, and drives.
 - 2. Centrifugal fans, motors, drives, accessories, and coatings.
 - a. In-line centrifugal fans.
 - b. Utility fans and vent sets.
 - 3. Prefabricated roof curbs.
 - 4. Certified Sound power levels for each fan.
 - 5. Motor ratings types, electrical characteristics, and accessories.
 - 6. Roof curbs.
 - 7. Belt guards.
- D. Certified fan performance curves for each fan showing liters per second (L/s) versus static pressure, efficiency, and horsepower for design point of operation and at 110 percent of design static pressure.
- E. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replacement parts, and troubleshooting guide:
 - 1. Include complete list indicating all components of the systems.
 - 2. Include complete diagrams of the internal wiring for each item of equipment.
 - 3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

- F. Completed System Readiness Checklist provided by the 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.
- 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. Refer to paragraph, QUALITY ASSURANCE, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- B. Fans and power ventilators: Bear the AMCA performance seal.
- C. Fans and power ventilators: Comply with the following standards:
 - 1. Testing and Rating: AMCA 210.
 - 2. Reverberant Room Method for Sound Testing of Fans: 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. Provide fans and motors capable of stable operation at design conditions and at 110 percent pressure.
 - 2. Lower than design pressure drop of approved individual components may allow use of a smaller fan motor and still provide the safety factor. When submitted as a deviation, a smaller motor may be approved in the interest of energy conservation. The Contractor shall be responsible for making necessary changes to the electrical system.
 - 3. Select fan operating point as follows:
 - a. Forward curved and axial fans: Right-hand side of peak pressure point.
 - b. Airfoil, backward inclined or tubular: Near the peak of 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. All steel: Mill-galvanized, or phosphatized and coated with minimum two coats, corrosion resistant enamel paint. Manufacturers paint and paint system shall meet the minimum specifications of: ASTM D1735 water fog and ASTM B117 salt spray.

2. If flammable gas, vapor, or combustible dust is present, the fan construction shall be as recommended by AMCA's Classification for Spark Resistant Construction.

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 CD or DVD inserted into a three ring binder. All aspects of system operation and maintenance procedures, including applicable piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices shall be included. A List of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.
- C. The installing contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. As-built drawings are to be provided, and a copy of them in Auto-CAD version 2018 or later provided on CD 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 CENTRIFUGAL FANS

- A. Standards and Performance Criteria: Refer to paragraph, QUALITY ASSURANCE. Record factory vibration test results on the fan or furnish to the Contractor.
- B. Fan arrangement, unless noted or approved otherwise:
 - 1. DWDI fans: Arrangement 3.
 - 2. SWSI fans: Arrangement 1, 3, 9 or 10.
- C. Construction: Wheel diameters and outlet areas shall be in accordance with AMCA standards.
 - 1. Housing: Low carbon steel, arc welded throughout, braced, and supported by structural channel or angle iron to prevent vibration or pulsation, flanged outlet, inlet fully streamlined. Provide lifting clips, and casing drain. Provide manufacturer's standard access door. Provide 15 mm (1/2 inch) wire mesh screens for fan inlets without duct connections.
 - 2. Wheel: Steel plate with die formed blades welded or riveted in place, factory balanced statically and dynamically.
 - 3. Shaft: Designed to operate at no more than 70 percent of the first critical speed at the top of the speed range of the fans class.
 - 4. Bearings: Heavy duty ball or roller type sized to produce a B-10 life of not less than 40,000 hours, and an average fatigue life of 200,000 hours.
 - 5. Belt Drives: Factory installed with final alignment belt adjustment made after installation.
 - 6. Motors and Fan Wheel Pulleys: Adjustable pitch for use with motors through 11 kW (15 hp), fixed-pitch for use with motors larger than 11 kW (15 hp). Select pulleys so that pitch adjustment is at the middle of the adjustment range at fan design conditions.
 - 7. Motor, adjustable motor base, drive, and guard: Furnish from factory with fan. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC for specifications. Provide protective sheet metal enclosure for fans located outdoors.
 - 8. Integral gravity backdraft damper.
- D. Explosion Proof Fans: If flammable gas, vapor, or combustible dust is present, the fan construction shall be as recommended by AMCA's Classification for Spark Resistant Construction.

2.2 CENTRIFUGAL CEILING FANS (SMALL CABINET FAN)

- A. Standards and Performance Criteria: Refer to Paragraph, QUALITY ASSURANCE.
- B. Steel housing, baked enamel finish, direct-connected fan assembly, attached grille. Integral backdraft assembly, wall cap, and insect screen.
- C. Motor: Shaded pole or permanent split capacitor, sleeve bearings, supported by steel brackets in combination with rubber isolators.
- D. Ceiling Grille: White plastic egg crate design, 80 percent free area.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. If an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no additional cost or time to the Government.
- B. Install fan, motor, and drive in accordance with manufacturer's instructions.
- C. Align fan and motor sheaves to allow belts to run true and straight.
- D. Bolt equipment to curbs with galvanized lag bolts.
- E. Install vibration control devices as shown on drawings and specified in Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.

3.2 PRE-OPERATION MAINTENANCE

- A. Lubricate bearings, pulleys, belts, and other moving parts with manufacturer recommended lubricants.
- B. Rotate impeller by hand and check for shifting during shipment and check all bolts, collars, and other parts for tightness.
- C. Clean fan interiors to remove foreign material and construction dirt and dust.

3.3 START-UP AND TESTING

- A. Make tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.
- B. Verify proper operation of motor, drive system, and fan wheel.
- C. Check vibration and correct as necessary for air balance work.

- D. After air balancing is complete and permanent sheaves are in place perform necessary field mechanical balancing to meet vibration tolerance in Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.
- E. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.
- F. The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and Commissioning Agent. Provide a minimum notice of 10 working days prior to startup and testing.

3.4 COMMISSIONING

- A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.
- B. Components provided under this section of the specification will be tested as part of a larger system.

3.5 DEMONSTRATION AND TRAINING

- A. Provide services of manufacturer's technical representative for four hours to instruct each VA personnel responsible in the 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.

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SECTION 23 37 00
AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Air outlets and inlets, including the following: Grilles, registers, and diffusers.
- 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 02, GENERAL REQUIREMENTS (Minor NCA Projects).
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Section 01 42 19, REFERENCE STANDARDS.
- D. Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS.
- E. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.
- F. Section 08 90 00, LOUVERS AND VENTS: Outdoor and Exhaust Louvers.
- G. Section 23 05 11, COMMON WORK RESULTS FOR HVAC: General mechanical requirements and items which are common to more than one section of Division 23.
- H. Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT: Noise Level Requirements.
- I. Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC: Testing and Balancing of Air Flows.
- J. Section 23 08 00, COMMISSIONING OF HVAC 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 Civil Engineers (ASCE):
ASCE 7-2010Minimum Design Loads for Buildings and Other Structures
- C. American Society for Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE):
70-2006 (R2011)Method of Testing for Rating the Performance of Air Outlets and Inlets

- D. American Society for Testing and Materials (ASTM):
B209-2014Standard Specification for Aluminum and
Aluminum-Alloy Sheet and Plate
- E. National Fire Protection Association (NFPA):
90A-2015Standard for the Installation of Air
Conditioning and Ventilating Systems
- F. Underwriters Laboratories, Inc. (UL):
181-2013Standard 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 37 00, AIR OUTLETS AND INLETS", 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. Grilles, registers, diffusers, and accessories.
- 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 replacement parts, and troubleshooting guide:
 - 1. Include complete list indicating all components of the systems.
 - 2. Include complete diagrams of the internal wiring for each item of equipment.
 - 3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.
- F. Completed System Readiness Checklist provided by the 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.

- 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. Refer to paragraph QUALITY ASSURANCE, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- B. Fire Safety Code: Comply with NFPA 90A.

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 CD or DVD// inserted into a three-ring binder. All aspects of system operation and maintenance procedures, including applicable piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices shall be included. A List of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.
- C. The installing contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. As-built drawings are to be provided, and a copy of them in Auto-CAD version 2018 or later provided on CD 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 EQUIPMENT SUPPORTS

- A. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

2.2 AIR OUTLETS AND INLETS

- A. Materials:

1. Steel or aluminum: Provide manufacturer's standard gasket.
2. Exposed Fastenings: The same material as the respective inlet or outlet. Fasteners for aluminum may be stainless steel.
3. 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 ASHRAE 70. Refer to Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT for NC criteria.

1. Supply Grilles and Registers: Extruded aluminum, white finish, and individually adjustable blades. Front bars parallel to the short dimension.
 - a. Border: Flat, 32 mm (1-1/4 inch) wide.
 - b. Bar spacing: 20 mm (3/4 inch) maximum.
 - c. Provide opposed blade damper.
2. Double Deflection Supply Grilles and Registers: Extruded aluminum, white finish, and individually adjustable blades. Front bars parallel to the short dimension.
 - a. Border: Flat, 32 mm (1-1/4 inches) wide.
 - b. Bar spacing: 20 mm (3/4 inch) maximum.
 - c. Provide opposed blade damper.
3. Grilles: Same as registers but without the opposed blade damper.

- C. Return and Exhaust Registers and Grilles: Provide opposed blade damper for registers.
 - 1. Finish: white baked enamel.
 - 2. Standard Type: Fixed horizontal face bars set at 35 degrees, 32 mm (1-1/4 inch) margin.
 - 3. Door Grilles: Are furnished with the doors.

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: 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 during construction against entry of foreign matter to the inside and clean both inside and outside before operation and painting.

3.2 TESTING, ADJUSTING, AND BALANCING (TAB)

- A. Refer to Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.

3.3 STARTUP AND TESTING

- A. Make tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.
- B. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.
- C. The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and Commissioning Agent. Provide a minimum notice of 10 working days prior to startup and testing.

3.4 COMMISSIONING

- A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

Black Hills National Cemetery
Renovate and Expand Administration and Maintenance Buildings
20901 Pleasant Valley Drive
Sturgis, SD 57785

NCA Project # 884CM3015

10/31/22

Bid Documents

- 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 each VA personnel responsible in the 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.

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**SECTION 23 40 00
HVAC AIR CLEANING DEVICES**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Air filters for heating, ventilating, and air conditioning.
- B. A complete listing of common acronyms and abbreviations are included in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- C. Definitions: Refer to ASHRAE 52.2 for definitions of MERV (Minimum Efficiency Reporting Value) PSE (Particle Size Efficiency) and particle size ranges for each MERV number. ASHRAE 52.2 contains provisions that shall be used to measure particle size efficiency (PSE).

1.2 RELATED WORK

- A. Section 01 00 02, GENERAL REQUIREMENTS (Minor NCA Projects).
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Section 01 42 19, REFERENCE STANDARDS.
- D. Section 01 81 13, SUBSTAINABLE DESIGN REQUIREMENTS.
- E. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.
- F. Section 23 05 11, COMMON WORK RESULTS FOR HVAC: General mechanical requirements and items which are common to more than one section of Division 23.
- G. Section 23 08 00, COMMISSIONING OF HVAC 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 Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE):
 - 52.2-2012Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size
- C. Underwriters Laboratories, Inc. (UL):
 - UL 586-2009 (R2015)Standard for High-Efficiency, Particulate, Air Filter Units
 - UL 900-2015Standard 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 40 00, HVAC AIR CLEANING DEVICES", 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. Holding frames. Identify locations.
 - 2. Side access housings. Identify locations, verify insulated doors.
 - 3. Magnehelic gages.
- D. 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.
- E. 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.
- F. Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

1.5 QUALITY ASSURANCE

- A. Refer to paragraph QUALITY ASSURANCE, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- B. Comply with UL 586 for flame test.
- C. Each filter bears a label indicating manufacturer's name, filter size, and rated efficiency.

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 inserted into a three-ring binder. All aspects of system operation and maintenance procedures, including applicable piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices shall be included. A List of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.
- C. The installing contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. As-built drawings are to be provided, and a copy of them in Auto-CAD version 2018 or later provided on CD 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 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 EQUIPMENT in Section 01 00 02, GENERAL REQUIREMENTS (Minor NCA Projects). Provide one complete set of additional (replacement) filter elements.

- 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 DISPOSABLE PANEL FILTER

- A. Description: Factory-fabricated, viscous-coated, flat-panel-type, disposable air filters, with holding frames.
 - 1. Media: Interlaced glass fibers sprayed with nonflammable adhesive.
 - 2. Frame: Cardboard frame with perforated metal retainer.
 - 3. MERV-8.

2.3 FILTER GAGES

- A. Description: Diaphragm type with dial and pointer in metal case, vent valves, black figures on white background, and front recalibration adjustment.
- B. Diameter: 115 mm (4-1/2 inches).
- C. Range: 0 to 125 Pa (0 to 0.5 inch WG)
- D. Accessories: Static-pressure tips, tubing, gage connections, and mounting bracket.

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 gages in accordance with manufacturer's instructions.
- C. Position each filter unit with clearance for normal service and maintenance.
- D. Install filters in position to prevent passage of unfiltered air.
- E. Install filter gage for each filter bank.
- F. Install filter gage static-pressure tips upstream and downstream from filters to measure pressure drop through filter. Mount filter gages on outside of filter housing or filter plenum in an accessible position.
- G. Coordinate filter installations with duct and air handling unit installations.

3.2 TEMPORARY USE

- A. Clean and vacuum air handling units to the satisfaction of the COR prior to starting air handling systems.
- B. Install or deliver replacement filter units as directed by the COR.

- C. If permanently installed air handlers are used during construction, filtration media with MERV-8 shall be used at each return air inlet. Replace all filtration media immediately prior to occupancy.

3.3 STARTUP AND TESTING

- A. Make tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.
- B. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.
- C. The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and Commissioning Agent. Provide a minimum notice of 10 working days prior to startup and testing.

3.4 COMMISSIONING

- A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.
- B. Components provided under this section of the specification will be tested as part of a larger system.

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**SECTION 23 81 00
UNITARY HVAC EQUIPMENT**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies split-systems: including air handling units, furnaces, and air-cooled condensing units; room-type air conditioners; and packaged terminal air conditioners.
- B. A complete listing of common acronyms and abbreviations are included in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- C. Definitions:
 - 1. Seasonal Energy Efficiency Ratio (SEER): (Btu/W-hour) is equal to the measured cooling capacity of the unit by its electrical input.
 - 2. 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. Where such equipment is provided in more than one assembly, the separated assemblies are connected with refrigerant piping and designed to be used together. The requirements of rating are based upon use of matched assemblies.

1.2 RELATED WORK

- A. Section 01 00 02, GENERAL REQUIREMENTS (Minor NCA Projects).
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Section 01 42 19, REFERENCE STANDARDS.
- D. Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS.
- E. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.
- F. Section 23 05 11, COMMON WORK RESULTS FOR HVAC: General mechanical requirements and items which are common to more than one section of Division 23.
- G. Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC EQUIPMENT.
- H. Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC: Requirements for testing and adjusting air balance.
- I. Section 23 07 11, HVAC INSULATION: Requirements for piping insulation.
- J. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.
- K. Section 23 11 23, FACILITY NATURAL-GAS PIPING.

- L. Section 23 23 00, REFRIGERANT PIPING: Requirements for refrigerant pipes, fittings, and installation.
- M. Section 23 31 00, HVAC DUCTS AND CASINGS.
- N. Section 23 34 00, HVAC FANS.
- O. Section 23 40 00, HVAC AIR CLEANING DEVICES: Requirements for air filtration.
- P. Section 23 82 16, AIR COILS.

1.3 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Air-Conditioning, Heating and Refrigeration Institute (AHRI):
 - 210/240-2008 (R2012) ...Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment
 - 300-2008Standard for Sound Rating and Sound Transmission Loss of Packaged Terminal Equipment
 - 310/380-2014Standard for Packaged Terminal Air-Conditioners and Heat Pumps (CSA C744-14)
- C. American National Standard Institute (ANSI):
 - Z21.47/CSA 2.3-2012Gas-Fired Central Furnaces
- D. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE):
 - 15-2013Safety Standard for Refrigeration Systems
 - 52.2-2012Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size
 - 62.1-2013Ventilation for Acceptable Indoor Air Quality
 - 90.1-2013Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings
- E. American Society of Testing and Materials (ASTM):
 - E331-2000 (R2009)Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
 - F438-2015Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40

- F441/F441M-2015Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80
- F493-2014Standard Specification for Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings

- F. National Fire Protection Association (NFPA):
 - 54-2015National Fuel Gas Code
 - 70-2014National Electrical Code (NEC)

- G. Underwriter Laboratories (UL):
 - 484-2014 (R2015)Standard for Room Air Conditioners

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 81 00, UNITARY HVAC EQUIPMENT", with applicable paragraph identification.
- C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity:
 - 1. Include clearly presented sufficient information, such as capacities, pressure drops, octave sound data, and piping connections to determine compliance with drawings and specifications 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, interlocks, and control wiring showing which are to be factory-installed and which portions are to be field-installed.
- D. Certification: Submit proof of specified AHRI Certification.
- E. Performance Rating: Submit catalog selection data showing equipment ratings and compliance with required sensible heat-ratio, seasonal energy efficiency ratio (SEER), and coefficient of performance (COP).

- 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 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.
- 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 paragraph QUALITY ASSURANCE, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

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 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. As-built drawings are to be provided, and a copy of them in Auto-CAD version 2018 or later provided on CD 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 SPLIT-SYSTEM AIR HANDLING UNIT

- A. Description: Factory assembled and tested air handling unit, wall mounted evaporator-fan combination air handling unit, with an air cooled remote condensing unit and field-installed refrigeration piping.
- B. Air Handling Unit Components:
 - 1. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
 - 2. Insulation: Factory-applied.
 - 3. Drain Pans: Galvanized steel, with connection for drain; insulated and complying with ASHRAE 62.1.
 - 4. Airstream Surfaces: Ensure surfaces in contact with the airstream 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: Air foil of galvanized steel; directly connected to motor.
 - 7. Fan Motors: Comply with requirements in Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC EQUIPMENT for multi-tapped, multi-speed motors with internal thermal protection and permanent lubrication.
 - a. Special Motor Features: Multi-tapped, multi-speed with internal thermal protection and permanent lubrication.

- b. Special Motor Features: Electronically controlled motor (ECM) controlled by integrated furnace/blower control.
- 8. Disposable Filters: 25 mm (1 inch) thick, in fiberboard frames with MERV rating of 8 according to ASHRAE 52.2 Section 23 40 00, HVAC AIR CLEANING DEVICES.
- 9. Wiring Terminations: Connect motor to chassis wiring with //plug connection or terminal block.

C. Air Cooled Condenser:

- 1. Casing: Steel, finished with baked enamel, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Ensure service valves, fittings, and gage ports are brass and located outside of the casing.
- 2. Compressor: Hermetically sealed scroll compressor with crankcase heater and mounted on vibration isolation. Ensure compressor motor has thermal and current sensitive overload devices, start capacitor, relay, and contactor.
- 3. Refrigerant: R-407C or R-410A unless otherwise indicated.
- 4. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with AHRI 210/240. Provide coil guard.//
- 5. Fan: Aluminum, propeller type, directly connected to motor.
- 6. Motor: Permanently lubricated, with integral thermal-overload protection.
- 7. Low Ambient Kit: Permit operation down to 7 degrees C (44 degrees F).
- 8. Mounting Base: Polyethylene.
- 9. Minimum Energy Efficiency: Comply with ASHRAE 90.1.
- 10. Refrigerant Piping: Comply with requirements of Section 23 23 00, REFRIGERANT PIPING and Section 23 07 11, HVAC INSULATION.

2.2 GAS-FIRED FURNACES, CONDENSING

- A. General Requirements for Gas-Fired, Condensing Furnaces: Factory assembled, piped, wired, and tested; complying with ANSI Z21.47/CSA 2.3 and with NFPA 54.
- B. Cabinet: Steel.
 - 1. Ensure cabinet interior around heat exchanger has factory installed insulation.
 - 2. Ensure lift-out panels expose burners and all other items requiring access for maintenance.

3. Ensure external cabinets are factory painted in manufacturer's standard color.
- C. Fan: Centrifugal, factory balanced, resilient mounted, direct drive.
1. Fan Motors: Comply with Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC EQUIPMENT.
 2. Motor Features: Single speed, premium efficiency with internal thermal protection, and permanent lubrication.
 3. Special Motor Features: Electronically controlled motor (ECM) controlled by integrated furnace/blower control.
- D. Type of Gas: Natural.
- E. AFUE: 95 percent efficiency.
- F. Heat Exchanger:
1. Primary: Stainless steel.
- G. Burner:
1. Gas Valve: 100 percent safety 2 stage main gas valve, main shutoff valve, pressure regulator, safety pilot with electronic flame sensor, limit control, transformer, and combination ignition/fan timer control board.
 2. Ignition: Electric pilot ignition, with hot-surface igniter.
- H. Gas-Burner Safety Controls:
1. Electronic Flame Sensor: Ensure gas valve is prevented from opening until pilot flame is proven; and signals to stop gas flow on ignition failure.
 2. Flame Rollout Switch: Installed on burner box; prevents burner operation.
 3. Limit Control: Fixed-stop at maximum permissible setting; de-energizes burner on excessive bonnet temperature; automatic reset.
- I. Combustion-Air Induced Air Fan: Provide centrifugal fan with thermally protected motor and sleeve bearings. Ensure fan pre-purges heat exchanger and vents combustion products. Provide pressure switch that will prevent furnace operation if combustion-air inlet or flue outlet is blocked.
- J. Furnace Controls: Solid-state board integrating ignition, heat, cooling, and fan speeds; adjustable fan-on and fan-off timing; terminals for connection to accessories; and diagnostic light with viewport.

K. Accessories:

1. Combination Combustion-Air Intake and Vent: PVC plastic fitting to combine combustion-air inlet and vent through outside wall or roof.
2. Plastic Vent Materials:
 - a. CPVC Plastic, Schedule 40 Pipe: ASTM F441/F441M.
 - b. CPVC Plastic, Schedule 40 Fittings: ASTM F438, socket type.
 - c. CPVC Solvent Cement: ASTM F493.

L. Characteristics:

1. Airflow Configuration: Horizontal.
2. Venting Type: Power venter with combustion-air intake.

M. Evaporator Coil: Copper tube, with mechanically bonded aluminum fins, complying with AHRI 210/240, and with thermal-expansion valve.

1. Drain Pan: Galvanized steel, with connection for drain; insulated and complying with ASHRAE 62.1.
2. Airstream Surfaces: Ensure surfaces in contact with the airstream comply with requirements in ASHRAE 62.1.

N. Air Cooled Condenser:

1. Casing: Steel, finished with baked enamel, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Ensure service valves, fittings, and gage ports are brass and located outside of the casing.
2. Compressor: Hermetically sealed scroll compressor with crankcase heater and mounted on vibration isolation. Ensure compressor motor has thermal and current sensitive overload devices, start capacitor, relay, and contactor.
3. Refrigerant: R-407C or R-410A unless otherwise indicated.
4. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with AHRI 210/240. Provide coil guard.//
5. Fan: Aluminum, propeller type, directly connected to motor.
6. Motor: Permanently lubricated, with integral thermal-overload protection.
7. Low Ambient Kit: Permit operation down to 7 degrees C (44 degrees F).
8. Mounting Base: Polyethylene.
9. Minimum Energy Efficiency: Comply with ASHRAE 90.1.

10. Refrigerant Piping: Comply with requirements of Section 23 23 00, REFRIGERANT PIPING and Section 23 07 11, HVAC INSULATION.

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 units level and plumb maintaining manufacturer's recommended clearances and tolerances.
- C. Install ground-mounting, compressor-condenser components on polyethylene mounting base .
- D. Install and connect refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit. Install in accordance with Section 23 23 00, REFRIGERANT PIPING.
- E. Install wall sleeves in finished wall assembly and weatherproof.

3.2 CONNECTIONS

- A. Verify condensate drainage requirements.
- B. Install condensate drain, minimum connection size, with trap and indirect connection to nearest floor drain.
- C. Install piping adjacent to units to allow service and maintenance.
- D. Gas Piping: Comply with applicable requirements in Section 23 11 23, FACILITY NATURAL-GAS PIPING. Connect gas piping to burner, full size of gas train inlet, and connect with union and shutoff valve with sufficient clearance for burner removal and service.
- E. Connect supply ducts to units with flexible duct connectors specified in Section 23 31 00, HVAC DUCTS AND CASINGS.
- F. Ground equipment and install power wiring, switches, and controls for self-contained and split systems.
- G. Connect refrigerant piping to coils with shutoff valves on the suction and liquid lines.

3.3 FIELD QUALITY CONTROL

- A. 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. Make tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.
- B. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.
- C. The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and Commissioning Agent. Provide a minimum notice of 10 working days prior to startup and testing.

3.5 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.

3.6 DEMONSTRATION AND TRAINING

- A. Provide services of manufacturer's technical representative for four hours to instruct each VA personnel responsible in the 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.

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SECTION 23 82 39
UNIT HEATERS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Cabinet unit heaters with centrifugal fans and electric-resistance heating coils.
- B. Propeller unit heaters with electric-resistance heating coils.
- C. Wall and ceiling heaters with propeller fans and electric-resistance heating coils.
- D. 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 02, GENERAL REQUIREMENTS (Minor NCA Projects).
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Section 01 42 19, REFERENCE STANDARDS.
- D. Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS.
- E. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.
- F. Section 23 05 11, COMMON WORK RESULTS FOR HVAC: General mechanical requirements and items which are common to more than one section of Division 23.
- G. Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC EQUIPMENT.
- H. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.
- I. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW).
- J. Section 26 05 26, GROUNDING AND BONDING 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.
- B. National Fire Protection Association (NFPA):
 - 70-2014National Electrical Code (NEC)
 - 90A-2015Standard for the Installation of Air-Conditioning and Ventilating Systems
- C. Underwriters Laboratories (UL):
 - 499-2014Electric Heating Appliances

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 82 39, UNIT 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.
- D. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each type of product indicated.
- E. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replacement parts, and troubleshooting guide:
 - 1. Include complete list indicating all components of the systems.
 - 2. Include complete diagrams of the internal wiring for each item of equipment.
 - 3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.
- F. Completed System Readiness Checklist provided by the 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.
- 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. Refer to paragraph QUALITY ASSURANCE, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

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 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. As-built drawings are to be provided, and a copy of them in Auto-CAD version 2018 or later provided on CD 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 CABINET UNIT HEATERS

- A. Description: Factory-packaged units constructed according to UL 499.
- B. Cabinet: Steel with baked-enamel finish in color selected by Architect.
 - 1. Horizontal Unit, Exposed Bottom Panels: Minimum 1.35 mm (0.053 inch) sheet steel, removable panels secured with tamperproof cam fasteners and safety chain.

2. Recessing Flanges: Steel, finished to match cabinet.
 3. Control Access Door: Key operated.
 4. Base: Minimum 1.35 mm (0.053 inch) thick steel, finished to match cabinet, 100 mm (4 inches) high with leveling bolts.
- C. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and hum, mounted in ceramic inserts in a galvanized steel housing; with fuses in terminal box for overcurrent protection and limit controls for high-temperature protection. Terminate elements in stainless steel machine-staked terminals secured with stainless steel hardware.
- D. Fan and Motor Board: Removable.
1. Fan: Forward curved, double width, centrifugal; directly connected to motor. Thermoplastic or painted steel wheels, and aluminum, painted steel, or galvanized steel fan scrolls.
 2. Motor: Permanently lubricated, multispeed; resiliently mounted on motor board. Comply with requirements in Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC EQUIPMENT.
 3. Wiring Terminations: Connect motor to chassis wiring with plug connection.
- E. Basic Unit Controls:
1. Control voltage transformer.
 2. Wall-mounted thermostat.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in forelectrical connections to verify actual locations before unit heater installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 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 wall boxes in finished wall assembly; seal and weatherproof.
- C. Install cabinet unit heaters to comply with NFPA 90A.
- D. Install propeller unit heaters level and plumb.

3.3 CONNECTIONS

- A. Ground electric convection heating units according to Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
- B. Connect wiring according to Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW).

3.4 STARTUP AND TESTING

- A. Make tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.
- B. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.
- C. The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and Commissioning Agent. Provide a minimum notice of 10 working days prior to startup and testing.

3.5 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.

3.6 DEMONSTRATION AND TRAINING

- A. Provide services of manufacturer's technical representative for two hours to instruct each VA personnel responsible in the 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.

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SECTION 26 05 11
REQUIREMENTS FOR ELECTRICAL INSTALLATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section applies to all sections of Division 26.
- B. Furnish and install electrical systems, materials, equipment, and accessories in accordance with the specifications and drawings. Capacities and ratings of motors, transformers, conductors and cable, switchboards, switchgear, panelboards, motor control centers, generators, automatic transfer switches, and other items and arrangements for the specified items are shown on the drawings.
- C. Electrical service entrance equipment and arrangements for temporary and permanent connections to the electric utility company's system shall conform to the electric utility company's requirements. Coordinate fuses, circuit breakers and relays with the electric utility company's system, and obtain electric utility company approval for sizes and settings of these devices.
- D. Conductor ampacities specified or shown on the drawings are based on copper conductors, with the conduit and raceways sized per NEC. Aluminum conductors are prohibited.

1.2 MINIMUM REQUIREMENTS

- A. The latest International Building Code (IBC), Underwriters Laboratories, Inc. (UL), Institute of Electrical and Electronics Engineers (IEEE), and National Fire Protection Association (NFPA) codes and standards are the minimum requirements for materials and installation.
- B. The drawings and specifications shall govern in those instances where requirements are greater than those stated in the above codes and standards.

1.3 TEST STANDARDS

- A. All materials and equipment shall be listed, labeled, or certified by a Nationally Recognized Testing Laboratory (NRTL) to meet Underwriters Laboratories, Inc. (UL), standards where test standards have been established.

Materials and equipment which are not covered by UL standards will be accepted, providing that materials and equipment are listed, labeled, certified or otherwise determined to meet the safety requirements of a NRTL. Materials and equipment which no NRTL accepts, certifies, lists, labels, or determines to be safe, will be considered if inspected or tested in accordance with national industrial standards, such as ANSI, NEMA, and NETA. Evidence of compliance shall include certified test reports and definitive shop drawings.

B. Definitions:

1. Listed: Materials and equipment included in a list published by an organization that is acceptable to the Authority Having Jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production or listed materials and equipment or periodic evaluation of services, and whose listing states that the materials and equipment either meets appropriate designated standards or has been tested and found suitable for a specified purpose.
2. Labeled: Materials and equipment to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the Authority Having Jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled materials and equipment, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.
3. Certified: Materials and equipment which:
 - a. Have been tested and found by a NRTL to meet nationally recognized standards or to be safe for use in a specified manner.
 - b. Are periodically inspected by a NRTL.
 - c. Bear a label, tag, or other record of certification.
4. Nationally Recognized Testing Laboratory: Testing laboratory which is recognized and approved by the Secretary of Labor in accordance with OSHA regulations.

1.4 QUALIFICATIONS (PRODUCTS AND SERVICES)

- A. Manufacturer's Qualifications: The manufacturer shall regularly and currently produce, as one of the manufacturer's principal products, the materials and equipment specified for this project, and shall have manufactured the materials and equipment for at least three years.

B. Product Qualification:

1. Manufacturer's materials and equipment shall have been in satisfactory operation, on three installations of similar size and type as this project, for at least three years.
2. The Government reserves the right to require the Contractor to submit a list of installations where the materials and equipment have been in operation before approval.

C. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within eight hours of receipt of notification that service is needed. Submit name and address of service organizations.

1.5 APPLICABLE PUBLICATIONS

- A. Applicable publications listed in all Sections of Division 26 shall be the latest issue, unless otherwise noted.
- B. Products specified in all sections of Division 26 shall comply with the applicable publications listed in each section.

1.6 MANUFACTURED PRODUCTS

- A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, and for which replacement parts shall be available. Materials and equipment furnished shall be new, and shall have superior quality and freshness.
- B. When more than one unit of the same class or type of materials and equipment is required, such units shall be the product of a single manufacturer.
- C. Equipment Assemblies and Components:
 1. Components of an assembled unit need not be products of the same manufacturer.
 2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
 3. Components shall be compatible with each other and with the total assembly for the intended service.
 4. Constituent parts which are similar shall be the product of a single manufacturer.
- D. Factory wiring and terminals shall be identified on the equipment being furnished and on all wiring diagrams.

E. When Factory Tests are specified, Factory Tests shall be performed in the factory by the equipment manufacturer, and witnessed by the contractor. In addition, the following requirements shall be complied with:

1. The Government shall have the option of witnessing factory tests. The Contractor shall notify the Government through the COR a minimum of thirty (30) days prior to the manufacturer's performing of the factory tests.
2. When factory tests are successful, contractor shall furnish four (4) copies of the equipment manufacturer's certified test reports to the COR fourteen (14) days prior to shipment of the equipment, and not more than ninety (90) days after completion of the factory tests.
3. When factory tests are not successful, factory tests shall be repeated in the factory by the equipment manufacturer, and witnessed by the Contractor. The Contractor shall be liable for all additional expenses for the Government to witness factory re-testing.

1.7 VARIATIONS FROM CONTRACT REQUIREMENTS

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

1.8 MATERIALS AND EQUIPMENT PROTECTION

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

5. Damaged paint on equipment shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious.

1.9 WORK PERFORMANCE

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

- At the minimum, the work plan must include relevant information such as proposed work schedule, area of work, description of work, name(s) of Supervisor and Qualified Person(s) performing the work, equipment to be used, procedures to be used on and near the live electrical equipment, barriers to be installed, safety equipment to be used, and exit pathways.
4. Energized electrical work shall begin only after the Contractor has obtained written approval of the work plan, and the energized electrical work request from the COR. 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 to witness the work.
- D. For work that affects existing electrical systems, arrange, phase and perform work to assure minimal interference with normal functioning of the facility. Refer to Article OPERATIONS AND STORAGE AREAS under Section 01 00 00, GENERAL REQUIREMENTS.
 - E. New work shall be installed and connected to existing work neatly, safely and professionally. Disturbed or damaged work shall be replaced or repaired to its prior conditions, as required by Section 01 00 00, GENERAL REQUIREMENTS.
 - F. Coordinate location of equipment and conduit with other trades to minimize interference.

1.10 EQUIPMENT INSTALLATION AND REQUIREMENTS

- A. Equipment location shall be as close as practical to locations shown on the drawings.
- B. Working clearances shall not be less than specified in the NEC.
- C. Inaccessible Equipment:
 1. Where the Government determines that the Contractor has installed equipment not readily accessible for operation and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to the Government.

2. "Readily accessible" is defined as being capable of being reached quickly for operation, maintenance, or inspections without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.

D. Electrical service entrance equipment and arrangements for temporary and permanent connections to the electric utility company's system shall conform to the electric utility company's requirements. Coordinate fuses, circuit breakers and relays with the electric utility company's system, and obtain electric utility company approval for sizes and settings of these devices.

1.11 EQUIPMENT IDENTIFICATION

- A. In addition to the requirements of the NEC, install an identification sign which clearly indicates information required for use and maintenance of items such as switchboards and switchgear, panelboards, cabinets, motor controllers, fused and non-fused safety switches, generators, automatic transfer switches, separately enclosed circuit breakers, individual breakers and controllers in switchboards, switchgear and motor control assemblies, control devices and other significant equipment.
- B. Identification signs for Normal Power System equipment shall be laminated black phenolic resin with a white core with engraved lettering. 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.
 - 3. Elementary and interconnection wiring diagrams for communication and signal systems, control systems, and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.
 - 4. Parts list which shall include information for replacement parts and ordering instructions, as recommended by the equipment manufacturer.

F. Maintenance and Operation Manuals:

1. Submit as required for systems and equipment specified in the technical sections. Furnish in hardcover binders or an approved equivalent.
2. Inscribe the following identification on the cover: the words "MAINTENANCE AND OPERATION MANUAL," the name and location of the system, material, equipment, building, name of Contractor, and contract name and number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the material or equipment.
3. Provide a table of contents and assemble the manual to conform to the table of contents, with tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in.
4. The manuals shall include:
 - a. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.
 - b. A control sequence describing start-up, operation, and shutdown.
 - c. Description of the function of each principal item of equipment.
 - d. Installation instructions.
 - e. Safety precautions for operation and maintenance.
 - f. Diagrams and illustrations.
 - g. Periodic maintenance and testing procedures and frequencies, including replacement parts numbers.
 - h. Performance data.
 - i. Pictorial "exploded" parts list with part numbers. Emphasis shall be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare and replacement parts, and name of servicing organization.
 - j. List of factory approved or qualified permanent servicing organizations for equipment repair and periodic testing and maintenance, including addresses and factory certification qualifications.

- G. Approvals will be based on complete submission of shop drawings, manuals, test reports, certifications, and samples as applicable.

- H. After approval and prior to installation, furnish the COR with one sample of each of the following:
1. A minimum 300 mm (12 inches) length of each type and size of wire and cable along with the tag from the coils or reels from which the sample was taken. The length of the sample shall be sufficient to show all markings provided by the manufacturer.
 2. Each type of conduit coupling, bushing, and termination fitting.
 3. Conduit hangers, clamps, and supports.
 4. Duct sealing compound.
 5. Each type of receptacle, toggle switch, lighting control sensor, outlet box, manual motor starter, device wall plate, engraved nameplate, wire and cable splicing and terminating material, and branch circuit single pole molded case circuit breaker.

1.13 SINGULAR NUMBER

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

1.14 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.

1.15 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.

1.16 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---

SECTION 26 05 19
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installation, connection, and testing of the electrical conductors and cables for use in electrical systems rated 600 V and below, indicated as cable(s), conductor(s), wire, or wiring in this section.

1.2 RELATED WORK

- A. Section 07 84 00, FIRESTOPPING: Sealing around penetrations to maintain the integrity of fire-resistant rated construction.
- B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
- C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
- D. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits for conductors and cables.
- E. Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION: Installation of conductors and cables in manholes and ducts.

1.3 QUALITY ASSURANCE

- A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

- A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:
1. Shop Drawings:
 - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
 - b. Submit the following data for approval:
 - 1) Electrical ratings and insulation type for each conductor and cable.
 - 2) Splicing materials and pulling lubricant.

2. Certifications: Two weeks prior to final inspection, submit the following.
 - a. Certification by the manufacturer that the conductors and cables conform to the requirements of the drawings and specifications.
 - b. Certification by the Contractor that the conductors and cables have been properly installed, adjusted, and tested.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are reference in the text by designation only.
- B. American Society of Testing Material (ASTM):
 - D2301-10Standard Specification for Vinyl Chloride
Plastic Pressure-Sensitive Electrical
Insulating Tape
 - D2304-10Test Method for Thermal Endurance of Rigid
Electrical Insulating Materials
 - D3005-10Low-Temperature Resistant Vinyl Chloride
Plastic Pressure-Sensitive Electrical
Insulating Tape
- C. National Electrical Manufacturers Association (NEMA):
 - WC 70-09Power Cables Rated 2000 Volts or Less for the
Distribution of Electrical Energy
- D. National Fire Protection Association (NFPA):
 - 70-17National Electrical Code (NEC)
- E. Underwriters Laboratories, Inc. (UL):
 - 44-14Thermoset-Insulated Wires and Cables
 - 83-14Thermoplastic-Insulated Wires and Cables
 - 467-13Grounding and Bonding Equipment
 - 486A-486B-13Wire Connectors
 - 486C-13Splicing Wire Connectors
 - 486D-15Sealed Wire Connector Systems
 - 486E-15Equipment Wiring Terminals for Use with
Aluminum and/or Copper Conductors
 - 493-07Thermoplastic-Insulated Underground Feeder and
Branch Circuit Cables
 - 514B-12Conduit, Tubing, and Cable Fittings

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Conductors and cables shall be in accordance with ASTM, NEMA, NFPA, UL, as specified herein, and as shown on the drawings.
- B. All conductors shall be copper.
- C. Single Conductor and Cable:
 - 1. No. 12 AWG: Minimum size, except where smaller sizes are specified herein or shown on the drawings.
 - 2. No. 8 AWG and larger: Stranded.
 - 3. No. 10 AWG and smaller: Solid; except shall be stranded for final connection to motors, transformers, and vibrating equipment.
 - 4. Insulation: THHN-THWN and XHHW-2. XHHW-2 shall be used for isolated power systems.
- D. Color Code:
 - 1. No. 10 AWG and smaller: Solid color insulation or solid color coating.
 - 2. No. 8 AWG and larger: Color-coded using one of the following methods:
 - a. Solid color insulation or solid color coating.
 - b. Stripes, bands, or hash marks of color specified.
 - c. Color using 19 mm (0.75 inches) wide tape.
 - 4. For modifications and additions to existing wiring systems, color coding shall conform to the existing wiring system.
 - 5. Conductors shall be color-coded as follows:

| 208/120 V | Phase | 480/277 V |
|--|---------|-----------|
| Black | A | Brown |
| Red | B | Orange |
| Blue | C | Yellow |
| White | Neutral | Gray * |
| * or white with colored (other than green) tracer. | | |

- 6. Lighting circuit "switch legs," and 3-way and 4-way switch "traveling wires," shall have color coding that is unique and distinct (e.g., pink and purple) from the color coding indicated above. The unique color codes shall be solid and in accordance with the NEC. Coordinate color coding in the field with the COR.

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

2.2 SPLICES

- A. Splices shall be in accordance with NEC and UL.
- B. Above Ground Splices for No. 10 AWG and Smaller:
 1. Solderless, screw-on, reusable pressure cable type, with integral insulation, approved for copper and aluminum conductors.
 2. The integral insulator shall have a skirt to completely cover the stripped conductors.
 3. The number, size, and combination of conductors used with the connector, as listed on the manufacturer's packaging, shall be strictly followed.
- C. Above Ground Splices for No. 8 AWG to No. 4/0 AWG:
 1. Compression, hex screw, or bolt clamp-type of high conductivity and corrosion-resistant material, listed for use with copper and aluminum conductors.
 2. Insulate with materials approved for the particular use, location, voltage, and temperature. Insulation level shall be not less than the insulation level of the conductors being joined.
 3. Splice and insulation shall be product of the same manufacturer.
 4. All bolts, nuts, and washers used with splices shall be zinc-plated.
- D. Above Ground Splices for 250 kcmil and Larger:
 1. Long barrel "butt-splice" or "sleeve" type compression connectors, with minimum of two compression indents per wire, listed for use with copper and aluminum conductors.
 2. Insulate with materials approved for the particular use, location, voltage, and temperature. Insulation level shall be not less than the insulation level of the conductors being joined.
 3. Splice and insulation shall be product of the same manufacturer.

2.3 CONNECTORS AND TERMINATIONS

- A. Mechanical type of high conductivity and corrosion-resistant material, listed for use with copper and aluminum conductors.
- B. Long barrel compression type of high conductivity and corrosion-resistant material, with minimum of two compression indents per wire, listed for use with copper and aluminum conductors.

- C. All bolts, nuts, and washers used to connect connections and terminations to bus bars or other termination points shall be zinc-plated.

2.4 CONTROL WIRING

- A. Unless otherwise specified elsewhere in these specifications, control wiring shall be as specified herein, except that the minimum size shall be not less than No. 14 AWG.
- B. Control wiring shall be sized such that the voltage drop under in-rush conditions does not adversely affect operation of the controls.

2.5 WIRE LUBRICATING COMPOUND

- A. Lubricating compound shall be suitable for the wire insulation and conduit, and shall not harden or become adhesive.
- B. Shall not be used on conductors for isolated power systems.

PART 3 - EXECUTION

3.1 GENERAL

- A. Installation shall be in accordance with the NEC, as shown on the drawings, and manufacturer's instructions.
- B. Install all conductors in raceway systems.
- C. Splice conductors only in outlet boxes, junction boxes, pullboxes, manholes, or handholes.
- D. Conductors of different systems (e.g., 120 V and 277 V) shall not be installed in the same raceway.
- E. Install cable supports for all vertical feeders in accordance with the NEC. Provide split wedge type which firmly clamps each individual cable and tightens due to cable weight.
- F. In panelboards, cabinets, wireways, switches, enclosures, and equipment assemblies, neatly form, train, and tie the conductors with non-metallic ties.
- G. For connections to motors, transformers, and vibrating equipment, stranded conductors shall be used only from the last fixed point of connection to the motors, transformers, or vibrating equipment.
- H. Use expanding foam or non-hardening duct-seal to seal conduits entering a building, after installation of conductors.
- I. Conductor and Cable Pulling:
 - 1. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling. Use lubricants approved for the cable.

2. Use nonmetallic pull ropes.
 3. Attach pull ropes by means of either woven basket grips or pulling eyes attached directly to the conductors.
 4. All conductors in a single conduit shall be pulled simultaneously.
 5. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- J. No more than three branch circuits shall be installed in any one conduit.
- K. When stripping stranded conductors, use a tool that does not damage the conductor or remove conductor strands.

3.3 SPLICE AND TERMINATION INSTALLATION

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

3.4 CONDUCTOR IDENTIFICATION

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

3.5 FEEDER CONDUCTOR IDENTIFICATION

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

3.6 EXISTING CONDUCTORS

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

3.7 CONTROL WIRING INSTALLATION

- A. Unless otherwise specified in other sections, install control wiring and connect to equipment to perform the required functions as specified or as shown on the drawings.

- B. Install a separate power supply circuit for each system, except where otherwise shown on the drawings.

3.8 CONTROL WIRING IDENTIFICATION

- A. Install a permanent wire marker on each wire at each termination.
- B. Identifying numbers and letters on the wire markers shall correspond to those on the wiring diagrams used for installing the systems.
- C. Wire markers shall retain their markings after cleaning.
- D. In each manhole and handhole, install embossed brass tags to identify the system served and function.

3.9 ACCEPTANCE CHECKS AND TESTS

- A. Perform in accordance with the manufacturer's recommendations. In addition, include the following:
 - 1. Visual Inspection and Tests: Inspect physical condition.
 - 2. Electrical tests:
 - a. After installation but before connection to utilization devices, such as fixtures, motors, or appliances, test conductors phase-to-phase and phase-to-ground resistance with an insulation resistance tester. Existing conductors to be reused shall also be tested.
 - b. Applied voltage shall be 500 V DC for 300 V rated cable, and 1000 V DC for 600 V rated cable. Apply test for one minute or until reading is constant for 15 seconds, whichever is longer. Minimum insulation resistance values shall not be less than 25 megohms for 300 V rated cable and 100 megohms for 600 V rated cable.
 - c. Perform phase rotation test on all three-phase circuits.

---END---

SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

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

1.2 RELATED WORK

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS:
Requirements that apply to all sections of Division 26.
- B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES:
Low-voltage conductors.
- C. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduit and boxes.
- D. Section 26 24 16, PANELBOARDS: Low-voltage panelboards.

1.3 QUALITY ASSURANCE

- A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

- A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:
 - 1. Shop Drawings:
 - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
 - b. Submit plans showing the location of system grounding electrodes and connections, and the routing of aboveground and underground grounding electrode conductors.
 - 2. Test Reports:
 - a. Two weeks prior to the final inspection, submit ground resistance field test reports to the COTR.

3. Certifications:

- a. Certification by the Contractor that the grounding equipment has been properly installed and tested.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. American Society for Testing and Materials (ASTM):
 - B1-13Standard Specification for Hard-Drawn Copper Wire
 - B3-13Standard Specification for Soft or Annealed Copper Wire
 - B8-11Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
- C. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - 81-12IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System Part 1: Normal Measurements
- D. National Fire Protection Association (NFPA):
 - 70-17National Electrical Code (NEC)
 - 70E-15National Electrical Safety Code
 - 99-15Health Care Facilities
- E. Underwriters Laboratories, Inc. (UL):
 - 44-14Thermoset-Insulated Wires and Cables
 - 83-14Thermoplastic-Insulated Wires and Cables
 - 467-13Grounding and Bonding Equipment

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING CONDUCTORS

- A. Equipment grounding conductors shall be insulated stranded copper, except that sizes No. 10 AWG and smaller shall be solid copper. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes No. 4 AWG and larger shall be identified per NEC.

- B. Bonding conductors shall be bare stranded copper, except that sizes No. 10 AWG and smaller shall be bare solid copper. Bonding conductors shall be stranded for final connection to motors, transformers, and vibrating equipment.
- C. Conductor sizes shall not be less than shown on the drawings, or not less than required by the NEC, whichever is greater.
- D. Insulation: THHN-THWN and XHHW-2. XHHW-2 shall be used for isolated power systems.

2.2 GROUND CONNECTIONS

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

2.3 EQUIPMENT RACK AND CABINET GROUND BARS

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

2.4 GROUND TERMINAL BLOCKS

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

2.5 GROUNDING BUS BAR

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

PART 3 - EXECUTION

3.1 GENERAL

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

3.2 INACCESSIBLE GROUNDING CONNECTIONS

- A. Make grounding connections, which are normally buried or otherwise inaccessible, by exothermic weld.
- B. 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.

3.3 RACEWAY

- A. Conduit Systems:
 - 1. Ground all metallic conduit systems. All metallic conduit systems shall contain an equipment grounding conductor.
 - 2. Non-metallic conduit systems, except non-metallic feeder conduits that carry a grounded conductor from exterior transformers to interior or building-mounted service entrance equipment, shall contain an equipment grounding conductor.

3. Metallic conduit that only contains a grounding conductor, and is provided for its mechanical protection, shall be bonded to that conductor at the entrance and exit from the conduit.
 4. Metallic conduits which terminate without mechanical connection to an electrical equipment housing by means of locknut and bushings or adapters, shall be provided with grounding bushings. Connect bushings with an equipment grounding conductor to the equipment ground bus.
- B. Feeders and Branch Circuits: Install equipment grounding conductors with all feeders, and power and lighting branch circuits.
- C. Boxes, Cabinets, Enclosures, and Panelboards:
1. Bond the equipment grounding conductor to each pullbox, junction box, outlet box, device box, cabinets, and other enclosures through which the conductor passes (except for special grounding systems for intensive care units and other critical units shown).
 2. Provide lugs in each box and enclosure for equipment grounding conductor termination.
- D. Wireway Systems:
1. Bond the metallic structures of wireway to provide electrical continuity throughout the wireway system, by connecting a No. 6 AWG bonding jumper at all intermediate metallic enclosures and across all section junctions.
 2. Install insulated No. 6 AWG bonding jumpers between the wireway system, bonded as required above, and the closest building ground at each end and approximately every 16 M (50 feet).
 3. Use insulated No. 6 AWG bonding jumpers to ground or bond metallic wireway at each end for all intermediate metallic enclosures and across all section junctions.
 4. Use insulated No. 6 AWG bonding jumpers to ground cable tray to column-mounted building ground plates (pads) at each end and approximately every 15 M (49 feet).
- E. Receptacles shall not be grounded through their mounting screws. Ground receptacles with a jumper from the receptacle green ground terminal to the device box ground screw and a jumper to the branch circuit equipment grounding conductor.

- F. Ground lighting fixtures to the equipment grounding conductor of the wiring system. Fixtures connected with flexible conduit shall have a green ground wire included with the power wires from the fixture through the flexible conduit to the first outlet box.
- G. Fixed electrical appliances and equipment shall be provided with a ground lug for termination of the equipment grounding conductor.
- I. Panelboard Bonding in Patient Care Areas: The equipment grounding terminal buses of the normal and essential branch circuit panel boards serving the same individual patient vicinity shall be bonded together with an insulated continuous copper conductor not less than No. 10 AWG, installed in rigid metal conduit.

3.4 CORROSION INHIBITORS

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

3.5 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.

3.6 GROUND RESISTANCE

- A. Grounding system resistance to ground shall not exceed 5 ohms. Make any modifications or additions to the grounding electrode system necessary for compliance without additional cost to the Government. Final tests shall ensure that this requirement is met.
- B. Grounding system resistance shall comply with the electric utility company ground resistance requirements.

3.7 ACCEPTANCE CHECKS AND TESTS

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

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- C. Below-grade connections shall be visually inspected by the COR prior to backfilling. The Contractor shall notify the COR 24 hours before the connections are ready for inspection.

---END---

SECTION 26 05 33
RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installation, and connection of conduit, fittings, and boxes, to form complete, coordinated, grounded raceway systems. Raceways are required for all wiring unless shown or specified otherwise.
- B. Definitions: The term conduit, as used in this specification, shall mean any or all of the raceway types specified.

1.2 RELATED WORK

- A. Section 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.

1.3 QUALITY ASSURANCE

A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:

1. Shop Drawings:

- a. Size and location of main feeders.
- b. Size and location of panels and pull-boxes.
- c. Layout of required conduit penetrations through structural elements.
- d. Submit the following data for approval:
 - 1) Raceway types and sizes.
 - 2) Conduit bodies, connectors and fittings.
 - 3) Junction and pull boxes, types and sizes.

2. Certifications: Two weeks prior to final inspection, submit the following:

- a. Certification by the manufacturer that raceways, conduits, conduit bodies, connectors, fittings, junction and pull boxes, and all related equipment conform to the requirements of the drawings and specifications.
- b. Certification by the Contractor that raceways, conduits, conduit bodies, connectors, fittings, junction and pull boxes, and all related equipment have been properly installed.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

B. American Iron and Steel Institute (AISI):

S100-12North American Specification for the Design of
Cold-Formed Steel Structural Members

C. National Electrical Manufacturers Association (NEMA):

C80.1-15Electrical Rigid Steel Conduit
C80.3-15Steel Electrical Metal Tubing

- C80.6-05Electrical Intermediate Metal Conduit
- FB1-14Fittings, Cast Metal Boxes and Conduit Bodies
for Conduit, Electrical Metallic Tubing and
Cable
- FB2.10-13Selection and Installation Guidelines for
Fittings for use with Non-Flexible Conduit or
Tubing (Rigid Metal Conduit, Intermediate
Metallic Conduit, and Electrical Metallic
Tubing)
- FB2.20-14Selection and Installation Guidelines for
Fittings for use with Flexible Electrical
Conduit and Cable
- TC-2-13Electrical Polyvinyl Chloride (PVC) Tubing and
Conduit
- TC-3-13PVC Fittings for Use with Rigid PVC Conduit and
Tubing
- D. National Fire Protection Association (NFPA):
 - 70-17National Electrical Code (NEC)
- E. Underwriters Laboratories, Inc. (UL):
 - 1-05Flexible Metal Conduit
 - 5-16Surface Metal Raceway and Fittings
 - 6-07Electrical Rigid Metal Conduit - Steel
 - 50-15Enclosures for Electrical Equipment
 - 360-13Liquid-Tight Flexible Steel Conduit
 - 467-13Grounding and Bonding Equipment
 - 514A-13Metallic Outlet Boxes
 - 514B-12Conduit, Tubing, and Cable Fittings
 - 514C-14Nonmetallic Outlet Boxes, Flush-Device Boxes
and Covers
 - 651-11Schedule 40 and 80 Rigid PVC Conduit and
Fittings
 - 651A-11Type EB and A Rigid PVC Conduit and HDPE
Conduit
 - 797-07Electrical Metallic Tubing
 - 1242-14Electrical Intermediate Metal Conduit - Steel

PART 2 - PRODUCTS

2.1 MATERIAL

- A. Conduit Size: In accordance with the NEC, but not less than 13 mm (0.5-inch) unless otherwise shown. Where permitted by the NEC, 13 mm (0.5-inch) flexible conduit may be used for tap connections to recessed lighting fixtures.
- B. Conduit:
 - 1. Size: In accordance with the NEC, but not less than 13 mm (0.5-inch).
 - 2. Rigid Steel Conduit (RMC): Shall conform to UL 6 and NEMA C80.1.
 - 4. Rigid Intermediate Steel Conduit (IMC): Shall conform to UL 1242 and NEMA C80.6.
 - 5. Electrical Metallic Tubing (EMT): Shall conform to UL 797 and NEMA C80.3. Maximum size not to exceed 105 mm (4 inches) and shall be permitted only with cable rated 600 V or less.
 - 6. Flexible Metal Conduit: Shall conform to UL 1.
 - 7. Liquid-tight Flexible Metal Conduit: Shall conform to UL 360.
 - 8. Direct Burial Plastic Conduit: Shall conform to UL 651 and UL 651A, heavy wall PVC or high density polyethylene (PE).
 - 9. Surface Metal Raceway: Shall conform to UL 5.
- C. Conduit Fittings:
 - 1. Rigid Steel and Intermediate Metallic Conduit Fittings:
 - a. Fittings shall meet the requirements of UL 514B and NEMA FB1.
 - b. Standard threaded couplings, locknuts, bushings, conduit bodies, and elbows: Only steel or malleable iron materials are acceptable. Integral retractable type IMC couplings are also acceptable.
 - c. Locknuts: Bonding type with sharp edges for digging into the metal wall of an enclosure.
 - d. Bushings: Metallic insulating type, consisting of an insulating insert, molded or locked into the metallic body of the fitting. Bushings made entirely of metal or nonmetallic material are not permitted.

- e. Erickson (Union-Type) and Set Screw Type Couplings: Approved for use in concrete are permitted for use to complete a conduit run where conduit is installed in concrete. Use set screws of case-hardened steel with hex head and cup point to firmly seat in conduit wall for positive ground. Tightening of set screws with pliers is prohibited.
 - f. Sealing Fittings: Threaded cast iron type. Use continuous drain-type sealing fittings to prevent passage of water vapor. In concealed work, install fittings in flush steel boxes with blank cover plates having the same finishes as that of other electrical plates in the room.
3. Electrical Metallic Tubing Fittings:
- a. Fittings and conduit bodies shall meet the requirements of UL 514B, NEMA C80.3, and NEMA FB1.
 - b. Only steel or malleable iron materials are acceptable.
 - c. Compression Couplings and Connectors: Concrete-tight and rain-tight, with connectors having insulated throats.
 - d. Indent-type connectors or couplings are prohibited.
 - e. Die-cast or pressure-cast zinc-alloy fittings or fittings made of "pot metal" are prohibited.
4. Flexible Metal Conduit Fittings:
- a. Conform to UL 514B. Only steel or malleable iron materials are acceptable.
 - b. Clamp-type, with insulated throat.
5. Liquid-tight Flexible Metal Conduit Fittings:
- a. Fittings shall meet the requirements of UL 514B and NEMA FB1.
 - b. Only steel or malleable iron materials are acceptable.
 - c. Fittings must incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening. Connectors shall have insulated throats.
6. Direct Burial Plastic Conduit Fittings: Fittings shall meet the requirements of UL 514C and NEMA TC3.
7. Surface Metal Raceway Fittings: As recommended by the raceway manufacturer. Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, conduit entry fittings, accessories, and other fittings as required for complete system.

8. Expansion and Deflection Couplings:
 - a. Conform to UL 467 and UL 514B.
 - b. Accommodate a 19 mm (0.75-inch) deflection, expansion, or contraction in any direction, and allow 30-degree angular deflections.
 - c. Include internal flexible metal braid, sized to guarantee conduit ground continuity and a low-impedance path for fault currents, in accordance with UL 467 and the NEC tables for equipment grounding conductors.
 - d. Jacket: Flexible, corrosion-resistant, watertight, moisture and heat-resistant molded rubber material with stainless steel jacket clamps.
- D. Conduit Supports:
 1. Parts and Hardware: Zinc-coat or provide equivalent corrosion protection.
 2. Individual Conduit Hangers: Designed for the purpose, having a pre-assembled closure bolt and nut, and provisions for receiving a hanger rod.
 3. Multiple Conduit (Trapeze) Hangers: Not less than 38 mm x 38 mm (1.5 x 1.5 inches), 12-gauge steel, cold-formed, lipped channels; with not less than 9 mm (0.375-inch) diameter steel hanger rods.
 4. Solid Masonry and Concrete Anchors: Self-drilling expansion shields, or machine bolt expansion.
- E. Outlet, Junction, and Pull Boxes:
 1. Comply with UL-50 and UL-514A.
 2. Rustproof cast metal where required by the NEC or shown on drawings.
 3. Sheet Metal Boxes: Galvanized steel, except where shown on drawings.
- F. Metal Wireways: Equip with hinged covers, except as shown on drawings. Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for a complete system.

PART 3 - EXECUTION

3.1 PENETRATIONS

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

3.2 INSTALLATION, GENERAL

- A. In accordance with NEC, NEMA, UL, as shown on drawings, and as specified herein.
- B. Raceway systems used for Essential Electrical Systems (EES) shall be entirely independent of other raceway systems.
- C. Install conduit as follows:
 - 1. In complete mechanically and electrically continuous runs before pulling in cables or wires.
 - 2. Unless otherwise indicated on the drawings or specified herein, installation of all conduits shall be concealed within finished walls, floors, and ceilings.
 - 3. Flattened, dented, or deformed conduit is not permitted. Remove and replace the damaged conduits with new conduits.
 - 4. Assure conduit installation does not encroach into the ceiling height head room, walkways, or doorways.
 - 5. Cut conduits square, ream, remove burrs, and draw up tight.
 - 6. Independently support conduit at 2.4 M (8 feet) on centers with specified materials and as shown on drawings.

7. Do not use suspended ceilings, suspended ceiling supporting members, lighting fixtures, other conduits, cable tray, boxes, piping, or ducts to support conduits and conduit runs.
8. Support within 300 mm (12 inches) of changes of direction, and within 300 mm (12 inches) of each enclosure to which connected.
9. Close ends of empty conduits with plugs or caps at the rough-in stage until wires are pulled in, to prevent entry of debris.
10. Conduit installations under fume and vent hoods are prohibited.
11. Secure conduits to cabinets, junction boxes, pull-boxes, and outlet boxes with bonding type locknuts. For rigid steel and IMC conduit installations, provide a locknut on the inside of the enclosure, made up wrench tight. Do not make conduit connections to junction box covers.
12. Flashing of penetrations of the roof membrane is specified in Section 07 60 00, FLASHING AND SHEET METAL.
13. Conduit bodies shall only be used for changes in direction, and shall not contain splices.

D. Conduit Bends:

1. Make bends with standard conduit bending machines.
2. Conduit hickey may be used for slight offsets and for straightening stubbed out conduits.
3. Bending of conduits with a pipe tee or vise is prohibited.

E. Layout and Homeruns:

1. Install conduit with wiring, including homeruns, as shown on drawings.
2. Deviations: Make only where necessary to avoid interferences and only after drawings showing the proposed deviations have been submitted and approved by the COR

3.3 CONCEALED WORK INSTALLATION

A. In Concrete:

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

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

3.4 EXPOSED WORK INSTALLATION

- A. Unless otherwise indicated on drawings, exposed conduit is only permitted in mechanical and electrical rooms.
- B. Conduit for Conductors Above 600 V: Rigid steel. Mixing different types of conduits in the system is prohibited.

- C. Conduit for Conductors 600 V and Below: Rigid steel, IMC, or EMT.
Mixing different types of conduits in the system is prohibited.
- D. Align and run conduit parallel or perpendicular to the building lines.
- E. Install horizontal runs close to the ceiling or beams and secure with conduit straps.
- F. Support horizontal or vertical runs at not over 2.4 M (8 feet) intervals.
- G. Surface Metal Raceways: Use only where shown on drawings.
- H. Painting:
 - 1. Paint exposed conduit as specified in Section 09 91 00, PAINTING.
 - 2. Paint all conduits containing cables rated over 600 V safety orange. Refer to Section 09 91 00, PAINTING for preparation, paint type, and exact color. In addition, paint legends, using 50 mm (2 inch) high black numerals and letters, showing the cable voltage rating. Provide legends where conduits pass through walls and floors and at maximum 6 M (20 feet) intervals in between.

3.5 DIRECT BURIAL INSTALLATION

Refer to Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION.

3.6 HAZARDOUS LOCATIONS

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

3.7 WET OR DAMP LOCATIONS

- A. Use rigid steel or IMC conduits unless as shown on drawings.
- B. Provide sealing fittings to prevent passage of water vapor where conduits pass from warm to cold locations, i.e., refrigerated spaces, constant-temperature rooms, air-conditioned spaces, building exterior walls, roofs, or similar spaces.
- C. Use rigid steel or IMC conduit within 1.5 M (5 feet) of the exterior and below concrete building slabs in contact with soil, gravel, or vapor barriers, unless as shown on drawings. Conduit shall be half-lapped with 10 mil PVC tape before installation. After installation, completely recoat or retape any damaged areas of coating.

- D. Conduits run on roof shall be supported with integral galvanized lipped steel channel, attached to UV-inhibited polycarbonate or polypropylene blocks every 2.4 M (8 feet) with 9 mm (3/8-inch) galvanized threaded rods, square washer and locknut. Conduits shall be attached to steel channel with conduit clamps.

3.8 MOTORS AND VIBRATING EQUIPMENT

- A. Use flexible metal conduit for connections to motors and other electrical equipment subject to movement, vibration, misalignment, cramped quarters, or noise transmission.
- B. Use liquid-tight flexible metal conduit for installation in exterior locations, moisture or humidity laden atmosphere, corrosive atmosphere, water or spray wash-down operations, inside airstream of HVAC units, and locations subject to seepage or dripping of oil, grease, or water.
- C. Provide a green equipment grounding conductor with flexible and liquid-tight flexible metal conduit.

3.9 EXPANSION JOINTS

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

3.10 CONDUIT SUPPORTS

- A. Safe working load shall not exceed one-quarter of proof test load of fastening devices.
- B. Use pipe straps or individual conduit hangers for supporting individual conduits.

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

3.11 BOX INSTALLATION

- A. Boxes for Concealed Conduits:
 - 1. Flush-mounted.
 - 2. Provide raised covers for boxes to suit the wall or ceiling, construction, and finish.

- B. In addition to boxes shown, install additional boxes where needed to prevent damage to cables and wires during pulling-in operations or where more than the equivalent of 4-90 degree bends are necessary.
- C. Locate pullboxes so that covers are accessible and easily removed. Coordinate locations with piping and ductwork where installed above ceilings.
- D. Remove only knockouts as required. Plug unused openings. Use threaded plugs for cast metal boxes and snap-in metal covers for sheet metal boxes.
- E. Outlet boxes mounted back-to-back in the same wall are prohibited. A minimum 600 mm (24 inch) center-to-center lateral spacing shall be maintained between boxes.
- F. Flush-mounted wall or ceiling boxes shall be installed with raised covers so that the front face of raised cover is flush with the wall. Surface-mounted wall or ceiling boxes shall be installed with surface-style flat or raised covers.
- G. Minimum size of outlet boxes for ground fault circuit interrupter (GFCI) receptacles is 100 mm (4 inches) square x 55 mm (2.125 inches) deep, with device covers for the wall material and thickness involved.
- H. Stencil or install phenolic nameplates on covers of the boxes identified on riser diagrams; for example "SIG-FA JB No. 1."
- I. On all branch circuit junction box covers, identify the circuits with black marker.

- - - E N D - - -

SECTION 26 08 00
COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The requirements of this Section apply to all sections of Division 26.
- B. This project will have selected building systems commissioned. The complete list of equipment and systems to be commissioned is specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. The commissioning process, which the Contractor is responsible to execute, is defined in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. A Commissioning Agent (CxA) appointed by the VA will manage the commissioning process.

1.2 RELATED WORK

- A. Section 01 00 00 GENERAL REQUIREMENTS.
- B. Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.
- C. Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

1.3 SUMMARY

- A. This Section includes requirements for commissioning the Facility electrical systems, related subsystems and related equipment. This Section supplements the general requirements specified in Section 01 91 00 General Commissioning Requirements.
- B. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for more details regarding processes and procedures as well as roles and responsibilities for all Commissioning Team members.

1.4 DEFINITIONS

- A. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for definitions.

1.5 COMMISSIONED SYSTEMS

- A. Commissioning of a system or systems specified in Division 26 is part of the construction process. Documentation and testing of these systems, as well as training of the VA's Operation and Maintenance personnel in accordance with the requirements of Section 01 91 00 and of Division 26, is required in cooperation with the VA and the Commissioning Agent.
- B. The Facility electrical systems commissioning will include the systems listed in Section 01 91 00 General Commissioning Requirements:

1.6 SUBMITTALS

- A. The commissioning process requires review of selected Submittals that pertain to the systems to be commissioned. The Commissioning Agent will provide a list of submittals that will be reviewed by the Commissioning Agent. This list will be reviewed and approved by the VA prior to forwarding to the Contractor. Refer to Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, and SAMPLES for further details.
- B. The commissioning process requires Submittal review simultaneously with engineering review. Specific submittal requirements related to the commissioning process are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 CONSTRUCTION INSPECTIONS

- A. Commissioning of Electrical systems will require inspection of individual elements of the electrical systems construction throughout the construction period. The Contractor shall coordinate with the Commissioning Agent in accordance with Section 01 91 00 and the Commissioning plan to schedule electrical systems inspections as required to support the Commissioning Process.

3.2 PRE-FUNCTIONAL CHECKLISTS

- A. The Contractor shall complete Pre-Functional Checklists to verify systems, subsystems, and equipment installation is complete and systems are ready for Systems Functional Performance Testing. The Commissioning Agent will prepare Pre-Functional Checklists to be used to document equipment installation. The Contractor shall complete the checklists. Completed checklists shall be submitted to the VA and to the Commissioning Agent for review. The Commissioning Agent may spot check a sample of completed checklists. If the Commissioning Agent determines that the information provided on the checklist is not accurate, the Commissioning Agent will return the marked-up checklist to the Contractor for correction and resubmission. If the Commissioning Agent determines that a significant number of completed checklists for similar equipment are not accurate, the Commissioning Agent will select a broader sample of checklists for review.

If the Commissioning Agent determines that a significant number of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and resubmission. Refer to SECTION 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for Pre-Functional Checklists, Equipment Startup Reports, and other commissioning documents.

3.3 CONTRACTORS TESTS

- A. Contractor tests as required by other sections of Division 26 shall be scheduled and documented in accordance with Section 01 00 00 GENERAL REQUIREMENTS. All testing shall be incorporated into the project schedule. Contractor shall provide no less than 7 calendar days' notice of testing. The Commissioning Agent will witness selected Contractor tests at the sole discretion of the Commissioning Agent. Contractor tests shall be completed prior to scheduling Systems Functional Performance Testing.

3.4 SYSTEMS FUNCTIONAL PERFORMANCE TESTING

- A. The Commissioning Process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions. The Commissioning Agent will prepare detailed Systems Functional Performance Test procedures for review and approval by the Resident Engineer. The Contractor shall review and comment on the tests prior to approval. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The Commissioning Agent will witness and document the testing. The Contractor shall sign the test reports to verify tests were performed. See Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS, for additional details.

3.5 TRAINING OF VA PERSONNEL

- A. Training of the VA operation and maintenance personnel is required in cooperation with the Resident Engineer and Commissioning Agent. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. Contractor shall submit training agendas and trainer resumes in accordance with the requirements of Section 01 91 00.

Black Hills National Cemetery
Renovate and Expand Administration and Maintenance Buildings
20901 Pleasant Valley Drive
Sturgis, SD 57785

NCA Project # 884CM3015

10/31/22

Bid Documents

The instruction shall be scheduled in coordination with the VA Resident Engineer after submission and approval of formal training plans. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS and Division 26 Sections for additional Contractor training requirements.

----- END -----

**SECTION 26 09 23
LIGHTING CONTROLS**

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies the furnishing, installation and connection of the lighting controls.

1.2 RELATED WORK

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General requirements that are common to more than one section of Division 26.
- B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): 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 24 16, PANELBOARDS: Panelboard enclosure and interior bussing used for lighting control panels.
- E. Section 26 27 26, WIRING DEVICES: Wiring devices used for control of the lighting systems.
- F. Section 26 51 00, INTERIOR LIGHTING: Luminaire ballast and drivers used in control of lighting systems.

1.3 QUALITY ASSURANCE

- A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

- A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:
 - 1. Shop Drawings:
 - a. Submit the following information for each type of lighting controls.
 - b. Material and construction details.
 - c. Physical dimensions and description.
 - d. Wiring schematic and connection diagram.
 - e. Installation details.

- 2. Manuals:
 - a. Submit, simultaneously with the shop drawings, complete maintenance and operating manuals, including technical data sheets, wiring diagrams, and information for ordering replacement parts.
 - b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
- 3. Certifications: Two weeks prior to final inspection, submit the following.
 - a. Certification by the Contractor that the lighting control systems have been properly installed and tested.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. National Electrical Manufacturer's Association (NEMA):
 - C136.10-10American National Standard for Roadway and Area Lighting Equipment—Locking-Type Photocontrol Devices and Mating Receptacles—Physical and Electrical Interchangeability and Testing
 - ICS-1-15Standard for Industrial Control and Systems General Requirements
 - ICS-2-05Standard for Industrial Control and Systems: Controllers, Contractors, and Overload Relays Rated Not More than 2000 Volts AC or 750 Volts DC: Part 8 - Disconnect Devices for Use in Industrial Control Equipment
 - ICS-6-16Standard for Industrial Controls and Systems Enclosures
- C. National Fire Protection Association (NFPA):
 - 70-17National Electrical Code (NEC)
- D. Underwriters Laboratories, Inc. (UL):
 - 20-10Standard for General-Use Snap Switches
 - 98-16Enclosed and Dead-Front Switches

- 773-16Standard for Plug-In Locking Type Photocontrols
for Use with Area Lighting
- 773A-16Nonindustrial Photoelectric Switches for
Lighting Control
- 916-15Standard for Energy Management Equipment
Systems
- 917-06Clock Operated Switches
- 924-16Emergency Lighting and Power Equipment (for use
when controlling emergency circuits).

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 INDOOR OCCUPANCY SENSORS

- A. Wall- or ceiling-mounting, solid-state units with a power supply and relay unit, suitable for the environmental conditions in which installed.
 - 1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a 1 to 15 minute adjustable time delay for turning lights off.
 - 2. Sensor Output: Contacts rated to operate the connected relay. Sensor shall be powered from the relay unit.
 - 3. Relay Unit: Dry contacts rated for 20A ballast load at 120 volt and 277 volt, for 13A tungsten at 120 volt, and for 1 hp at 120 volt.
 - 4. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
 - 5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.

6. Bypass Switch: Override the on function in case of sensor failure.
 7. Manual/automatic selector switch.
 8. Automatic Light-Level Sensor: Adjustable from 21.5 to 2152 lx (2 to 200 fc); keep lighting off when selected lighting level is present.
 9. Faceplate for Wall-Switch Replacement Type: Refer to wall plate material and color requirements for toggle switches, as specified in Section 26 27 26, WIRING DEVICES.
- B. Dual-technology Type: Ceiling mounting; combination PIR and ultrasonic detection methods, field-selectable.
1. Sensitivity Adjustment: Separate for each sensing technology.
 2. Detector Sensitivity: Detect occurrences of 150 mm (6-inch) minimum movement of any portion of a human body that presents a target of not less than 232 sq. cm (36 sq. in), and detect a person of average size and weight moving not less than 305 mm (12 inches) in either a horizontal or a vertical manner at an approximate speed of 305 mm/s (12 inches/s).
- C. Detection Coverage: Shall be sufficient to provide coverage as required by sensor locations shown on drawing.

2.3 INDOOR VACANCY SENSOR SWITCH

- A. Wall mounting, solid-state units with integral sensor and switch.
1. Operation: Manually turn lights on with switch and sensor detects vacancy to turn lights off.
 2. Switch Rating: 120/277 volt, 1200 watts at 277 volt, 800 watts at 120-volt unit.
 3. Mounting:
 - a. Sensor: Suitable for mounting in a standard switch box.
 - b. Time-Delay and Sensitivity Adjustments: Integral with switch and accessible for reprogramming without removing switch.
 4. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
 5. Switch: Manual operation to turn lights on and override lights off.
 6. Faceplate: Refer to wall plate material and color requirements for toggle switches, as specified in Section 26 27 26, WIRING DEVICES.

PART 3 - EXECUTION

3.1 INSTALLATION

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

- B. Aim outdoor photoelectric sensor according to manufacturer's recommendations. Set adjustable window slide for 1 footcandle turn-on.
- C. Aiming for wall-mounted and ceiling-mounted motion sensor switches shall be per manufacturer's recommendations.
- D. Set occupancy sensor "on" duration to 15 minutes.
- E. Locate photoelectric sensors as indicated and in accordance with the manufacturer's recommendations. Adjust sensor for the available light level at the typical work plane for that area.
- F. Label time switches and contactors with a unique designation.
- G. Program lighting control panels per schedule on drawings.

3.2 ACCEPTANCE CHECKS AND TESTS

- A. Perform in accordance with the manufacturer's recommendations.
- B. Upon completion of installation, conduct an operating test to show that equipment operates in accordance with requirements of this section.
- C. Test for full range of dimming ballast and dimming controls capability. Observe for visually detectable flicker over full dimming range.
- D. Test occupancy sensors for proper operation. Observe for light control over entire area being covered.

3.3 FOLLOW-UP VERIFICATION

Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that the lighting control devices are in good operating condition and properly performing the intended function in the presence of COR.

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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-15International Building Code
- C. National Electrical Manufacturers Association (NEMA):
 - PB 1-11Panelboards
 - 250-14Enclosures for Electrical Equipment (1,000V Maximum)
- D. National Fire Protection Association (NFPA):
 - 70-17National Electrical Code (NEC)
 - 70E-18Standard for Electrical Safety in the Workplace

E. Underwriters Laboratories, Inc. (UL):

- 50-15Enclosures for Electrical Equipment
- 67-09Panelboards
- 489-16Molded 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.

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, tripped, and open positions.
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.

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. Rust and scale shall be removed from the inside of existing enclosures where new interior components are to be installed. Paint inside of enclosures with rust-preventive paint before the new interior components are installed. Provide new trim. Trim shall fit tight to the enclosure.
- G. 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---

SECTION 26 27 26
WIRING DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, connection, and testing of wiring devices.

1.2 RELATED WORK

A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements that are common to more than one section of Division 26.

B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Cables and wiring.

C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents.

D. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduit and boxes.

E. Section 26 51 00, INTERIOR LIGHTING: Fluorescent ballasts and LED drivers for use with manual dimming controls.

1.3 QUALITY ASSURANCE

A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:

1. Shop Drawings:

a. Submit sufficient information to demonstrate compliance with drawings and specifications.

b. Include electrical ratings, dimensions, mounting details, construction materials, grade, and termination information.

- 2. Manuals:
 - a. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals, including technical data sheets and information for ordering replacement parts.
 - b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
- 3. Certifications: Two weeks prior to final inspection, submit the following.
 - a. Certification by the manufacturer that the wiring devices conform to the requirements of the drawings and specifications.
 - b. Certification by the Contractor that the wiring devices have been properly installed and adjusted.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by basic designation only.
- B. National Electrical Manufacturers Association (NEMA):
 - WD 1-99(R2015)General Color Requirements for Wiring Devices
 - WD 6-16Wiring Devices - Dimensional Specifications
- C. National Fire Protection Association (NFPA):
 - 70-17National Electrical Code (NEC)
 - 99-18Health Care Facilities
- D. Underwriter's Laboratories, Inc. (UL):
 - 5-16Surface Metal Raceways and Fittings
 - 20-10General-Use Snap Switches
 - 231-16Power Outlets
 - 467-13Grounding and Bonding Equipment
 - 498-17Attachment Plugs and Receptacles
 - 943-16Ground-Fault Circuit-Interrupters
 - 1449-14Surge Protective Devices
 - 1472-15Solid State Dimming Controls

PART 2 - PRODUCTS

2.1 RECEPTACLES

- A. General: All receptacles shall comply with NEMA, NFPA, UL, and as shown on the drawings.
 - 1. Mounting straps shall be nickel plated brass, brass, nickel plated steel or galvanize steel with break-off plaster ears, and shall include a self-grounding feature. Terminal screws shall be brass, brass plated or a copper alloy metal.
 - 2. Receptacles shall have provisions for back wiring with separate metal clamp type terminals (four minimum) and side wiring from four captively held binding screws.
- B. Duplex Receptacles - Hospital-grade: shall be listed for hospital grade, single phase, 20 ampere, 120 volts, 2-pole, 3-wire, NEMA 5-20R, with break-off feature for two-circuit operation.
 - 1. Bodies shall be ivory in color.
 - 2. Switched duplex receptacles shall be wired so that only the top receptacle is switched. The lower receptacle shall be unswitched.
 - 3. Duplex Receptacles on Emergency Circuit:
 - a. In rooms without emergency powered general lighting, the emergency receptacles shall be of the self-illuminated type.
 - 4. Ground Fault Current Interrupter (GFCI) Duplex Receptacles: Shall be an integral unit, hospital-grade, suitable for mounting in a standard outlet box, with end-of-life indication and provisions to isolate the face due to improper wiring. GFCI receptacles shall be self-test receptacles in accordance with UL 943.
 - a. Ground fault interrupter shall consist of a differential current transformer, self-test, solid state sensing circuitry and a circuit interrupter switch. Device shall have nominal sensitivity to ground leakage current of 4-6 milliamperes and shall function to interrupt the current supply for any value of ground leakage current above five milliamperes (+ or - 1 milliampere) on the load side of the device. Device shall have a minimum nominal tripping time of 0.025 second.

- b. Self-test function shall be automatically initiated within 5 seconds after power is activated to the receptacles. Self-test function shall be periodically and automatically performed every 3 hours or less.
 - c. End-of-life indicator light shall be a persistent flashing or blinking light to indicate that the GFCI receptacle is no longer in service.
5. Tamper-Resistant Duplex Receptacles:
- a. Bodies shall be ivory in color.
 - 1) Shall permit current to flow only while a standard plug is in the proper position in the receptacle.
 - 2) Screws exposed while the wall plates are in place shall be the tamperproof type.
- C. Duplex Receptacles - Non-hospital Grade: shall be the same as duplex receptacles - hospital grade in accordance with sections 2.1A and 2.1B of this specification, except for the hospital grade listing.
- 1. Bodies shall be ivory nylon.
- D. Receptacles - 20, 30, and 50 ampere, 250 Volts: Shall be complete with appropriate cord grip plug.
- E. Weatherproof Receptacles: Shall consist of a duplex receptacle, mounted in box with a gasketed, weatherproof, cast metal cover plate and cap over each receptacle opening. The cap shall be permanently attached to the cover plate by a spring-hinged flap. The weatherproof integrity shall not be affected when heavy duty specification or hospital grade attachment plug caps are inserted. Cover plates on outlet boxes mounted flush in the wall shall be gasketed to the wall in a watertight manner.

2.2 TOGGLE SWITCHES

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

3. Switches shall be rated 20 amperes at 120-277 Volts AC.

2.3 MANUAL DIMMING CONTROL

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

2.4 WALL PLATES

- A. Wall plates for switches and receptacles shall be type 302 stainless steel. Oversize plates are not acceptable.
- C. For receptacles or switches mounted adjacent to each other, wall plates shall be common for each group of receptacles or switches.
- D. In areas requiring tamperproof wiring devices, wall plates shall be type 302 stainless steel, and shall have tamperproof screws and beveled edges.

2.5 SURFACE MULTIPLE-OUTLET ASSEMBLIES

- A. Shall have the following features:
 - 1. Enclosures:
 - a. Thickness of steel shall be not less than 1 mm (0.040 inch) for base and cover. Nominal dimensions shall be 40 mm x 70 mm (1-1/2 inches by 2-3/4 inches) with inside cross sectional area not less than 2250 square mm (3-1/2 square inches). The enclosures shall be thoroughly cleaned, phosphatized, and painted at the factory with primer and the manufacturer's standard baked enamel finish.
 - 2. Receptacles shall be duplex, specification . See paragraph 'RECEPTACLES' in this Section. Device cover plates shall be the manufacturer's standard corrosion resistant finish and shall not exceed the dimensions of the enclosure.
 - 3. Unless otherwise shown on drawings, receptacle spacing shall be 600 mm (24 inches) on centers.
 - 4. Conductors shall be as specified in Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLE.

5. Installation fittings shall be the manufacturer's standard bends, offsets, device brackets, inside couplings, wire clips, elbows, and other components as required for a complete system.
6. Bond the assemblies to the branch circuit conduit system.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be in accordance with the NEC and as shown as on the drawings.
- B. Install wiring devices after wall construction and painting is complete.
- C. The ground terminal of each wiring device shall be bonded to the outlet box with an approved green bonding jumper, and also connected to the branch circuit equipment grounding conductor.
- D. Outlet boxes for toggle switches and manual dimming controls shall be mounted on the strike side of doors.
- E. Provide barriers in multi-gang outlet boxes to comply with the NEC.
- F. Coordinate the electrical work with the work of other trades to ensure that wiring device flush outlets are positioned with box openings aligned with the face of the surrounding finish material. Pay special attention to installations in cabinet work, and in connection with laboratory equipment.
- G. Exact field locations of floors, walls, partitions, doors, windows, and equipment may vary from locations shown on the drawings. Prior to locating sleeves, boxes and chases for roughing-in of conduit and equipment, the Contractor shall coordinate exact field location of the above items with other trades.
- H. Install wall switches 1.2 M (48 inches) above floor, with the toggle OFF position down.
- I. Install wall dimmers 1.2 M (48 inches) above floor.
- J. Install receptacles 450 mm (18 inches) above floor, and 152 mm (6 inches) above counter backsplash or workbenches. Install specific-use receptacles at heights shown on the drawings.
- K. Install horizontally mounted receptacles with the ground pin to the right.
- L. When required or recommended by the manufacturer, use a torque screwdriver. Tighten unused terminal screws.

- M. Label device plates with a permanent adhesive label listing panel and circuit feeding the wiring device.

3.2 ACCEPTANCE CHECKS AND TESTS

- A. Perform manufacturer's required field checks in accordance with the manufacturer's recommendations, and the latest NFPA 99. In addition, include the following:
 - 1. Visual Inspection and Tests:
 - a. Inspect physical and electrical conditions.
 - b. Vacuum-clean surface metal raceway interior. Clean metal raceway exterior.
 - c. Test wiring devices for damaged conductors, high circuit resistance, poor connections, inadequate fault current path, defective devices, or similar problems using a portable receptacle tester. Correct circuit conditions, remove malfunctioning units and replace with new, and retest as specified above.
 - d. Test GFCI receptacles.
 - 2. Receptacle testing in the Patient Care Spaces, such as retention force of the grounding blade of each receptacle, shall comply with the latest NFPA 99.

---END---

SECTION 26 29 21
ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installation, and connection of fused and unfused disconnect switches (indicated as switches in this section), and separately-enclosed circuit breakers for use in electrical systems rated 600 V and below.

1.2 RELATED WORK

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
- B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.
- C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground faults.
- D. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits.
- E. Section 26 24 16, PANELBOARDS: Molded-case circuit breakers.

1.3 QUALITY ASSURANCE

- A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

- A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:
1. Shop Drawings:
 - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
 - b. Submit the following data for approval:
 - 1) Electrical ratings, dimensions, mounting details, materials, required clearances, terminations, weight, fuses, circuit breakers, wiring and connection diagrams, accessories, and device nameplate data.

2. Manuals:
 - a. Submit complete maintenance and operating manuals including technical data sheets, wiring diagrams, and information for ordering fuses, circuit breakers, and replacement parts.
 - 1) Include schematic diagrams, with all terminals identified, matching terminal identification in the enclosed switches and circuit breakers.
 - 2) Include information for testing, repair, troubleshooting, assembly, and disassembly.
 - b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
3. Certifications: Two weeks prior to final inspection, submit the following.
 - a. Certification by the manufacturer that the enclosed switches and circuit breakers conform to the requirements of the drawings and specifications.
 - b. Certification by the Contractor that the enclosed switches and circuit breakers have been properly installed, adjusted, and tested.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. International Code Council (ICC):
IBC-15International Building Code
- C. National Electrical Manufacturers Association (NEMA):
FU 1-12Low Voltage Cartridge Fuses
KS 1-13Heavy Duty Enclosed and Dead-Front Switches
(600 Volts Maximum)
- D. National Fire Protection Association (NFPA):
70-17National Electrical Code (NEC)
- E. Underwriters Laboratories, Inc. (UL):
98-16Enclosed and Dead-Front Switches
248 1-11Low Voltage Fuses

489-13Molded Case Circuit Breakers and Circuit
Breaker Enclosures

PART 2 - PRODUCTS

2.1 FUSED SWITCHES RATED 600 AMPERES AND LESS

- A. Switches shall be in accordance with NEMA, NEC, UL, as specified, and as shown on the drawings.
- B. Shall be NEMA classified General Duty (GD) for 240 V switches, and NEMA classified Heavy Duty (HD) for 480 V switches.
- C. Shall be horsepower (HP) rated.
- D. Shall have the following features:
 - 1. Switch mechanism shall be the quick-make, quick-break type.
 - 2. Copper blades, visible in the open position.
 - 3. An arc chute for each pole.
 - 4. External operating handle shall indicate open and closed positions, and have lock-open padlocking provisions.
 - 5. Mechanical interlock shall permit opening of the door only when the switch is in the open position, defeatable to permit inspection.
 - 6. Fuse holders for the sizes and types of fuses specified.
 - 7. Solid neutral for each switch being installed in a circuit which includes a neutral conductor.
 - 8. Ground lugs for each ground conductor.
 - 9. Enclosures:
 - a. Shall be the NEMA types shown on the drawings.
 - b. Where the types of switch enclosures are not shown, they shall be the NEMA types most suitable for the ambient environmental conditions.
 - c. Shall be finished with manufacturer's standard gray baked enamel paint over pretreated steel.
 - 10. Electrically operated switches shall only be installed where shown on the drawings.

2.2 UNFUSED SWITCHES RATED 600 AMPERES AND LESS

- A. Shall be the same as fused switches, but without provisions for fuses.

2.3 MOTOR RATED TOGGLE SWITCHES

- A. Type 1, general purpose for single-phase motors rated up to 1 horsepower.

- B. Quick-make, quick-break toggle switch with external reset button and thermal overload protection matched to nameplate full-load current of actual protected motor.

2.4 CARTRIDGE FUSES

- A. Shall be in accordance with NEMA FU 1.
- C. Feeders: Class RK1, fast acting
- D. Motor Branch Circuits: Class RK1, time delay.
- E. Other Branch Circuits: Class RK1, time delay.

2.5 SEPARATELY-ENCLOSED CIRCUIT BREAKERS

- A. Provide circuit breakers in accordance with the applicable requirements in Section 26 24 16, PANELBOARDS.
- B. Enclosures shall be the NEMA types shown on the drawings. Where the types are not shown, they shall be the NEMA type most suitable for the ambient environmental conditions.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be in accordance with the NEC, as shown on the drawings, and manufacturer's instructions.
- B. Fused switches shall be furnished complete with fuses. Arrange fuses such that rating information is readable without removing the fuses.

3.2 ACCEPTANCE CHECKS AND TESTS

- A. Perform in accordance with the manufacturer's recommendations. In addition, include the following:
 - 1. Visual Inspection and Tests:
 - a. Compare equipment nameplate data with specifications and approved shop drawings.
 - b. Inspect physical, electrical, and mechanical condition.
 - c. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method.
 - d. Vacuum-clean enclosure interior. Clean enclosure exterior.

3.3 SPARE PARTS

- A. Two weeks prior to the final inspection, furnish one complete set of spare fuses for each fused disconnect switch installed on the project. Deliver the spare fuses to the COR.

---END---

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 24 16, PANELBOARDS: 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 C62.41.2-02Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits
 - IEEE C62.45-08Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits
- C. National Fire Protection Association (NFPA):
 - 70-17National Electrical Code (NEC)
- D. Underwriters Laboratories, Inc. (UL):
 - UL 1283-15Electromagnetic Interference Filters
 - UL 1449-14Surge Protective Devices

PART 2 - PRODUCTS

2.1 PANELBOARD SPD

- A. General Requirements:
 - 1. Comply with UL 1449 and IEEE C62.41.2.
 - 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.
- B. Surge Current per Phase: Minimum 120kA per phase.

2.2 ENCLOSURES

- A. Enclosures: NEMA 3R.

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.

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Renovate and Expand Administration and Maintenance Buildings
20901 Pleasant Valley Drive
Sturgis, SD 57785

NCA Project # 884CM3015

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Bid Documents

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---

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 REV A-13Manufacture, Performance, and Testing of Metal
Suspension Systems for Acoustical Tile and Lay-
in Panel Ceilings
- C. Environmental Protection Agency (EPA):
40 CFR 261Identification 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-79-08Electrical and Photometric Measurements of
Solid-State Lighting Products
 - LM-80-15Measuring Lumen Maintenance of LED Light
Sources
 - LM-82-12Characterization 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-15International Building Code
- H. National Electrical Manufacturer's Association (NEMA):
 - C78.376-14Chromaticity of Fluorescent Lamps
 - C82.1-04(R2015)Lamp Ballasts - Line Frequency Fluorescent Lamp
Ballasts
 - C82.2-02(R2016)Method of Measurement of Fluorescent Lamp
Ballasts
 - C82.4-17Lamp Ballasts - Ballasts for High-Intensity
Discharge and Low-Pressure Sodium (LPS) Lamps
(Multiple-Supply Type)
 - C82.11-17Lamp Ballasts - High Frequency Fluorescent Lamp
Ballasts
 - LL 9-11Dimming of T8 Fluorescent Lighting Systems
 - SSL 1-16Electronic Drivers for LED Devices, Arrays, or
Systems
- I. National Fire Protection Association (NFPA):
 - 70-17National Electrical Code (NEC)
 - 101-18Life Safety Code
- J. Underwriters Laboratories, Inc. (UL):
 - 496-17Lampholders
 - 542-05Fluorescent Lamp Starters
 - 844-12Luminaires for Use in Hazardous (Classified)
Locations

- 924-16Emergency Lighting and Power Equipment
- 935-01Fluorescent-Lamp Ballasts
- 1029-94High-Intensity-Discharge Lamp Ballasts
- 1029A-06.....Ignitors and Related Auxiliaries for HID Lamp
Ballasts
- 1598-08Luminaires
- 1574-04.....Track Lighting Systems
- 2108-15.....Low-Voltage Lighting Systems
- 8750-15.....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.

2.2 LED EXIT LIGHT FIXTURES

- A. Exit light fixtures shall meet applicable requirements of NFPA and UL.
- B. Housing and door shall be die-cast aluminum.
- C. For general purpose exit light fixtures, door frame shall be hinged, with latch. For vandal-resistant exit light fixtures, door frame shall be secured with tamper-resistant screws.
- D. Finish shall be satin or fine-grain brushed aluminum.
- E. There shall be no radioactive material used in the fixtures.

F. Fixtures:

1. Inscription panels shall be cast or stamped aluminum a minimum of 2.25 mm (0.090 inch) thick, stenciled with 150 mm (6 inch) high letters, baked with red color stable plastic or fiberglass. Lamps shall be luminous Light Emitting Diodes (LED) mounted in center of letters on red color stable plastic or fiberglass.
2. Double-Faced Fixtures: Provide double-faced fixtures where required or as shown on drawings.

3. Directional Arrows: Provide directional arrows as part of the inscription panel where required or as shown on drawings. Directional arrows shall be the "chevron-type" of similar size and width as the letters and meet the requirements of NFPA 101.

G. Voltage: Multi-voltage (120 - 277V).

2.3 LED LIGHT FIXTURES

A. General:

1. LED light fixtures shall be in accordance with IES, NFPA, UL, as shown on the drawings, and as specified.
2. LED light fixtures shall be Reduction of Hazardous Substances (RoHS)-compliant.
3. LED drivers shall include the following features unless otherwise indicated:
 - a. Minimum efficiency: 85% at full load.
 - b. Minimum Operating Ambient Temperature: -20° C. (-4° F.)
 - c. Input Voltage: 120 - 277V (±10%) at 60 Hz.
 - d. Integral short circuit, open circuit, and overload protection.
 - e. Power Factor: ≥ 0.95 .
 - f. Total Harmonic Distortion: $\leq 20\%$.
 - g. Comply with FCC 47 CFR Part 15.
4. LED modules shall include the following features unless otherwise indicated:
 - a. Comply with IES LM-79 and LM-80 requirements.
 - b. Minimum CRI 80 and color temperature 3000° K unless otherwise specified in LIGHTING FIXTURE SCHEDULE.
 - c. Minimum Rated Life: 50,000 hours per IES L70.
 - d. Light output lumens as indicated in the LIGHTING FIXTURE SCHEDULE.

B. LED Downlights:

1. Housing, LED driver, and LED module shall be products of the same manufacturer.

C. LED Troffers:

1. LED drivers, modules, and reflector shall be accessible, serviceable, and replaceable from below the ceiling.
2. Housing, LED driver, and LED module shall be products of the same manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be in accordance with the NEC, manufacturer's instructions, and as shown on the drawings or specified.
- B. Align, mount, and level the lighting fixtures uniformly.
- C. Wall-mounted fixtures shall be attached to the studs in the walls, or to a 20-gauge metal backing plate that is attached to the studs in the walls. Lighting fixtures shall not be attached directly to gypsum board.
- D. Lighting Fixture Supports:
 - 1. Shall provide support for all of the fixtures. Supports may be anchored to channels of the ceiling construction, to the structural slab or to structural members within a partition, or above a suspended ceiling.
 - 2. Shall maintain the fixture positions after cleaning and relamping.
 - 3. Shall support the lighting fixtures without causing the ceiling or partition to deflect.
 - 4. Hardware for recessed lighting fixtures:
 - a. All fixture mounting devices connecting fixtures to the ceiling system or building structure shall have a capacity for a horizontal force of 100 percent of the fixture weight and a vertical force of 400 percent of the fixture weight.
 - b. Mounting devices shall clamp the fixture to the ceiling system structure (main grid runners or fixture framing cross runners) at four points in such a manner as to resist spreading of these supporting members. Each support point device shall utilize a screw or approved hardware to "lock" the fixture housing to the ceiling system, restraining the fixture from movement in any direction relative to the ceiling. The screw (size No. 10 minimum) or approved hardware shall pass through the ceiling member (T-bar, channel or spline), or it may extend over the inside of the flange of the channel (or spline) that faces away from the fixture, in a manner that prevents any fixture movement.

- c. In addition to the above, the following is required for fixtures exceeding 9 kg (20 pounds) in weight.
 - 1) Where fixtures mounted in ASTM Standard C635 "Intermediate Duty" and "Heavy Duty" ceilings and weigh between 9 kg and 25 kg (20 pounds and 56 pounds), provide two 12-gauge safety hangers hung slack between diagonal corners of the fixture and the building structure.
 - 2) Where fixtures weigh over 25 kg (56 pounds), they shall be independently supported from the building structure by approved hangers. Two-way angular bracing of hangers shall be provided to prevent lateral motion.
 - d. Where ceiling cross runners are installed for support of lighting fixtures, they must have a carrying capacity equal to that of the main ceiling runners and be rigidly secured to the main runners.
5. Surface mounted lighting fixtures:
- a. Fixtures shall be bolted against the ceiling independent of the outlet box at four points spaced near the corners of each unit. The bolts (or stud-clips) shall be minimum 6 mm (1/4 inch) bolt, secured to main ceiling runners and/or secured to cross runners. Non-turning studs may be attached to the main ceiling runners and cross runners with special non-friction clip devices designed for the purpose, provided they bolt through the runner, or are also secured to the building structure by 12-gauge safety hangers. Studs or bolts securing fixtures weighing in excess of 25 kg (56 pounds) shall be supported directly from the building structure.
 - b. Where ceiling cross runners are installed for support of lighting fixtures, they must have a carrying capacity equal to that of the main ceiling runners and be rigidly secured to the main runners.
 - c. Fixtures less than 6.8 kg (15 pounds) in weight and occupying less than 3715 sq cm (two square feet) of ceiling area may, when designed for the purpose, be supported directly from the outlet box when all the following conditions are met.
 - 1) Screws attaching the fixture to the outlet box pass through round holes (not key-hole slots) in the fixture body.
 - 2) The outlet box is attached to a main ceiling runner (or cross runner) with approved hardware.

- 3) The outlet box is supported vertically from the building structure.
- d. Fixtures mounted in open construction shall be secured directly to the building structure with approved bolting and clamping devices.
6. Single or double pendant-mounted lighting fixtures:
 - a. Each stem shall be supported by an approved outlet box mounted swivel joint and canopy which holds the stem captive and provides spring load (or approved equivalent) dampening of fixture oscillations. Outlet box shall be supported vertically from the building structure.
7. Outlet boxes for support of lighting fixtures (where permitted) shall be secured directly to the building structure with approved devices or supported vertically in a hung ceiling from the building structure with a nine-gauge wire hanger, and be secured by an approved device to a main ceiling runner or cross runner to prevent any horizontal movement relative to the ceiling.
- E. Furnish and install the new lamps as specified for all lighting fixtures installed under this project, and for all existing lighting fixtures reused under this project.
- F. The electrical and ceiling trades shall coordinate to ascertain that approved lighting fixtures are furnished in the proper sizes and installed with the proper devices (hangers, clips, trim frames, flanges, etc.), to match the ceiling system being installed.
- G. Bond lighting fixtures to the grounding system as specified in Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
- H. At completion of project, replace all defective components of the lighting fixtures at no cost to the Government.
- I. Dispose of lamps per requirements of Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT, 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 the COTR. Observe for visually detectable flicker over full dimming range, and replace defective components at no cost to the Government.
 - b. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Government. Burn-in period to be 40 hours minimum, unless specifically recommended otherwise by the lamp manufacturer. Burn-in dimmed fluorescent and compact fluorescent lamps for at least 100 hours at full voltage, unless specifically recommended otherwise by the lamp manufacturer. Replace any lamps and ballasts which fail during burn-in.

3.3 FOLLOW-UP VERIFICATION

- A. Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that the lighting systems are in good operating condition and properly performing the intended function.

---END---

**SECTION 27 05 00
COMMON WORK RESULTS FOR COMMUNICATIONS**

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. New state-of-the-art fully functioning communications and electronic safety and security systems installed in VA's National Cemetery (NCA) Black Hills to regulate access to restricted buildings, building areas, and fenced areas Contract Project Number: 17001048.23.
2. General administrative, product, and installation requirements governing Division 27 and Division 28 specifications.

B. In Circumstances of a need for additional detail or conflict resolution between drawings, specifications, reference to code or standards, comply with:

1. FAR 42-236-21 (<http://www.farmaster.com/farmaster/data/idx/FAR84/5202360021.html>), and:
2. VAAR 852.236.91 (<http://www.va.gov/oal/library/vaar852.asp>).

1.2 DEFINITIONS

- A. Conduits means any raceway types such as raceways, cable tray and pathway.
- B. Telecommunications (a.k.a. Telecom) means The science and practice of communications by electromagnet (EMF) and radio frequency (RF) means, as opposed, to merely just the processing information (IT).

1.3 RELATED REQUIREMENTS

- A. Tests, Operations and Storage Areas, and Instructions: Section 01 00 01, GENERAL REQUIREMENTS.
- B. Communications System: Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS, Section 27 05 33, CONDUITS AND BACKBOXES FOR COMMUNICATIONS SYSTEMS, Section 27 10 00, STRUCTURED CABLING, Section 27 11 00 COMMUNICATIONS EQUIPMENT ROOM FITTINGS, Section 27 51 23, INTERCOMMUNICATIONS AND PROGRAM SYSTEMS.
- C. Security Systems: Section 28 10 00, ACCESS CONTROL, Section 28 20 00, VIDEO SURVEILLANCE, Section 28 31 00, INTRUSION DETECTION, Section 28 46 00, FIRE DETECTION AND ALARM.

1.4 PREINSTALLATION MEETINGS

- A. Conduct preinstallation meeting at project site minimum 30 days before beginning Work specified in Division 27 and Division 28.
 1. Required Participants:
 - a. Contracting Officer's Representative (COR).
 - b. VA AHJ SMCS 07A2, for special communications systems.
 - c. Architect/Engineer.
 - d. Inspection and Testing Agency.
 - e. Contractor.
 - f. Installer.
 - g. Field representative.
 - h. Other installers responsible for adjacent and intersecting work, including electrical installer.
 2. Meeting Agenda: Distribute agenda to participants minimum 3 days before meeting.
 - a. Installation schedule.
 - b. Installation sequence.
 - c. Preparatory work.
 - d. Protection before, during, and after installation.
 - e. Installation.
 - f. Terminations.
 - g. Transitions and connections to other work.
 - h. Inspecting and testing.
 - i. Other items affecting successful completion.
 3. Document and distribute meeting minutes to participants to record decisions affecting installation.

1.5 APPLICABLE PUBLICATIONS

- A. Comply with references to extent specified in this section.
- B. American National Standards Institute/Telecommunications Industry Association/Electronics Industries Alliance (ANSI/TIA/EIA):
 1. 526-7 - Measurement of Optical Power Loss of Installed Single-mode Fiber Cable Plant.
 2. 526-14 - Optimal Power Loss Measurements of Installed Multimode Fiber Cable Plant.
 3. 568-D-15 - Generic Telecommunications Cabling for Customer Premises.

4. 568-D.1-15 - Commercial Building Telecommunications Infrastructure Standard.
 5. 568-D.2-15 - Balanced Twisted-Pair Telecommunication Cabling and Components Standard.
 6. 568-D.3-15 - Optical Fiber Cabling Components Standard.
- C. Master Painters Institute (MPI):
1. No. 18 - Primer, Zinc Rich, Organic.
- D. National Fire Protection Association (NFPA):
1. 70-14 - National Electrical Code.
- E. CFM Telecommunications; and, Special Telecommunications Design Manual.
1. CFM Electrical Design Manual.
 2. CFM OI&T Design Guide.

1.6 SUBMITTALS

- A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
1. Submittal Drawings and As-Built Drawings: 4 sets paper format Architectural F size. 2 sets electronic format.
- B. System Operational Description: Submit detailed description of system operation, performance, and interface with other entities, equipment, and systems.
- C. Submittal Drawings:
1. Show size, configuration, fabrication, and installation details.
 2. Cover Sheet:
 - a. Identify each drawing included in submittal.
 - b. Show facility name, building name, floor, and sheet number.
 - c. Include security abbreviations and symbols lists.
 - d. Reference general notes included in submittal.
 - e. Specification and scope of work pages for individual security systems.
 - f. Include detailed device identification table.
 3. Floor Plans and Site Plans:
 - a. Show drawing scale in metric and English units.
 - b. Show each device identification and location.
 - c. Show control and power wiring.
 - d. Show pull box and conduit locations, sizes, and fill capacities.
 - e. Include general and drawing specific notes.

4. Riser Diagram:
 - a. Include sequence of operation.
 - b. Show relationship of integrated components on 1 diagram.
 - c. Show number, size, identification, and maximum lengths of interconnecting wires.
 - d. Include wiring schedule showing conductor type, wiring drawing symbol, manufacturer's name, and part number.
 - e. Identify factory wiring and field wiring.
 5. System Drawing for Each Security System:
 - a. Show equipment, including panels and devices, and system layout.
 - b. Show point-to-point wiring.
 - c. Identify wire types.
 - d. Show device locations on floor plans.
 - e. Include general and drawing specific notes.
 6. System Equipment Schedule: Show the following:
 - a. Device ID.
 - b. Device Location.
 - c. Mounting type.
 - d. Power supply or circuit breaker and power panel number.
 - e. Door number, door type, locking mechanism and control device.
 7. Detail and Elevation Drawings: Show installation details.
- D. When requesting variations from contract requirements according to Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, coordinate connecting work and related components including additions or revisions to branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels and installation methods.
- E. Obtain COR approval of equipment and material before delivery to project site. Delivery, storage, and installation of unapproved equipment and material will not be permitted.
- F. Submit product data, submittal drawings, and other data substantiating proposed equipment and materials comply with specified requirements. Submit legible product data clearly identifying equipment.
- G. For individual systems and equipment assemblies consisting of more than one item or component, submit complete system or assembly. Partial submittals will not be considered for approval.
1. Mark submittals, "SUBMITTED UNDER SECTION _____".
 2. Include specification section and paragraph numbers.

3. Submit each section separately.
- H. Include the following:
1. Information substantiating compliance with contract requirements. Include manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, photographs, nameplate data and test reports as required.
 2. Elementary and interconnection wiring diagrams for communication and signal systems, control system, and equipment assemblies. Identify terminal points and wiring on wiring diagrams.
 3. Parts list, including replacement parts recommended by equipment manufacturer, quantity of parts, current price and availability of each part.
- I. Manufacturer's Literature and Data:
1. Description of each product.
 2. Installation instructions.
- J. Certificates: Certify products comply with specifications.
1. Show product is OSHA's NRTL (UL) Listed and Labeled for specified application.
- K. Equipment Lists: As bill of materials.
1. Show quantities for each specified product.
 2. Identify products included on GSA Approved Products List and approval status.
- L. Samples:
1. After approval and before installation, submit one of each of the following for COR's approval:
 2. 300 mm (12 inch) length of each type and size of wire and cable with tag from reel coils from which samples were taken.
 3. Each type of conduit and pathway coupling, bushing and termination fitting.
 4. TCO with backbox, outlet (six ports), proper color coded female connectors (four RJ-45), two port plugs, cover plate, 300 mm (12 inch) length of connecting wire and conduit indicating completed installation (Contact SMCS 07A2 for typical detail if not provided in contract documents).
 5. Raceway and pathway conduit hangers, clamps and supports.
 6. Duct sealing compound.
- M. Submit manufacture's certification of UL LLC (UL) listing as specified.

- N. Qualifications: Substantiate qualifications comply with specifications.
 - 1. System integrator with project experience list
 - a. Responsible BICSI RDCC Certified Architect/Engineer approved by AHJ SMCS 07A2 on team.
 - 2. Installer with project experience list.
 - a. Factory authorized representative.
 - b. BICSI RDCC Certified Architect/Engineer on team.
 - 3. Field representative with project experience list.
- O. Design Drawings and Calculations: Each signed, dated, and sealed by VA COR delegated BICSI RCDD certified responsible design professional.
 - 1. Ensure no deviations from details shown on drawings and specifications.
- P. Factory Test Reports: Submit 4 certified copies containing test data and results maximum 90 days after test completion, before final inspection.
- Q. Field conditions report indicating differing conditions.
- R. Field survey report identifying equipment by manufacturer and model number wherever possible indicating:
 - 1. Non-functioning equipment, proposed replacement equipment, and replacement cost.
 - 2. Existing equipment reuse, removal, and replacement schedule.
 - 3. Existing equipment connection and disconnecting schedule, including times for system interruption.
- S. Acceptance Test Plan: Submit minimum 30 days before testing.
 - 1. Include individual component and subsystem acceptance testing procedures.
 - 2. Include integrated system test ensuring proper operation.
- T. Field Representative:
 - 1. Observation reports and supplemental instructions issued.
 - 2. Installation certification.
- U. Field Quality Control Reports: 4 copies. Submit minimum 15 working days before scheduled acceptance test.
 - 1. System pretest recorded measurements.
 - 2. Certifications system is acceptance test ready.

- V. Operation and Maintenance Data: 4 sets bound in hardback binders according to Section 01 00 01, GENERAL REQUIREMENTS. Submit one manual minimum 15 working days before scheduled performance tests. Submit remaining manuals before contract completion.
1. Section 01 00 01 Include following identification on cover:
 - a. "MAINTENANCE AND OPERATION MANUAL."
 - b. Name and location of system, equipment, building.
 - c. Contractor's name and contract number.
 2. Include in manual: Names, addresses, and telephone numbers of each subcontractor installing system or equipment and local representatives for system or equipment.
 3. Provide "Table of Contents" and assemble manual coordinated with table of contents. Include tab sheet separating each subject's instructions.
 4. Provide legible instructions with large sheets of drawings folded in.
 5. Manuals to include:
 - a. Installation, start up, maintenance, troubleshooting, emergency, and shut down instructions for each operational product.
 - b. Demonstration and training video recordings.
 - c. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of equipment.
 - d. Control sequence describing start-up, operation, and shutdown.
 - e. Description of each principal item of equipment's function.
 - f. Safety precautions.
 - g. Diagrams and illustrations.
 - h. Testing methods.
 - i. Performance data.
 - j. Pictorial "exploded" parts list with part numbers. Identify required special tools and instruments. Include recommended spare parts part supply sources, and servicing organization name.
 - k. Appendix: List qualified equipment service organizations, including addresses and qualifications.
 6. Approvals will be based on complete submission of manuals and submittal drawings.
- W. Submit training schedule minimum 30 days before planned training.

- X. As-Built Drawings: Submit minimum 15 working days before scheduled performance tests.
 - 1. Wiring diagrams showing labels, inputs, outputs, and room locations.
 - 2. Electronic Format: Match NCA specified AutoCAD version.

1.7 QUALITY ASSURANCE

- A. System Integrator: BICSI RCDD System designer and installer.
 - 1. Regularly integrates communications and electronic safety and security systems and specified products.
 - 2. Employs BICSI RCDD certified licensed design professional responsible for system design.
 - 3. Integrated communications and electronic safety and security systems and 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. Manufacturer Qualifications:
 - 1. Regularly manufactures specified products.
 - 2. Manufactured specified products with satisfactory service on five similar installations for minimum five years.
 - a. Project Experience List: Provide contact names and addresses for completed projects.
 - 3. Factory Authorized Representative: As directed by COR.
 - 4. Field Representative: BICSI certified Registered Communications Distribution Designer (RCDD) experienced with specified components and systems.
- C. Installer Qualifications: BICSI RCDD certified and licensed security contractor. Manufacturer authorized representative.
 - 1. Regularly installs specified products.
 - 2. Installed specified products with satisfactory service on five similar installations for minimum five years.
 - a. Project Experience List: Provide contact names and addresses for completed projects.

D. Product Qualifications:

1. Demonstrated satisfactory operation on three similar size and type projects for approximately 5 years.
 - a. Project Experience List: Provide contact names and addresses for completed projects when requested by COR.

E. Service Provider Qualifications:

1. Qualified service organization, manufacturer maintained or trained by manufacturer capable of servicing installation within 24 hours of service request. Submit name and address of service organizations.

1.8 DELIVERY

- A. Deliver products in manufacturer's original sealed packaging.
- B. Mark packaging, legibly. Indicate manufacturer's name or brand, type, equipment brand, color, production run number, manufacture date, NRTL (i.e. UL) Label and point of manufacture.
- C. Before installation, return or dispose of products within distorted, damaged, or opened packaging.
- D. COR may inventory system equipment at time of delivery and recommend rejecting non-conforming items.

1.9 STORAGE AND HANDLING

- A. Store products indoors in dry, weathertight conditioned facility.
 1. Store products in approved location preventing physical damage, dirt, moisture, cold, rain, snow, and other detrimental exposure.
- B. Protect products from damage during handling and construction operations.

1.10 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.
 - a. Install products outdoors only when rated for exterior wet exposure.

- B. Existing Conditions: Review drawings and specifications with existing site conditions.
 - 1. Report discrepancies affecting system design and installation and propose solution.
 - 2. Request COR's approval for proposed solution.
- C. Field Measurements: Verify field conditions affecting product fabrication and installation. Show field measurements on Submittal Drawings.
 - 1. Coordinate field measurement and fabrication schedule to avoid delay.
 - 2. Request COR instructions for proposed conflict resolution.

1.11 WARRANTY

- A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."
- B. Manufacturer's Warranty: Warrant buried cables, equipment against material and manufacturing defects, and degradation.
 - 1. Warranty Period: 10 years.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. System: Nonproprietary system fully integrated with Sections 28 10 00, ACCESS CONTROL (PACS), 28 20 00, VIDEO SURVEILLANCE AND 28 31 00, INTRUSION DETECTION.
- B. Fully compatible components as systems, integrated with associated security subsystems, whether stand alone or computer network.
- C. Allow future modular expansion with minimal equipment modifications.
- D. Provide compatible system equipment and materials ensuring specified functional operation.
- E. Standalone, local access controls connected to remote host facility central station providing system software and access privileges database management for system functions.
 - 1. Protocol: Internet, addressable, and programmable.
 - 2. Interface: Computer, via VA-FTS and Telco Tie Lines or current federal communications media.
- F. System Capabilities:
 - 1. Locate individual protected asset area and portals.

2. Locate specific coverage areas.
 3. Locate individual system component failures.
 4. Locate individual system component tampering.
 5. Provide and adjust devices maximizing space and area coverage. When multiple devices are required, ensure device coverage is overlapping.
- G. Detection Sensitivity: Provide maximum secure area coverage while limiting environmental and small animal's false alarms.
- H. Detection Devices: Anti masking type, except video motion detection.
- I. Provide dual sensor technology not defeated by single method when possible to minimize false alarms.
- J. System General Components:
1. Communications and control panels.
 2. Interface cabinet for hard wired existing and standalone system extension.
 3. Head end cabinet for standalone system.
 4. Exterior detection devices (sensors-digital, analog, video, etc.).
 5. Interior detection devices (sensors-digital, analog, video, etc.).
 6. Power supply.
 7. Power and control wiring, raceways, and grounding.
- K. Ease of Use: Design, install, and program IDS for ease of operation, programming, servicing, maintaining, testing, and upgrading.
- L. System Integration:
1. With other security subsystems via computer programming and direct/stand-alone hardwiring.
 2. Designed, date stamped and signed by approved BICSI RCDD design professional.
 3. Determine methodology when system is designed and engineered.
 4. Include output module for integration with other security subsystems.
 5. Include software and upgrades required to integrate systems before system start up.
 6. Provide programming according to manufacturer's instructions and COR for correct system operations.
 7. System integration computers must meet or exceed minimum system requirements specified in system software packages; and approved by Facility OI&T.

2.2 SYSTEM PERFORMANCE

A. General:

1. Environment Rating: NFPA 70.
 - a. Exterior Locations: Wet.
 - b. Maintenance Building Interior Locations: Damp.
 - c. Other Interior Locations: Dry.
 - d. Hazardous Locations: NFPA 70; Class II, Division 1, Group F rated.
2. Electrical Power: 120 Volts AC, 60 Hz.
3. Control Power: 12 Volts AC and 12 Volts DC.
4. Backup Power: 96 hour duration, on primary power loss.
5. UPS: 1 hour for general systems/2 hour for emergency, security, safety systems.

2.3 PRODUCTS - GENERAL

- A. Products, Equipment, and Assemblies specified singular in number include quantities required for complete installation shown on drawings.
- B. Provide each product type from 1 manufacturer.
- C. Products and Equipment: Currently produced with available replacement parts.
- D. Equipment Assemblies:
 1. Assembly Manufacturer: Assume complete responsibility for entire assembly.
 2. Components: Compatible with each other and with total assembly for intended service.
 - a. Provide each component type from 1 manufacturer.

2.4 INTERFACE, HEAD END, CONTROL, AND COMMUNICATIONS CABINETS, OR PANELS PLUS STAND ALONE EQUIPMENT RACK

- A. Cabinet with Internal Equipment Mounting Rails:
 1. Construction: 1.37 mm (0.0538 inch) thick steel, with lockable access door and fully adjustable internal equipment mounting racks or rails allowing front panel equipment mounting and access.
 2. Install mounting rails to provide internal cabinet ground for each installed equipment items.

3. Connect equipment grounding terminal to separate mounting hole on mounting rail to the right viewed from the rear with minimum 12 AWG stranded copper wire with protective jacket and connectors installed.
4. Finish: Baked-on iron phosphate primer and baked enamel paint, color to be selected by COR or FMS Service Chief.
5. Mounting: Floor or wall mounted with knock-out holes for cable.
6. Ventilation Fan: Quiet type with non-disposable air filter for equipment cooling.
7. Keying: Keyed alike. Provide 4 keys to COR for every 10 cabinets.
8. Provide minimum of 1 cabinet with blank rack space, for additional expansion equipment. Install blank panels covering unused rack space. Provide 2, 120 Volt AC power strips connected to surge protector, ventilation fan, and conduit or cable duct interfaced to adjacent cabinet and local room wire management system.
 - a. Blank Panels: 3 mm (1/8 inch) thick aluminum with vertical dimensions in increments of one rack unit (RU) or 44 mm (1.75 inches) with mounting holes spaced to accommodate EIA 482 mm (19 inches) rack dimensions. Color code blank panels matching cabinet.
 - b. Use single blank panels to fill unused panel or rack spaces. Install 1, 44 mm (1.75 inches) high blank panel between each equipment item.
9. Provide internal cabinet communications grounding system and connect to communications ground bus bar with minimum 6 AWG stranded copper wire with protective covering.
 - a. Connect cabinet to communications grounding system.
 - b. Connect communications system grounding wire to a cabinet provided ground terminal or bolted to each equipment mounting rail.
10. Technical Characteristics:

| | |
|---------------------------|------------------------------------|
| Overall Height | 2,180 mm (85-7/8 inches), maximum |
| Overall Depth | 650 mm (25-1/2 inches), maximum |
| Overall Width | 535 mm (21-1/16 inches), maximum |
| Front Panel Opening Width | 480 mm (19 inches), EIA horizontal |
| Hole Spacing | per EIA and Industry Standards |

11. Cabinet Minimum Internal Components:

- a. AC Power Outlet Strip: "U" grounded AC outlets, self-contained in a metal enclosure with maximum 2 meter (6 feet) long connecting cords with three prong AC male plug.
 - 1) Quantity: 2 for each panel.
 - 2) Provide as directed by OEM. Provide AC strips with minimum 8 AC power outlets at spare empty cabinet. Mount strips inside at rear of cabinet.
 - 3) Technical Characteristics:
 - a) Power capacity 20 Ampere, 120 Volt AC continuous duty.
 - b) Wire gauge: Three conductor, 12 AWG copper.
- b. Cabinet AC Power Line Surge Protector and Filter:
 - 1) House surge protector and filter in single enclosure. Perform instantaneous regulation of AC input voltage and isolate and filter AC input line noise. Equip unit with AC voltage and current surge protectors to prevent damage to electronic equipment from power line induced voltage spikes, surges, lightning, etc.
 - 2) Surge Protector Construction: UL listed device.
 - a) Primary Surge Protection Components: Silicon semiconductors.
 - b) Incorporate visual device indicating surge suppression components are functioning.
 - c) Provide voltage and current surge protectors on ancillary equipment.
 - 3) Mounting: Cabinet mounted with cabinet AC power strips connected.
 - 4) Technical Characteristics:

| | |
|---------------------------|---|
| Input Voltage range | 120 Volt AC + 15% |
| Power capacity | 20 AMP, 120 VAC |
| Voltage output regulation | +3.0% |
| Circuit breaker | 15 AMP, may be self-contained |
| Noise filtering | Greater than -45 dB |
| AC outlets | Four (4) duplex grounded types, minimum |

| | |
|-------------------|------------------------------------|
| Response time | 5.0 ns |
| Surge Suppression | 10,000 A |
| Noise Suppression | -40 dB common, -45 dB differential |

5) Current and Surge Protection Performance:

- a) Voltage protection threshold, line to neutral, starts at no more than 220 Volts peak. The transient voltage shall not exceed 300 volts peak. Provide documentation on peak clamping voltage as a function of transient AMP.
- b) Peak power dissipation minimum 35 Joules per phase, as measured for 1.0 ms at sub branch panels, 100 Joules per phase at branch panels and 300 Joules per phase at service entrance panels. Provide documentation of how ratings were measured or empirically derived.
- c) Surge protector must not short circuit AC power line any time.
- d) Power dissipation 12,000 Watts for 1.0 ms (or 12 Joules).
- e) Voltage protection threshold starts at maximum 100 VAC.

B. Uninterruptible Power Supply (UPS): Provide internal COTS UPS at each cabinet. UPS may be combined with Surge Protector and Filter when 50 percent expansion is provided.

- 1. Continuous Full Load Capacity: Provide minimum 1 hour and 2 hours if working with emergency safety system.
- 2. Continuous Full Load Reserve Capacity: 25 percent, minimum 1 hour, in event of Facility Primary or Emergency AC Power failure.
- 3. Supervision, Monitoring, and Signaling:

| | |
|------------------------------|--|
| Protection switch | Automatically protect UPS unit and associated connected equipment. |
| First/fast charge unit | Provide clean predicable charge voltage/current when needed. |
| Over Voltage/Current protect | Must not short circuit the AC power line at any time. |
| Trickle charge unit | Maintain internal battery charge without damaging batteries. |
| Internally mounted | Per OEM's direction. |
| Proper ventilation | Not override cabinets' ventilation |

| | |
|----------------------------|---|
| | system. |
| Power change from AC input | Accomplish without interruption to communications link or subsystem being protected. Provide audible and visual alarms on power loss. |
| Electrical supervision | Audible and visual reported locally and remotely annunciating panel status via direct connection for trouble and alarm indication |

C. Stand Alone Equipment Rack:

1. Construction: 1.37 mm (0.0538 inch) thick steel, with fully adjustable internal equipment mounting racks or rails allowing front panel equipment mounting and access.
2. Finish: Baked-on iron phosphate primer and baked enamel paint, color to be selected by COR or FMS Service Chief.
3. Mounting: Floor or wall mounted or mounted on casters as directed by COR.
4. Technical Characteristics:

| | |
|---------------------|--|
| Overall Height | 2,180 mm (85-7/8 inches), maximum |
| Overall Depth | 650 mm (25-1/2 inches), maximum |
| Overall Width | 535 mm (21-1/16 inches), maximum |
| Front Panel Opening | 480 mm (19 inches), EIA horizontal width |
| Hole Spacing | per EIA and Industry Standards |

D. Panels: Expandable, network capable, expandable, providing entire facility access control through primary interface head end panel.

1. Indoor Locations: NEMA 250; Type 1.
2. Outdoor Locations: NEMA 250; Type 4X.
3. Mounting: Wall.
4. Access Doors: Locking, front only; operable without disturbing and damaging internal wiring.
5. Ventilation: Electric fan, non-disposable air filter, and enclosure openings required to dissipate heat from panel modules.

6. Signal Wiring Strips:
 - a. Input Strip: Top row, receiving output signal from connected devices.
 - b. Output Strip: Bottom row transmitting input signal to connected devices.
 7. Power outlet strip.
 8. Bulkhead connector panel.
 9. Computer Access: Password protected.
 10. Database: Single, integrated, relational type.
 11. Operating System:
 - a. Comply with client applications requirements.
 - b. Linux embedded OS, browser based thin-client.
 12. Programming Source Code: Single, unified 32-bit program interfacing with panel modules.
 13. Panel Modules: Programmable; general control, access control, alarm monitoring, credential management, and intrusion detection.
- E. Client Applications: Web enabled using panel database.
1. Operating System Support:
 - a. Microsoft: Windows 11.

2.5 POWER SUPPLIES

- A. Use power supplies only when control panel cannot support IDS load requirements.
- B. Power Supplies: UL Listed; capable of powering two detection devices, continuously, without failure.
 1. Input Power: 110 Volt AC, 60 Hz, 2.0 Amperes.
 2. Output Power: 12 Volt DC nominal (13.8 Volt DC) and 24 Volt DC nominal (27.6 Volt DC); filtered and regulated.
 3. Battery: Minimum 14 Ampere-hour at full load, rechargeable.
 4. Output Current: Maximum 4 Amperes at 13.8 Volt DC and 3 Amperes at 27.6 Volt DC.
 5. Battery Fuse: 3.5 Ampere at 250 Volts AC.
 6. Battery Charging Circuit: Manufacturer's standard.

2.6 LABELS

- A. Labeling Abbreviations: Use accepted industry standards consistent with submittal drawings and recorded in as-built drawings.

- B. Wire Labels: Permanent, with contrasting identification alpha or numeric, identifying each cable according to system submittal drawings.
- C. Equipment and AC Power Labels: Permanent with contrasting plastic laminate or Bakelite material.
 - 1. Equipment Nameplates: Laminated black phenolic resin with white core and engraved lettering, minimum 6 mm (1/4 inch) high. Secure nameplates with screws. Manufacturer's nameplates furnished as standard catalog item, or where other method of identification is herein specified, may be permitted by COR.

2.7 INSTALLATION KIT

- A. Include, at minimum, connectors and terminals, labeling systems, audio spade lugs, barrier strips, punch blocks, wire wrap terminals, heat shrink tubing, cable ties, solder, hangers, clamps, bolts, conduit, cable duct, cable tray, and other items required for neat and secure installation.
 - 1. Terminate wires in spade lug and barrier strip, wire wrap terminal or punch block.
 - 2. Unfinished and unlabeled wire connections are not allowed.
 - 3. Deliver unused and partially opened installation kit boxes, coaxial, fiber-optic, and twisted pair cable reels, conduit, cable tray, cable duct bundles, wire rolls, and physical installation hardware to COR.
- B. System Grounding Kit: Include cable and installation hardware required to connect head end equipment, power supplies, and following components to earth ground via internal building wiring, according to NFPA 70.
 - 1. Coaxial cable shields.
 - 2. Control cable shields.
 - 3. Data cable shields.
 - 4. Equipment racks.
 - 5. Equipment cabinets.
 - 6. Conduits.
 - 7. Cable duct blocks.
 - 8. Cable trays.
 - 9. Power panels.
 - 10. Connector panels.

- C. Wire and Cable Kit: Include connectors and terminals, audio spade lugs, barrier straps, punch blocks, wire wrap strips, heat shrink tubing, tie wraps, solder, hangers, clamps, labels, and other items required for neat and secure installation.
- D. Conduit, Cable Duct, and Cable Tray Kit: Include conduit, duct, trays, junction boxes, backboxes, cover plates, feed through nipples, hangers, clamps, and other hardware required for neat and secure conduit, cable duct, and cable tray installation according to NFPA 70.
- E. Equipment Interface Kit: Include equipment, cable, mounting hardware, and materials to interface systems with subsystems according to manufacturer's instructions.
- F. Labeling Kit: Include labels, tools, stencils, and materials to label each subsystem according to manufacturer's instructions and as-built drawings.
- G. Documentation Kit: Include items, computer discs, as-built drawings, equipment, operation and maintenance manuals, and manufacturer's publications to fully document installed system.

2.8 ACCESSORIES

- A. Sealant: See Section 07 92 00, JOINT SEALANTS.
- B. Provide connectors, terminators, and other accessories required for operable system.
- C. Galvanizing Repair Paint: MPI No. 18.

2.9 SOURCE QUALITY CONTROL

- A. Special Inspections and Tests:
- B. Shop Inspections:
- C. Shop Tests:
- D. When Factory Testing Is Specified:
 - 1. Allow COR to witness factory tests.
 - 2. Notify COR minimum 15 working days before manufacturer's factory tests.
 - 3. When factory tests fail, provide additional tests and pay Government expenses to witness tests.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Examine and verify substrate suitability for product installation.

- B. Field survey, test, and inspect existing equipment and signal lines intended to be incorporated into the system.
 - 1. Equipment and wiring usable without modification may be reused with COR's approval.
- C. Prepare report of unforeseen conditions affecting Work performance. Submit recommendation signed, dated, and sealed by VA delegated BICSI RCDD certified design professional.
- D. Examine and verify substrate suitability for product installation.
- E. Cutting or Holes:
 - 1. Locate holes in advance where proposed in structural sections such as ribs or beams. Obtain COR's approval before drilling through structural sections.
 - 2. Cut holes through concrete and masonry in new and existing construction with diamond core drill or concrete saw. Pneumatic hammer, impact electric, hand or manual hammer type drills are not acceptable, except as permitted by COR as required by limited working space.
- F. Obtain COR's approval minimum 3 days before interrupting existing system service.
- G. Protect existing construction and completed work from damage.
 - 1. Repair damage caused by construction operations.
- H. Remove existing equipment and wiring to permit new installation.
 - 1. Retain existing serviceable equipment indicated for reuse.
 - 2. Dispose of removed materials.

3.2 INSTALLATION - GENERAL

- A. Install products according to manufacturer's instructions, system specifications, and approved submittal drawings.
 - 1. When manufacturer's instructions deviate from specifications, submit proposed resolution for COR consideration.
- B. Configure components with service points to pinpoint system trouble in less than 15 minutes.
- C. Ensure components are fully compatible with entire system and can be integrated with associated and remote subsystems, whether system is stand-alone, hardwired, or networked to meet requirements of AHJ SMCS 07A2.

- D. Install system components including Government furnished equipment, and appurtenances according to manufacturer's instructions. Provide necessary connectors, terminators, interconnections, services, and adjustments required for operable system.
- E. Connect existing equipment, wiring, and devices shown on drawings.
- F. Raceway Penetrations:
 - 1. Enter control panels through panel bottom.
 - 2. Seal penetrations located outdoors. Seal penetrations through building exterior enclosure.
 - 3. Firestop penetrations through fire rated assemblies. See Section 07 84 00, FIRESTOPPING.
 - 4. Terminate conduit riser in hot-dip galvanized metal cable terminator. Fill terminator with sealant recommended by cable manufacturer.
- G. Control Panels:
 - 1. Install control panels plumb and level, securely attached to wall.
 - a. Mount panels allowing servicing and testing access.
 - 2. Connect wiring to control modules.
 - 3. Program control modules to provide specified functions.
- H. Touch up damaged factory finishes.
 - 1. Repair galvanized surfaces with galvanized repair paint.
- I. Perform communications and electronic safety and security work without interrupting existing systems. See Article OPERATIONS AND STORAGE AREAS, Section 01 00 01, GENERAL REQUIREMENTS.
- J. Make connections to existing work neatly and carefully. Replace or repair damaged work to its original condition, as required by Section 01 00 01, GENERAL REQUIREMENTS.
- K. Coordinate equipment, pathways, and conduit locations to minimize interferences.

3.3 EQUIPMENT INSTALLATION

- A. Locate equipment where shown on drawings.
- B. Inaccessible Equipment:
 - 1. Where COR determines equipment is not conveniently accessible for operation and maintenance, remove and reinstall equipment as directed by COR.

2. "Conveniently accessible" is defined as being capable of being reached without using ladders and without climbing or crawling under or over obstacles such as motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.

3.4 INSTALLATION - WIRING

- A. Grounding and Bonding: See Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.
- B. Raceway Installation: See Section 27 05 33, CONDUITS AND BACKBOXES FOR COMMUNICATIONS SYSTEMS.
- C. Wiring: See Section 27 10 00 - STRUCTURED CABLING.

3.5 LABELING

- A. Cable and Wires: Install labels on cables at each termination, pull box, and break in conductor run.
 1. Labels: Permanent, with contrasting identification alpha or numeric, identifying each cable according to system submittal drawings.
- B. Equipment: Label equipment, and equipment inputs and outputs.
 1. Permanently affix labels to equipment face with metal screws, permanent mounting devices, or cement.
 2. Label equipment corresponding to control source. Label remote control equipment corresponding to controlled equipment.
- C. AC Power: Label power panel circuit breaker identifying connected access control panel.
 1. Permanently affix labels to equipment face with metal screws, permanent mounting devices or cement.
- D. Conduit: Label access control system conduit with permanent marking devices or spray painted stenciling, maximum 3000 mm (10 feet) spacing.

3.6 SYSTEM START-UP

- A. Do not apply power to System until the following items have been completed:
 1. System equipment items and have been set up according to manufacturer's instructions.
 2. Visual inspection of System has been conducted to ensure defective equipment items have not been installed and there are no loose connections.
 3. System wiring has been tested and verified as correctly connected as indicated.

4. System communications and electrical grounding and transient protection systems have been verified as installed and connected as indicated.
5. Power supplies to be connected to CCTV System have been verified as correct Voltage, phasing, and frequency as indicated.
6. Satisfaction of above requirements will not relieve Contractor of responsibility for incorrect installation, defective equipment items, or collateral damage as result of Contractor's work efforts.

3.7 FIELD QUALITY CONTROL

- A. Field Tests: Performed by testing laboratory specified in Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Field Representative Services:
 1. Observe preparation and initial construction.
 2. Provide technical assistance and recommendations.
 3. Provide assistance with follow-up phases of quality control on as needed basis.
 4. Observe system start-up, testing, and certification.
 5. Certify system is fully operational according to contract requirements.
- C. Interim Inspection:
 1. The RE may require the test at approximately 75 percent of the installation; and, 10 working days before inspection suggested start date.
 2. Inspection to be conducted by OEM, factory-certified contractor, and witnessed by RE, Facility and AHJ 07A2 Representatives.
 3. Verify equipment provided adheres to installation requirements. Perform interim inspection by a factory certified representative and witnessed by RE.
 - a. Check each item of installed equipment for appropriate UL certification markings.
 - b. Verify cabling terminations in telecommunications rooms and at workstations adhere to color code for ANSI/TIA/EIA 568 D, T568B pin assignments and cabling connections comply with ANSI/EIA/TIA standards.
 - c. Visually confirm Category 6 marking of outlets, faceplates, outlet/connectors and patch cords.

4. Perform fiber optical field inspection tests via attenuation measurements on factory reels. Provide results along with manufacturer certification for factory reel tests. Remove failed cable reels from project site upon attenuation test failure.
5. Notify COR, in writing, estimated date for interim inspection, minimum 20 working days before requested inspection date.
6. Submit interim inspection results to COR. Repeat interim inspection when major or multiple deficiencies are discovered before continuing system installation.
7. COR will determine when additional inspection is required, or when allowed to proceed with installation. In either case, re inspection of deficiencies noted during interim inspections, will be part of proof of performance test. Interim inspection may not affect Systems' completion date. COR will ensure test documents will become a part of Systems record documentation.

D. Pretesting:

1. Align and balance system when installation is complete. Pretest entire system.
2. Pretesting Procedure:
 - a. Verify (using approved spectrum analyzer and test equipment) System is fully operational and meets system performance requirements.
 - b. Pretest and verify System functions and specification requirements are met, and operational, no unwanted aural effects, such as signal distortion, noise pulses, glitches, audio hum, poling noise, etc. are present. Measure and record aural carrier levels of each system telephone and data channel, at each of the following points in system:
 - 1) Local Telephone Company Interfaces or Inputs.
 - 2) EPBX interfaces or inputs and outputs.
 - 3) MDF interfaces or inputs and outputs.
 - 4) EPBX output S/NR for each telephone and data channel.
 - 5) Signal Level at each interface point to distribution system, last outlet on each trunk line plus outlets installed as part of this contract.

- 6) Submit four copies of recorded system pretest measurements and written certification that System is ready for formal acceptance test to COR.

E. Acceptance Test:

1. Submit system pretesting results and certification to COR. Notify COR 30 days before start of acceptance test.
2. Test System in the presence of COR and manufacturer's certified representative utilizing approved test equipment to certify proof of performance and Life Safety compliance. Test to verify total System meets specified requirements. Acceptance test notification includes expected test duration.

F. Verification Tests:

1. Test UTP copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors, and between conductors and shield, when cable has an overall shield. Test operation of shorting bars in connection blocks. Test cables after termination and before cross connection.
2. Single mode Fiber Optic Cable: Perform end to end attenuation tests according to ANSI/EIA/TIA 568 D.3 and ANSI/EIA/TIA 526 7 using Method A, Optical Power Meter and Light Source and/or Method B, OTDR. Perform verification acceptance test.

G. Performance Testing:

1. Perform Category 6 tests according to ANSI /EIA/TIA 568 D.1 and ANSI/EIA/TIA 568 D.2. Test includes the following:
 - a. Wire map.
 - b. Length.
 - c. Insertion loss.
 - d. Return loss.
 - e. NEXT.
 - f. PSNEXT.
 - g. ELFEXT.
 - h. PSELFEXT.
 - i. Propagation delay.
 - j. Delay skew.
2. Fiber Optic Links: Perform end to end fiber optic cable link tests according to ANSI/EIA/TIA 568 D.3.

- H. Total System Acceptance Test: Perform verification tests for UTP copper cabling systems and the single mode fiber optic cabling systems after complete telecommunication distribution system and workstation outlet are installed.
- I. Voice Testing: Connect to network interface device at demarcation point. Go off hook and receive dial tone from LEC. When a test number is available, place and receive a local, long distance, and FTS telephone call.
- J. Data Testing: Connect to network interface device at demarcation point. Log onto network to ensure proper connection to network is achieved.
- K. Test system to ensure all components are fully compatible as system and can be integrated with all associated subsystems, whether system is stand alone or part of complete Information Technology (IT) computer network.
- L. System Certification:
 - 1. COR and AHJ SMCS 07A2 will compare all recorded test results and determine when the system can be certified for VA use and execute appropriate government acceptance forms.
 - a. Read, approve and sign documents providing transfer of system ownership to VA.
 - 2. Develop, plan, and agree on retesting of system with COR, AHJ SMCS 07A2 and OEM when system cannot be certified.
 - 3. COR will make appropriate recommendation to CO when system retest costs shall be borne by contactor.
- M. Test Conclusion: See FAR clause 52.246 21, "Warranty of Construction."

3.8 DEMONSTRATION AND TRAINING

- A. Provide training according to Article, INSTRUCTIONS, Section 01 00 01, GENERAL REQUIREMENTS.
 - 1. Coordinate training schedule with COR with training approval from AHJ SMCS 07A2.
 - 2. Use training plan developed and approved in the Technical Submittal.
 - a. Submit finalized plan to COR 30 days before expended training dates.
 - b. COR will obtain technical approval from AHJ SMCS 07A2 before plan submission for final project action.

3. Provide factory authorized representative for demonstration and training.
4. Training Time:
 - a. VA Cemetery Director, Cemetery Foreman, and Resident Engineer (RE): Four (4) hour periods.
 - b. Other Selected VA Facility Personnel: Eight (8) hour periods.
 - c. Schedule training sessions with COR. Complete training before final system certification.

3.9 PROTECTION

- A. Protect enclosures, equipment, controls, controllers, circuit protective devices, and other items against contamination. Vacuum clean both inside and outside before testing and operating system.
- B. Replace or repair damaged equipment, as determined by COR.
- C. Protect painted surfaces from damage with factory installed removable covering.

- - - E N D - - -

SECTION 27 05 26
GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. General grounding and bonding requirements of telecommunication and electronic safety and security installations for equipment operations.
- B. See Section 27 05 00, COMMON WORK RESULTS FOR COMMUNICATIONS for requirements governing work of this section.

1.2 DEFINITIONS

- A. Grounding electrode system" means electrodes required by NFPA 70 and made, supplementary, telecommunications system grounding electrodes.
- B. Grounding electrode conductor means earth grounding electrode that is connected to a separate circulating communications grounding conductor, to the equipment grounding conductor at the source of a separately derived system.
- C. The terms "connect" and "bond" are used interchangeably in this specification and have same meaning.

1.3 RELATED REQUIREMENTS

- A. Communications General Requirements: Section 27 05 00, COMMON WORK RESULTS FOR COMMUNICATIONS.

1.4 APPLICABLE PUBLICATIONS

- A. ASTM International (ASTM):
 - 1. B1-13 - Hard-Drawn Copper Wire.
 - 2. B8-11 - Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
- B. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - 1. 81-2012 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System.
- C. National Fire Protection Association (NFPA):
 - 1. 70-17 - National Electrical Code (NEC).
- D. Telecommunications Industry Association (TIA):
 - 1. 607-2015 - Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises.

- E. UL LLC (UL):
 - 1. 83-14 - Thermoplastic-Insulated Wires and Cables.
 - 2. 467-13 - Grounding and Bonding Equipment.
- F. United States Department of Veterans Affairs (VA):
 - 1. VA Construction and Facilities Management (CFM):
 - a. DM Telecom - Telecommunications & Special Telecommunications Systems Design Manual, 2016.

1.5 SUBMITTALS

- A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

1.6 WARRANTY

- A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."

PART 2 - PRODUCTS

2.1 PRODUCTS - GENERAL

- A. Provide each product type by a single manufacturer.

2.2 GROUNDING AND BONDING CONDUCTORS

- A. Equipment Grounding Conductors: UL 83 insulated stranded copper, except solid copper for sizes 6 sq. mm (10 AWG) and smaller. Continuous green insulation color for equipment grounding conductors, except wire sizes 25 sq. mm (4 AWG) and larger may be identified according to NFPA 70.
- B. Bonding Conductors: ASTM B8 bare stranded copper, except ASTM B1 solid bare copper at sizes 6 sq. mm (10 AWG) and smaller.
- C. Isolated Power System: Type XHHW-2 insulation with 3.5 or less dielectric constant.
- D. Telecom System Grounding Riser Conductor: TIA 607, minimum 50 sq. mm (1/0 AWG) insulated stranded copper grounding conductor, unless otherwise indicated.

2.3 SPLICES AND TERMINATION COMPONENTS

- A. Splices and Termination Components: Meet or exceed UL 467, clearly marked with manufacturer, catalog number, and permitted conductor sizes.

2.4 TELECOMMUNICATION SYSTEM GROUND BUSBARS

- A. Busbar: Solid copper, pre-drilled from two-hole lug connections, minimum 6 mm (1/4 inch) thick for wall and backboard mounting using standard insulators sized as follows:
 - 1. Room Signal Grounding: 300 mm by 100 mm (12 inches by 4 inches).
 - 2. Master Signal Ground: 600 mm by 100 mm (24 inches by 4 inches).

2.5 GROUND CONNECTIONS

- A. Below Grade: Exothermic-welded type connectors.
- B. Above Grade:
 - 1. Bonding Jumpers: Compression type connectors, using zinc-plated fasteners and external tooth lockwashers.
 - 2. Ground Busbars: Two-hole compression type lugs using tin-plated copper or copper alloy bolts and nuts.
 - 3. Rack and Cabinet Ground Bars: One-hole compression-type lugs using zinc-plated or copper alloy fasteners.
- C. Cable Shields: Make ground connections to multipair communications cables with metallic shields using shield bonding connectors with screw stud connection.

2.6 GROUND TERMINAL BLOCKS

- A. Terminal Blocks: Provide screw lug-type at equipment mounting locations, such as backboards and hinged cover enclosures, where rack-type ground bars cannot be mounted.

2.7 SPLICE CASE GROUND ACCESSORIES

- A. Splice Case Grounding and Bonding Accessories: Supplied by splice case manufacturer or 16 sq. mm (6 AWG) insulated ground wire with shield bonding connectors.

PART 3 - EXECUTION

3.1 GROUNDING - GENERAL

- A. Ground according to NFPA 70, TDM Chapter 4, as shown on drawings, and as specified.
- B. Grounding:
 - 1. Ground equipment to eliminate shock hazard and minimize, to maximum extent possible, ground loops, common mode returns, noise pickup, and cross-talk.

2. System:
 - a. Ground CFE and identified GFE to earth ground, via approved electrical ground with wires run inside building, to eliminate shock hazards. Provide minimum number of ground connections. Ground resistance to be 0.1 Ohm or less.
 - b. Use of AC neutral for system control, subcarrier or audio reference ground, either in power panel or receptacle outlet, is not acceptable.
 - c. Conduit or signal duct may not be used as system or electrical ground. These items are acceptable only for dissipation of internally generated system static charges, not to be confused with externally generated lightning, that may be applied or generated outside mechanical and physical confines of system to earth ground. Discovery of improper system grounding is ground to declare system unacceptable and termination of system acceptance testing.
 3. Cabinet Bus: Extend minimum 6 sq. mm (10 AWG) solid copper wire common ground bus throughout each equipment cabinet. Home-run common ground bus from each equipment cabinet to system ground.
 4. Equipment: Bond equipment to cabinet ground bus with copper braid equivalent to minimum 2 sq. mm (14 AWG).
 - a. Acceptable Alternatives: Self-grounding equipment enclosures, racks or cabinets, providing OEM certified functional ground connections through physical contact with installed equipment.
 5. Cable Shields: Bond cable shields to cabinet ground buss with minimum 2 sq. mm (14 AWG) stranded copper wire at one end of cable run. Insulate cable shields from each other, face-plates, equipment racks, consoles, enclosures or cabinets, except at system common ground point. Provide one ground connection at source for coaxial and audio cables, if possible, with minimum number of cable shield ground connections.
- C. System Grounding:
1. Secondary Service Neutrals: Ground at supply side of secondary disconnecting means and at related transformers.
 2. Separately Derived Systems (Transformers Downstream from Service Entrance): Ground secondary neutral.

3. Do not system ground isolation transformers and isolated power systems.

D. Equipment Grounding: Bond and ground metallic structures, including ductwork and building steel, enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity to electrical circuits.

3.2 INACCESSIBLE GROUNDING CONNECTIONS

A. Inaccessible Grounding Connections: Exothermically weld buried or otherwise normally inaccessible grounding connections, except connections for which periodic testing access is required.

3.3 SECONDARY EQUIPMENT AND CIRCUITS

A. Main Bonding Jumper: Bond secondary service neutral to ground bus in service equipment.

B. Metallic Piping, Building Steel, and Supplemental Electrodes:

1. Provide grounding electrode conductor sized according to NFPA 70 between service equipment ground bus and metallic water and gas pipe systems, building steel, and supplemental or made electrodes. Jumper insulating joints in metallic piping. Make connections to electrodes with fittings according to UL 467.

2. Provide supplemental ground electrode and bond to grounding electrode system.

C. Conduit Systems:

1. Ground metallic conduit systems. Provide metallic conduit systems with equipment grounding conductor.

2. Provide equipment grounding conductor for non-metallic conduit systems, except for non-metallic feeder conduits carrying grounded conductor from exterior transformers to interior or building-mounted service entrance equipment.

3. Bond conduit containing only grounding conductor, provided for mechanical protection of conductor at entrance and exit from conduit.

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

- E. Boxes, Cabinets, Enclosures, and Panelboards:
 - 1. Bond equipment grounding conductor to each pullbox, junction box, outlet box, device box, cabinets, and other enclosures through which conductor passes.
 - 2. Provide lugs in each box and enclosure for equipment grounding conductor termination.
 - 3. Provide ground bars in panelboards, bolted to housing, with sufficient lugs to terminate equipment grounding conductors.
- F. Do not ground receptacles through their mounting screws, ground with jumper from receptacle green ground terminal to device box ground screw and branch circuit equipment grounding conductor.

3.4 CORROSION INHIBITORS

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

3.5 CONDUCTIVE PIPING

- A. Bond conductive piping systems, interior and exterior, to building to grounding electrode system. Make bonding connections as close as practical to equipment ground bus.

3.6 TELECOMMUNICATIONS SYSTEM

- A. Bond telecommunications system grounding equipment to facility main electrical grounding electrode system at source point.
- B. Provide wire and hardware required to properly ground, bond and connect communications raceway, metallic cable shields, and equipment to ground source.
- C. Provide continuous ground bonding jumpers without splices. Use shortest possible bonding jumper length.
- D. Provide permanent and continuous ground paths with maximum 1 ohm resistance from raceway, and equipment connections to building grounding electrode. Resistance across individual bonding connections to be maximum 10 milli ohms.
- E. Below-Grade Grounding Connections: When making exothermic welds, wire brush or file point of contact to bare metal surface. Use exothermic welding cartridges and molds according to manufacturer's instructions.

After welds have been made and cooled, brush slag from weld area and thoroughly clean joint area. Notify Contracting Officer's Representative (COR) before backfilling any ground connections.

- F. Above-Grade Grounding Connections: When making bolted or screwed connections to attach bonding jumpers, remove paint to expose entire contact surface by grinding where necessary, thoroughly clean connector, plate and other contact surfaces, and apply appropriate corrosion inhibitor to surfaces before joining.
- G. Bonding Jumpers:
1. Provide insulated ground wire of size and type shown on Drawings or use minimum 16 sq. mm (6 AWG) insulated copper wire.
 2. Assemble bonding jumpers using insulated ground wire terminated with compression connectors.
 3. Provide compression connectors of proper size for conductors specified. Use connector manufacturer's compression tool.
- H. Bonding Jumper Fasteners:
1. Conduit: Fasten bonding jumpers with screw lugs on grounding bushings or conduit strut clamps, or clamp pads on push-type conduit fasteners. When screw lug connection to conduit strut clamp is not possible, fasten plain end of bonding jumper wire by slipping plain end under conduit strut clamp pad and firmly tighten clamp screw. Where appropriate, use zinc-plated external tooth lockwashers.
 2. Wireway: Fasten bonding jumpers using zinc-plated bolts, external tooth lockwashers, and nuts. Install protective cover, for example, zinc-plated acorn nuts on any bolts extending into wireway to prevent cable damage.
 3. Ground Plates and Busbars: Fasten bonding jumpers using two-hole compression lugs. Provide tin-plated copper or copper alloy bolts, external tooth lockwashers, and nuts.
 4. Raised Floor Stringers: Fasten bonding jumpers using zinc-plated, self-drill screws and external tooth lockwashers. Contact AHJ 07A2 for specific instructions.

3.7 COMMUNICATION ROOM GROUNDING

- A. Telecommunications Ground Busbars:
 - 1. Provide communications room telecommunications ground busbar hardware, minimum size as described in TDM Chapter 4 at locations indicated on Drawings.
 - 2. Connect telecommunications room ground busbars to other room grounding busbars as indicated on drawings.
- B. Telephone-Type Cable Rack Systems: An aluminum pan installed on telephone-type cable rack serves as primary ground conductor within communications room. Make ground connections by installing the following bonding jumpers:
 - 1. 16 sq. mm (6 AWG) bonding between telecommunications ground busbar and nearest access to aluminum pan installed on cable rack.
 - 2. Provide 16 sq. mm (6 AWG) bonding jumpers across aluminum pan junctions.
- C. Self-Supporting and Cabinet-Mounted Equipment Rack Ground Bars:
 - 1. When ground bars are provided at rear of lineup of bolted together equipment racks, bond copper ground bars together using solid copper splice plates furnished by ground bar manufacturer.
 - 2. Bond together nonadjacent ground bars on equipment racks and cabinets with 16 sq. mm (6 AWG) insulated copper wire bonding jumpers attached at each end with compression-type connectors and mounting bolts.
- D. Backboards: Provide screw lug-type terminal block or drilled and tapped copper strip near top of backboards used for communications cross-connect systems.

3.8 COMMUNICATIONS CABLE GROUNDING

- A. Bond metallic cable sheaths in multipair communications cables together at each splicing or terminating location to provide 100 percent metallic sheath continuity throughout communications distribution system.
 - 1. At terminal points, install cable shield bonding connector to provide screw stud connection for ground wire. Use bonding jumper to connect cable shield connector to appropriate ground source, such as rack or cabinet ground bar.

2. Bond metallic cable shields together within splice closures using cable shield bonding connectors or splice case grounding and bonding accessories furnished by splice case manufacturer. When an external ground connection is provided as part of splice closure, connect to approved ground source and other metallic components and equipment at that location.

3.9 COMMUNICATIONS RACEWAY GROUNDING

- A. Conduit: Provide insulated 16 sq. mm (6 AWG) bonding jumpers to ground metallic conduit at each end and to bond at intermediate metallic enclosures.
- B. Wireway: Provide insulated 16 sq. mm (6 AWG) bonding jumpers to ground or bond metallic wireway at each end at intermediate metallic enclosures and across section junctions.

3.10 GROUND RESISTANCE

- A. Grounding System Resistance: Maximum 5.0 ohms to ground. Make necessary modifications or additions to grounding electrode system for compliance at no additional cost to Government. Perform tests to ensure requirement is met.
- B. Measure grounding electrode system resistance using four-terminal fall-of-potential method according to IEEE 81. Make ground resistance measurements before electrical distribution system is energized in normally dry conditions minimum 48 hours after last rainfall. Make resistance measurements of separate grounding electrode systems before systems are bonded together below grade. Combined resistance of separate systems is acceptable to meet required resistance, but specified number of electrodes must still be provided.
- C. Comply with utility company ground resistance requirements for services at utility company interface points.
- D. COR will inspect below-grade connections before backfilling. Notify COR and AHJ SMCS 07A2 24 hours before connections are ready for inspection.
- E. Provide Communications Circulating Ground System certification certificate, accomplished by an approved commercial certified grounding professional, which is additionally signed and stamped by the Project's BICSI RCDD Certified design professional, to the COR for inclusion in the project official documents after approved by AHJ SMCS 07A2.

3.11 GROUNDING FOR RF/EMI CONTROL

- A. See DM Telecom, Paragraph 9.1.(d) for minimum requirements.
- B. Install bonding jumpers to bond conduit, sleeves and equipment for low voltage signaling and data communications circuits. Bonding jumpers consist of 100 mm (4 inches) wide copper strip or two 6 sq. mm (10 AWG) copper conductors spaced minimum 100 mm (4 inches) apart. Provide 16 sq. mm (6 AWG) copper where exposed and subject to damage.
- C. Comply with the following when shielded cable is used for data circuits:
 - 1. Shields to be continuous throughout each circuit.
 - 2. Connect shield drain wires together at each circuit connection point and insulate from ground. Do not ground the shield.
 - 3. Do not connect shields from different circuits together.
 - 4. Connect shield only at one end. Connect shield to signal reference at circuit origin. Consult equipment manufacturer to determine signal reference.

- - - E N D - - -

SECTION 27 05 33
CONDUITS AND BACKBOXES FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. New state-of-the-art fully functional conduits, fittings, and boxes to form complete, coordinated raceway system for FMS and OI&T communications cabling installed in VA's National Cemetery (NCA) Black Hills to regulate communication pathways to accommodate the facility's entire TIP to buildings, building areas, and fenced areas unless otherwise officially specified and shown of the drawings. Project Number: 884CM3015.

B. See Section 27 05 00, COMMON WORK RESULTS FOR COMMUNICATIONS for requirements governing work of this section.

1.2 RELATED REQUIREMENTS

A. Mounting Board for Communication Closets: Section 06 10 00, ROUGH CARPENTRY.

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. General electrical requirements and items common to more than one Division 27 section: Section 27 05 00, COMMON WORK RESULTS FOR COMMUNICATIONS.

1.3 APPLICABLE PUBLICATIONS

A. Comply with references to extent specified in this section.

B. National Electrical Manufacturers Association (NEMA):

1. TC-3-15 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.

2. FB-1-14 - Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing (EMT) and Cable.

- C. National Fire Protection Association (NFPA):
 - 1. 70-17 - National Electrical Code (NEC).
- D. UL LLC (UL):
 - 1. 1-05 - Flexible Metal Conduit.
 - 2. 5-16 - Surface Metal Raceway and Fittings.
 - 3. 6-07 - Electrical Rigid Metal Conduit-Steel.
 - 4. 50-15 - Electrical Equipment, Non-Environmental Considerations.
 - 5. 360-13 - Liquid-Tight Flexible Steel Conduit.
 - 6. 467-13 - Grounding and Bonding Equipment.
 - 7. 514A-13 - Metallic Outlet Boxes.
 - 8. 514B-12 - Conduit, Tubing, and Cable Fittings.
 - 9. 514C-14 - Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers.
 - 10. 651-11 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings.
 - 11. 651A-11 - Schedule 40 and 80 High Density Polyethylene (HDPE) Conduit.
 - 12. 797-07 - Electrical Metallic Tubing-Steel.
 - 13. 1242-06 - Electrical Intermediate Metal Conduit-Steel.
- E. United States Department of Veterans Affairs (VA):
 - 1. VA Construction and Facilities Management (CFM):
 - a. DG OIT - Office of Information & Technology, 2011.
 - b. DM Electrical - Electrical Design Manual, 2015.
 - c. DM Telecom - Telecommunications & Special Telecommunications Systems Design Manual, 2016.
 - d. PRSDM - Physical Resilience Security Design Manual for VA Life-Safety Protected Facilities, 2016.

1.4 SUBMITTALS

- A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

1.5 WARRANTY

- A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."

PART 2 - PRODUCTS

2.1 PRODUCTS - GENERAL

- A. Conduit Size: NFPA 70, but minimum 19.05 mm (1/2 inch), unless otherwise shown on drawings. Where permitted by NFPA 70, 25.40 mm (1 inch) flexible conduit is acceptable for tap connections to recessed lighting fixtures.
- B. Conduit:
1. Rigid galvanized steel: UL 6, ANSI C80.1.
 2. Rigid aluminum: UL 6A, ANSI C80.5.
 3. Rigid intermediate steel conduit (IMC): UL 1242, ANSI C80.6.
 4. Electrical metallic tubing (EMT): UL 797, ANSI C80.3. Maximum 105 mm (4 inch) and only with cable rated maximum 600 Volts.
 5. Flexible galvanized steel conduit: UL 1.
 6. Liquid-tight flexible metal conduit: UL 360.
 7. Direct burial plastic conduit: UL 651 and UL 651A, heavy wall PVC or high-density polyethylene (PE).
 8. Surface metal raceway: UL 5.
- C. Conduit Fittings:
1. Rigid Steel and IMC Conduit Fittings: UL 514B and NEMA FB 1.
 - a. Standard Threaded Couplings, Locknuts, Bushings, and Elbows: Steel or malleable iron materials. Integral retractable type IMC couplings are also acceptable.
 - b. Locknuts: Bonding type with sharp edges for digging into metal wall of an enclosure.
 - c. Bushings: Metallic insulating type, with insulating insert molded or locked into fitting metallic body. Metal or nonmetallic bushing materials are not acceptable.
 - d. Erickson (Union-Type) and Set Screw Type Couplings: Approved for use in concrete to complete conduit run. Provide case-hardened steel set screws with hex head and cup point to firmly seat in conduit wall for positive ground. Do not tighten set screws with pliers.

- e. Sealing Fittings: Threaded cast iron type. Provide continuous drain type sealing fittings to prevent passage of water vapor. In concealed work, install fittings in flush steel boxes with blank cover plates in finish to match other electrical plates in same room.
2. Rigid Aluminum Conduit Fittings:
 - a. Standard Threaded Couplings, Locknuts, Bushings, and Elbows: Malleable iron, steel or aluminum alloy materials, zinc or cadmium plate iron or steel fittings. Maximum 0.4 percent copper permitted in aluminum fittings.
 - b. Locknuts and Bushings: As specified for rigid steel and IMC conduit.
 - c. Set Screw Fittings: Not acceptable for use with aluminum conduit.
 3. Electrical Metallic Tubing Fittings: UL 514B and NEMA FB-1, steel or malleable iron materials.
 - a. Couplings and Connectors: Concrete tight and rain tight, with insulated throats connectors.
 - 1) Provide gland and ring compression type couplings and connectors for conduit sizes 50 mm (2 inches) and smaller.
 - 2) Provide set screw type couplings with four set screws each for conduit sizes over 50 mm (2 inches).
 - 3) Provide case-hardened steel set screws with hex head and cup point to firmly seat in wall of conduit for positive grounding.
 - b. Do not use indent type connectors or couplings.
 - c. Do not use die-cast or pressure-cast zinc-alloy fittings or "pot metal" fittings.
 4. Flexible Steel Conduit Fittings:
 - a. Comply with UL 514B, steel or malleable iron materials.
 - b. Clamp type, with insulated throat.
 5. Liquid-tight flexible metal conduit fittings: UL 514B and NEMA FB-1, steel or malleable iron materials.
 - a. Provide fittings with threaded grounding cone, steel or plastic compression ring, and gland for tightening. Connectors to have insulated throats.

6. Direct Burial Plastic Conduit Fittings:
 - a. Fittings: UL 514C and NEMA TC-3.
 - b. As recommended by conduit manufacturer.
7. Surface Metal Raceway Fittings: As recommended by raceway manufacturer.
8. Expansion and Deflection Couplings:
 - a. Comply with UL 467 and UL 514B.
 - b. Allowable Deflection, Expansion, or Contraction in Any Direction: 19 mm (0.75 inch).
 - c. Allowable Angular Deflection: 30 degrees.
 - d. Include internal flexible metal braid sized to guarantee conduit ground continuity and fault currents according to UL 467 and NFPA 70 tables for ground conductors.
 - e. Jacket: Flexible, corrosion-resistant, watertight, moisture and heat resistant molded rubber material with stainless steel jacket clamps.
- D. Conduit Supports:
 1. Parts and Hardware: Zinc-coat or equivalent corrosion protection.
 2. Individual Conduit Hangers: To suit application, with pre-assembled closure bolt and nut and provisions for receiving hanger rod.
 3. Multiple Conduit (Trapeze) Hangers: Minimum 38 mm by 38 mm (1-1/2 by 1-1/2 inch), 2.8 mm (0.11 inch) thick 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, Junction, and Pull Boxes: UL 50 and UL 514A.
 1. Cast metal where required by NFPA 70 or shown on drawings, and equipped with rustproof boxes.
 2. Sheet Metal Boxes: Galvanized steel, except as otherwise shown on drawings.
 3. Install flush mounted wall or ceiling boxes with raised covers so that front face of raised cover is flush with adjacent finish surface. Install surface mounted wall or ceiling boxes with surface style flat or raised covers.
- F. Wireways: Equip with hinged covers, except where removable covers are shown on drawings.

- G. Warning Tape: Standard, 0.10 mm (4 mil) thick, polyethylene 76 mm (3 inch) wide non-detectable type tape, red with black letters, and imprinted "CAUTION BURIED COMMUNICATIONS CABLE BELOW".

PART 3 - EXECUTION

3.1 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 acceptable. Remove and replace damaged conduits with new undamaged material.
3. Ensure conduit installation does not encroach into ceiling height head room, walkways, or doorways.
4. Cut square with hacksaw, ream, remove burrs, and draw up tight.
5. Mechanically continuous.
6. Independently support conduit at 2400 mm (8 feet) on center. Supports such as suspended ceilings, suspended ceiling supporting members, lighting fixtures, conduits, mechanical piping, or mechanical ducts are not acceptable.
7. Support within 300 mm (1 foot) of changes of direction, and within 300 mm (1 foot) of each enclosure to which connected.
8. Close ends of empty conduit with plugs or caps at rough-in stage to prevent entry of debris, until wires are pulled in.
9. Secure conduits to cabinets, junction boxes, pull boxes and outlet boxes with bonding type locknuts. For rigid and IMC conduit installations, provide locknut inside enclosure, made up wrench tight. Do not make conduit connections to junction box covers.
10. Flashing of roofing membrane penetrations is specified in Section 07 60 00, FLASHING AND SHEET METAL.
11. Aluminum conduits in wet locations are not acceptable.
12. Unless otherwise indicated on drawings or specified, install conduits concealed within finished walls, floors and ceilings.

B. Conduit Bends:

1. Make bends with standard conduit bending machines.
2. Conduit hickey is acceptable for slight offsets, and for straightening stubbed out conduits.
3. Bending of conduits with pipe tee or vise is not acceptable.

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 proposed deviations have been submitted to and approved by Contracting Officer's Representative (COR).

D. Fire Alarm:

1. Paint fire alarm conduit red (red "top-coated" conduit from conduit manufacturer is acceptable in lieu of painted conduit) as specified in Section 28 31 00, FIRE DETECTION AND ALARM.

3.2 CONCEALED WORK INSTALLATION

A. In Concrete:

1. Conduit: Rigid steel, IMC or EMT. Do not install EMT in concrete slabs in contact with soil, gravel or vapor barriers.
2. Align and run conduit in direct lines.
3. Install conduit through concrete beams only when the following occurs:
 - a. Where shown on structural drawings.
 - b. Approved by COR before construction and after submission of drawing showing location, size, and position of each penetration.
4. Do not install conduit in concrete less than 75 mm (3 inches) thick.
 - a. Conduit outside diameter larger than 1/3 of slab thickness is prohibited.
 - b. Space between Conduits in Slabs: Approximately six conduit diameters apart, except one conduit diameter at conduit crossings.
 - c. Install conduits approximately in center of slab so there will be minimum 19 mm (3/4 inch) of concrete around conduits.
5. Install couplings and connections watertight. Provide UL approved conductive type thread compounds to ensure low resistance ground continuity through conduits. Do not tighten set screws with pliers.

B. In Furred or Suspended Ceilings and Walls:

1. Conduit for conductors above 600 Volts:
 - a. Rigid steel or rigid aluminum.

- b. Aluminum conduit mixed indiscriminately with other types in same system is not acceptable.
2. Conduit for conductors 600 Volts and below:
 - a. Rigid steel, IMC, rigid aluminum, or EMT. Different type conduits mixed indiscriminately in same system is not acceptable.
3. Align and run conduit parallel or perpendicular to building lines.
4. Connect recessed lighting fixtures to conduit runs with maximum 1800 mm (6 feet) of flexible metal conduit extending from junction box to fixture.
5. Do not tighten set screws with pliers.

3.3 EXPOSED WORK INSTALLATION

- A. Unless otherwise indicated on drawings, exposed conduit is only permitted in mechanical and electrical rooms.
- B. Conduit for Conductors above 600 Volts:
 1. Rigid steel or rigid aluminum.
 2. Aluminum conduit mixed indiscriminately with other types in same system is not acceptable.
- C. Conduit for Conductors 600 Volts and below:
 1. Rigid steel, IMC, rigid aluminum, or EMT. Different type of conduits mixed indiscriminately in system is not acceptable.
- D. Align and run conduit parallel or perpendicular to building lines.
- E. Install horizontal runs close to ceiling or beams and secure with conduit straps.
- F. Support horizontal or vertical runs at maximum 2400 mm (8 foot) intervals.
- G. Surface metal raceways: Provide only where shown on drawings.
- H. Painting:
 1. Paint exposed conduit as specified in Section 09 91 00, PAINTING.
 2. Paint conduits containing cables rated over 600 Volts safety orange. Refer to Section 09 91 00, PAINTING for preparation, paint type, and exact color. Paint legends with 50 mm (2 inch) high black numerals and letters, showing cable Voltage rating. Provide legends where conduits pass through walls and floors and at maximum 6000 mm (20 foot) intervals in between.

3.4 EXPANSION JOINTS

- A. Provide expansion and deflection couplings for conduits 75 mm (3 inches) and larger, secured to building structure on opposite sides of building expansion joint. Install couplings according to manufacturer's instructions.
- B. Provide conduits smaller than 75 mm (3 inches) with junction boxes on both sides of expansion joint. Connect conduits to junction boxes with sufficient flexible conduit slack to produce 125 mm (5 inch) vertical drop midway between ends. Install copper green ground bonding jumper at flexible conduit. Expansion and deflection couplings as specified above for 375 mm (15 inches) and larger conduits are also acceptable.
- C. Install expansion and deflection couplings where shown on Drawings.

3.5 CONDUIT SUPPORT INSTALLATION

- A. Safe Working Load: Maximum 1/4 of fastening devices proof test load.
- B. Provide pipe straps or individual conduit hangers to support individual conduits with 2.5 m (8 foot) on center maximum distance between supports.
- C. Support multiple conduit runs with trapeze hangers. Provide trapeze hangers designed to support load equal to or greater than sum of conduit weights, wires, hanger itself, and 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: Steel or malleable iron concrete inserts set in place before concrete placement.
 - 2. Existing Construction:
 - a. Steel expansion anchors minimum 6 mm (1/4 inch) bolt size and minimum 28 mm (1-1/8 inch) embedment.
 - b. Power set fasteners minimum 6 mm (1/4 inch) diameter with depth of penetration minimum 75 mm (3 inches).
 - c. Provide 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: Provide machine screw fasteners or other devices, designed and approved for application.
- I. Attachment by wood plugs, rawl plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is not acceptable.
- J. Chain, wire, or perforated strap to support or fasten conduit is not acceptable.
- K. Spring steel type supports or fasteners are not acceptable except as horizontal and vertical supports/fasteners within walls.
- L. Vertical Supports: Provide riser clamps and supports at vertical conduit runs according to NFPA 70 and as shown on drawings. Provide cable and wire supports with fittings that include internal wedges and retaining collars.

3.6 BOX INSTALLATION

- A. Boxes for Concealed Conduits:
 - 1. Flush mounted.
 - 2. Provide raised covers for boxes to suit wall or ceiling, construction and finish.
- B. In addition to boxes shown on drawings, install additional boxes where required to prevent damage to cables and wires during pulling in operations.
- C. Remove knockouts only as required and plug unused openings. Provide threaded plugs for cast metal boxes and snap-in metal covers for sheet metal boxes.
- D. Back-to-back outlet boxes in same wall are not acceptable. Maintain minimum 600 mm (24 inches), center-to-center lateral spacing between boxes.
- E. Minimum outlet box for ground fault interrupter (GFI) receptacles: 100 mm (4 inches) square by 55 mm (2-1/8 inches) deep, with device covers coordinated with wall material and thickness.
- F. Stencil or install phenolic nameplates on box covers identified on riser diagrams; for example "SIG-FA JB No. 1".
- G. Identify circuits on branch circuit junction box covers with black marker.

3.7 COMMUNICATION AND ELECTRONIC SAFETY AND SECURITY SYSTEM CONDUIT

- A. Install communication raceway system as shown on drawings.

- B. Minimum Conduit Size: 19 mm (3/4 inch), but minimum size shown on drawings.
- C. Equip conduit ends with insulated bushings.
- D. Provide pull boxes after every two 90-degree bends at 100 mm (4 inch) conduits within buildings. Size boxes according to NFPA 70.
- E. Terminate vertical conduits/sleeves through closet floors minimum 75 mm (3 inches) below floor and minimum 75 mm (3 inches) below ceiling of floor below.
- F. Terminate conduit runs to and from closet backboard or interstitial space at top or bottom of backboard. Conduits to enter communication closets next to wall and be flush with backboard.
- G. Where drilling is required for vertical conduits, locate holes where approved in structural sections, such as ribs or beams.
- H. Seal empty conduits located in communication closets or on backboards with standard non-hardening duct seal compound to prevent moisture and gas entry and to meet fire resistance requirements.
- I. Maximum four quarter turns (90-degree bends) are permitted in conduit runs between pull boxes/backboards. Minimum communication conduit bend radius as follows (special long radius):

| 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) |

- J. Provide 19 mm (3/4 inch) thick fire retardant treated plywood specified in Section 06 10 00, ROUGH CARPENTRY on communication closet walls where shown on drawings. Install plywood with bottom edge 300 mm (1 foot) above finished floor.
- K. Provide and pull wire in empty conduits, except through floor sleeves.

3.8 FIRESTOPPING

- A. Firestopping: Where conduits, wireways, and other communications and electronic safety and security raceways pass through fire partitions, fire walls, smoke partitions, or floors, install fire stop that provides an effective barrier against spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING, with only rock wool fiber or silicone foam sealant. Completely fill and seal clearances between raceways and openings with fire stop material.

3.9 WATERPROOFING

- A. Waterproofing: At floor, exterior wall, and roof conduit penetrations, completely seal clearances around conduit and make watertight as specified in Section 07 92 00, JOINT SEALANTS.

3.10 CLEANING

- A. Remove and legally dispose of debris and excess material from project site.

- - - E N D - - -

SECTION 27 08 00
COMMISSIONING OF COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The requirements of this Section apply to all sections of Division 27.
- 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 REQUIREMENTS. A Commissioning Agent (CxA) appointed by the VA will manage the commissioning process.

1.2 RELATED WORK

- A. Section 01 00 01 GENERAL REQUIREMENTS (MAJOR NCA PROJECTS)
- B. Section 01 00 02 GENERAL REQUIREMENTS (MINOR NCA PROJECTS).
- C. Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.
- D. Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

1.3 SUMMARY

- A. This Section includes requirements for commissioning the Facility communications 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 27 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 27, 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 Communications systems will require inspection of individual elements of the communications system 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 communications 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 27 shall be scheduled and documented in accordance with Section 01 00 00 GENERAL REQUIREMENTS. All testing shall be incorporated into the project schedule. Contractor shall provide no less than 7 calendar days' notice of testing. The Commissioning Agent will witness selected Contractor tests at the sole discretion of the Commissioning Agent. Contractor tests shall be completed prior to scheduling Systems Functional Performance Testing.

3.4 SYSTEMS FUNCTIONAL PERFORMANCE TESTING:

- A. The Commissioning Process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions. The Commissioning Agent will prepare detailed Systems Functional Performance Test procedures for review and approval by the Resident Engineer. The Contractor shall review and comment on the tests prior to approval. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The Commissioning Agent will witness and document the testing. The Contractor shall sign the test reports to verify tests were performed. See Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS, for additional details.

3.5 TRAINING OF VA PERSONNEL

- A. Training of the VA operation and maintenance personnel is required in cooperation with the Resident Engineer and Commissioning Agent. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. Contractor shall submit training agendas and trainer resumes in accordance with the requirements of Section 01 91 00.

Black Hills National Cemetery
Renovate and Expand Administration and Maintenance Buildings
20901 Pleasant Valley Drive
Sturgis, SD 57785

NCA Project # 884CM3015
10/31/22
Bid Documents

The instruction shall be scheduled in coordination with the VA Resident Engineer after submission and approval of formal training plans. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS and Division 27 Sections for additional Contractor training requirements.

----- END -----

**SECTION 27 10 00
STRUCTURED CABLING**

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. New state of the art fully functioning Telecommunications Infrastructure Plant (TIP) Structured Cabling System (TIP-SCS) installed in VA's National Cemetery (NCA) Black Hills to regulate communication signals to restricted buildings, building areas, and fenced areas. Project Number: 884CM3015.
2. System includes voice, data, and signal communication signals to provide a comprehensive telecommunications and electronic safety and security communication systems.
3. See Section 27 05 00, COMMON WORK RESULTS FOR COMMUNICATIONS for requirements governing work of this section.

1.2 RELATED REQUIREMENTS

- A. General electrical requirements common to more than one Division 27 section: Section 27 05 00, COMMON WORK RESULTS FOR COMMUNICATIONS.
- B. General electrical requirements that are common to more than one Division 27: Section 27 05 00, COMMON WORK RESULTS FOR COMMUNICATIONS.
- C. Electrical Power Wiring: Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- D. Electrical Power Conductors: Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW).
- E. Electrical Power System Grounding: Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
- F. Electrical Power System: Section 26 05 33, RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS and Section 26 27 26, WIRING DEVICES.
- G. Lightning Protection: Section 26 41 00, FACILITY LIGHTNING PROTECTION.
- H. Communications System: Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS, Section 27 05 33, CONDUITS AND BACKBOXES FOR COMMUNICATIONS SYSTEMS, and Section 27 15 00, COMMUNICATIONS HORIZONTAL CABLING.
- I. Alarm Systems: Section 28 31 00, INTRUSION DETECTION.
- J. Control Systems: Section 28 10 00, ACCESS CONTROL (PACS) SYSTEM.

- K. CFM Telecommunications and Special Telecommunications Design Manual (TDM).
- L. CFM Electrical Design Manual (EDM).

1.3 APPLICABLE PUBLICATIONS

- A. Comply with references to extent specified in this section.
- B. American National Standards Institute/Telecommunications Industry Association (ANSI/TIA):
 - 1. 568-D-15 - Generic Telecommunications Cabling for Customer Premises.
 - 2. 568-D.1-15 - Commercial Building Telecommunications Infrastructure Standard.
 - 3. 568-D.2-15 - Balanced Twisted-Pair Telecommunication Cabling and Components Standard.
 - 4. 568-D.3-15 - Optical Fiber Cabling Components Standard.
 - 5. 569-C-12 - Commercial Building Standard for Telecommunications Pathways and Spaces.
- C. Building Industry Consulting Service International, Inc. (BICSI™).
 - 1. Electronic Safety and Security Design Reference Manual.
 - 2. Information Technology Systems Installation Methods Manual.
 - 3. Outside Plant Design Reference Manual.
 - 4. Registered Communications Distribution Designer (RCDD) requirements.
 - 5. Telecommunications Distribution Methods Manual.
 - 6. ANSI/BICSI 005 - Electronic Safety and Security (ESS) Systems Design and Implementation Best Practices (2015).
 - 7. NECA/BICSI 607 - Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Building (2011).
- D. Government Accountability Office (GAO):
 - 1. 03-8-02-Security Responsibilities for Federally Owned and Leased Facilities.
- E. Institute of Electrical and Electronics Engineers (IEEE):
 - 1. C62.41.1-2002 - IEEE Guide on the Surge Environment in Low-Voltage (1000 V and less) AC Power Circuits.
 - 2. 802.3af-08 - IEEE Standard for Information Technology.
- F. National Fire Protection Association (NFPA):
 - 1. 70-17 - National Electrical Code (NEC).
- G. Telecommunications Industry Association(TIA):

- H. 232-F - Interface Between Data Terminal Equipment and Data
Circuit-Terminating Equipment Employing Serial Binary Data UL LLC (UL):
 - 1. Listed - Online Certifications Directory.
- I. United States Access Board (USAB):
 - 1. ABA - Architectural Barriers Act Accessibility Standards.
- J. United States Department of Veterans Affairs (VA):
 - 1. VA Construction and Facilities Management (CFM):
 - a. DG OIT - Office of Information & Technology, 2011.
 - b. DM Electrical - Electrical Design Manual, 2015.
 - c. DM Telecom - Telecommunications & Special Telecommunications
Systems Design Manual, 2016.
 - d. PRSDM - Physical Resilience Security Design Manual for
VA Life-Safety Protected Facilities.
 - 2. VA Office of Security and Law Enforcement (SLA):
 - a. Directive 0730-12 - Security and Law Enforcement.
 - b. VA Office of Information and Technology (OI&T):
 - 1) Handbook 6330-93 - Directives Management Procedures.
 - 2) Handbook 6500-15 - Risk Management Framework for VA Information
Systems - Tier 3: VA Information Security Program.

1.4 SUBMITTALS

- A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND
SAMPLES.

1.5 WARRANTY

- A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. TIP Integration:
 - 1. Designed and date stamped by approved BICSI RCDD.
 - 2. Install and test with manufacturer guidance.
 - 3. Acceptance tested and commissioned by AHJ SMCS 07A2.

- B. TIP: Standalone, local access controls in preparation to connected to remote VA Medical Center central station providing system connections and functions at a later date.
 - 1. Protocol: Provide FTS, LEC, service providers, internet, LAN, WAN, FMS, OI&T, interconnect capability including addressable, and programmable signals.
 - 2. Interface: Active and passive TIP hardware via VA FTS and Telco Tie Lines or current federal communications media.
- C. System Components Includes:
 - 1. Interface cabinet for hard wired existing system extension.
 - 2. Head end cabinet for standalone system.
 - 3. Control and communications panels.
 - 4. Connect Card readers at restricted access entry points.
 - 5. TIP network design Includes:
 - a. Door position indicators.
 - b. Portal control devices.
 - c. Entry control devices.
 - d. Electronic door hardware.
 - e. FMS & OI&T Power supplies.
 - f. FMS & OI&T power and control wiring, raceways, and grounding.
- D. TIP Network Design Includes Access Control Locations:
 - 1. Administration Building:
 - a. Employee/public entrances.
 - b. Secure designated records storage.
 - c. Telephone, MCR, and telecom rooms.
 - d. Electrical rooms.
 - e. Weapons storage room.
 - f. Specific interior locations as shown on the project drawings.
 - 2. Maintenance Building:
 - a. Main building entry.
 - b. Specific interior locations as shown on the project drawings.
 - 3. Other Facilities:
 - a. Water storage and water well areas where applicable.
 - b. Specific interior locations as shown on the project drawings.
 - 4. Comply with manufacturer requirements for correct system operations. Ensure system integration computers meet or exceed system software minimum system requirements.

2.2 SYSTEM PERFORMANCE

- A. TIP system and system components complying with specified site performance.
 - 1. Duty Rating: Continuous service.
 - 2. Totally functional, without degradation, to host or secondary control/management systems. If found not compliant with host facility systems, immediately contact Contracting Officer's Representative (COR) for directions.

2.3 EXISTING WIRING

- A. Existing wiring is not acceptable for reuse for new installations, unless otherwise indicated by contract approved MOU cited in the system specifications and on the drawings. If indicated, only wiring that complies with specifications and applicable codes may be reused.

2.4 WIRE AND CABLES

- A. Power Cables:
 - 1. Rated for either 110 or 220 VAC, 50 or 60 Hz, and complying with Section 26 05 21, LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW).
 - 2. Sized according and complying with NFPA 70. High voltage power cables to be minimum three conductors, 2 sq. mm (14 AWG), stranded, and coated with non-conductive polyvinylchloride (PVC) jacket.
- B. Low Voltage Power Cables:
 - 1. Minimum 0.8 sq. mm (18 AWG), stranded with polyvinylchloride outer jacket.
 - 2. Determine specific cable size using basic voltage over distance calculation and comply with NFPA 70 low voltage cable requirements.

2.5 CONTROL WIRING

- A. Control Wiring: 2 sq. mm (14 AWG) wire size, unless otherwise indicated.
- B. Size control wiring large enough so Voltage drop under inrush conditions does not adversely affect controls operation.

2.6 COMMUNICATION AND SIGNAL WIRING

- A. Communication and Signal Wiring: Minimum shown on drawings and as recommended by communication and signal systems manufacturer.

B. Typical system wiring is shown on drawings and described herein. Provide wiring as required for systems being provided.

C. Color code multi-conductor cables conductors.

2.7 UNSHIELDED TWISTED PAIR (UTP) CATEGORY 6

A. IEEE 802.3af 100BaseT UTP Level 6, 0.2 sq. mm (24 AWG) plenum rated cable grade.

2.8 OPTICAL FIBER CABLE

A. Single-mode Fiber:

1. Core Diameter: 7 - 9 microns.
2. Cladding Diameter: 125 microns.
3. Buffer diameter: 250 microns.
4. Proof Test: Minimum 50 kpsi.
5. Numerical Aperture: 0.11.
6. Attenuation: Maximum 0.5dB/Km at 1310 nm and 0.4dB/km at 1550 nm.

B. Termination: Make Single-mode terminations with SC connectors.

2.9 TCO OUTLETS

A. Outlets: BICSI IDC jacks meeting or exceeding Category 6 operational specification.

2.10 WIRE LUBRICATING COMPOUND

A. Wire Lubricating Compound: Compatible with wire insulation and conduit; non-hardening non-adhering. Not acceptable for use on wire for isolated type electrical power systems.

2.11 TAPES

A. Fireproofing Tape: Flexible, conformable fabric tape coated one side with flame-retardant elastomer.

1. Self-extinguishing and will not support combustion, arc-proof and fireproof.
2. Will not deteriorate when exposed to water, gases, salt water, sewage, or fungus and is resistant to sunlight and ultraviolet light.
3. Application capable of withstanding 200-ampere arc for minimum 30 seconds.

B. Securing Tape: Glass cloth electrical tape minimum 0.18 mm (7 mils) thick and 19 mm (3/4 inch) wide.

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 unused TIP wires and cables at COR's direction.

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.
- B. Conduits:
 1. Size and install conduits according to NFPA 70.
 - a. Wire Fill: Maximum 50 percent of conduit capacity, unless otherwise indicated.
 2. Clearly label conduit, pull boxes, and junction boxes with colored permanent tape or paint to distinguish from other conduit and infrastructure.
 3. Install non-metallic pull rope with signal and power cables to assist in future work.
- C. Raceway Penetrations:
 1. Enter control panels through panel bottom.
 2. Seal penetrations located outdoors. Seal penetrations through building exterior enclosure.
 3. Firestop penetrations through fire rated assemblies. See Section 07 84 00, FIRESTOPPING.
 4. Terminate conduit riser in hot dip galvanized metal cable terminator. Fill terminator with sealant recommended by cable manufacturer.
- D. Wires and Cables:
 1. Install wiring in enclosed conduit system, utilizing electromagnetic tubing (EMT), equivalent in flexible metal, rigid galvanized steel (RGS), and equivalent of liquid tight, polyvinylchloride (PVC) Schedule 40 or 80.
 - a. Splice cables and wires in outlet boxes, junction boxes, or pull boxes.

- b. Seal cable and wire entering a building from underground, between wire and conduit where cable exits conduit, with non-hardening approved compound.
 2. Wire Pulling:
 - a. Prevent cutting and abrading insulation during wire installation.
 - b. Install wire using nonmetallic pull ropes.
 - c. Attach wires to pull ropes with woven basket grips or pulling eyes attached directly to conductors.
 - d. Pull multiple cables together through each conduit.
 3. Terminate wires, including spare future capacity wires, at both ends with documentation, labeling and test results provided.
 4. Install security system signal and power cables that traverse or originate in high security office space in either EMT or RGS conduit.
 5. Install power wiring greater than 30 Volt DC and 30 Volt AC and signal cables in separate conduits.
- E. Install surge protection for cables and conductors, except fiber optic cables acting as area control, communication, and signal lines. Locate surge protection at equipment end and additional triple electrode gas surge protectors rated for application on each wire line circuit within 1 m (3 feet) of building cable entrance. Test inputs and outputs in both normal and common mode using the following wave forms:
 1. 10 microsecond rise time by 1000 microsecond pulse width waveform with peak voltage of 1500 volts and peak current of 60 Amperes.
 2. 8 microsecond rise time by 20 microsecond pulse width wave form with peak voltage of 1000 volts and peak current of 500 Amperes.
- F. Protect equipment connected to AC power from surges. Equipment protection to withstand surge test waveforms described in IEEE C62.41.1. Fuses are not acceptable to provide surge protection.

3.3 CONDUIT AND SIGNAL DUCTS

- A. Conduit:
 1. Minimum Conduit Size: 25 mm (1.25 inch) diameter for primary signal distribution and 25 or 19 mm (1 or 3/4 inch) for remote connections.

2. Install cables in separate conduit and signal ducts. Install conduit according to Section 27 05 33, CONDUITS AND BACKBOXES FOR COMMUNICATIONS SYSTEMS.

B. Signal Duct or Cable Duct:

1. Use existing signal duct, cable duct, and cable tray only when approved by COR.
2. Signal and Cable Duct: Minimum 100 mm by 100 mm (4 inch by 4 inch) inside dimensions with removable tops or sides, as required. Provide protective sleeves, guides, or barriers on sharp corners, openings, anchors, bolts, or screw ends, junction, interface and connection points.
3. Cable Tray: Fully covered, mechanically and physically partitioned for multiple electronic circuit use and UL certified and labeled for telecommunication circuits and systems. Obtain technical approval in writing from Spectrum Management and Communications Security (SMCS) 0050P2H3.
 - a. Dimensions: Width and height as approved by COR.
4. Do not pull wires and cables through boxes, fittings, or enclosures where change in alignment and direction occurs. Provide bend radius for each wire and cable according to manufacturer's instructions to change alignment and direction.
5. Protect wire and cable from excessive tension and damaging bending during installation by temporary guides, sheaves, rollers, and other approved means. Abrasion to wire or cable jacket is not acceptable. Replace abraded cable jackets. Discovery of abraded and damaged cables during proof of performance test will be grounds for rejecting individual telecommunication system. Completely cover edges of wire or cable pass through holes in chassis, cabinets or racks, enclosures, pull or junction boxes, and conduit with plastic or nylon grommeting.
6. Provide accessible cable junctions and taps. Do not install junction blocks, multi distribution connections or other distribution equipment (active or passive) items inside signal ducts.

Provide minimum 150 mm by 150 mm by 100 mm (6 inch by 6 inch by 4 inch) covered junction box attached to signal duct fixed side for distribution system passive equipment installation (see detail drawing). Provide accessible equipment and connection assembly junctions.

3.4 DISTRIBUTION SYSTEM SIGNAL WIRES AND CABLES (TIP)

- A. Install and protect wires and cables to comply with NFPA 70, able to withstand any adverse environmental conditions in their respective locations without deterioration. Wires and cables to enter equipment enclosures, consoles, cabinets or racks so doors or access panels open and close without removing or disturbing cables.
- B. Routing and Interconnection:
 - 1. Fully capable and compliant with Facility's (local or remote) TIP and not degrade operation of local, remote, or host facility's TIP when connected.
 - 2. Install wires or cables between consoles, cabinets, racks, and other equipment in approved conduit, signal duct, cable duct, or cable tray secured to solid building construction.
 - 3. Insulate wires and cables to prevent contact with signal or current carrying conductors and shield 100 percent. Form wires or cables used in assembling consoles, panels, equipment cabinets and racks into harnesses, bundled and tied. Comb straight, form, and dress harnessed wires or cables in either vertical or horizontal relationship to equipment, controls, components or terminations.
 - 4. Tie off harnesses with intertwined members termination at harness or bundle point with ample, neatly formed service loop.
 - 5. Group wires and cables according to service, such as AC, grounds, signal, bundle and tied off in 600 to 900 mm (24 to 36 inch) lengths. Maintain position in group throughout run. Concealed splices are not acceptable.
 - 6. Separate, organize, bundle, and route wires or cables to restrict channel cross-talk or feedback oscillation inside enclosures.
 - a. Looking at enclosures from rear:
 - 1) Locate AC power, DC, and speaker wires and cables on left.
 - 2) Locate coaxial, control, microphone, and line level audio and data wires and cables on right.

- 3) Locate DC, control and signal cables may be included with any group.
 - b. Form wires and cables neatly and maintain position in group throughout conduit run.
 - c. Neatly form wires and cables in approved signal duct, conduit, cable ducts, or cable trays, with cables on right.
 - d. Install wires and cables with ties and fasteners that will not damage or distort wires or cables.
 - e. Limit spacing between tied off points to maximum 150 mm (6 inches).
7. Install and fasten distribution cables without sharp bends or rubbing cables against sharp edges. Fasten cables with hardware which will not damage or distort them. "O" rings, "U" clamps or other types of hangers are not acceptable.
8. Label cables with permanent markers at electronic and passive equipment terminals and at each system junction point. Cable labels to correspond to as-installed diagram lettering.
9. Test cables after installation and replace defective cables.
10. Provide system input and output polarity according to manufacturer's instructions. Ensure each color coded wire or cable is connected and terminated to maintain system polarity to same quality as professional audio systems. Indicate color codes, wire and cable terminations on system as-installed drawings.

3.5 OUTLET BOXES, BACK BOXES, AND FACEPLATES

- A. Outlet Boxes: Provide signal, power, interface, connection, distribution, and junction boxes as required by system design, on-site inspection, and drawings.
 1. See CFM's TDM for TCO outlet and cover specifics.
- B. Back Boxes: Provide back boxes according to manufacturer's instructions as required by approved system design, on-site inspection, and drawings.
- C. Face-plates (or Cover Plates): Standard type, stainless steel, anodized aluminum or UL approved cycolac plastic construction. Clearly and permanently mark connectors and jacks appearing on faceplates.

3.6 CONNECTORS

- A. Provide circuits, transmission lines and signal extensions with continuity, correct connection, and polarity. Maintain polarity between points in system:
- B. Wires:
 - 1. Neatly form wire ends and, where insulation has been cut, provide heat shrink tubing to secure insulation on each wire. No tape will be permitted.
 - 2. Install audio spade lugs on each wire (including spare or unused) end and connect to screw terminals of appropriate size barrier strips. Provide AC barrier strips with protective cover to prevent accidental contact with wires carrying live AC current. Punch blocks are approved for signal wires, but not AC wires. Wire nut and Scotchlok connectors are not acceptable for signal wire installation.
- C. Cables: Coordinate each connector with cable size and install with manufacturer's approved installation tool. Typical system cable connectors include, but are not limited to, audio spade lug, punch block, and wire-wrap.

3.7 AC POWER

- A. Connect AC circuits which supply power to system to Facility's designated Critical Branch Emergency AC panel board and indicate on panel board directory circuits that supply power to system.
- B. Provide 120 Volt AC branch circuit, wired to separate breaker, from designated power panel to minimum quad receptacle mounted inside each equipment rack or cabinet in conduit and according to NFPA 70 for Critical Branch Emergency and Life Safety Systems.
- C. Install AC power outlet convenient to each equipment item inside equipment rack or cabinet. Extension or "pig tail" non-protected cords from system cabinet or rack to system wall outlet are not acceptable and, will be grounds to declare entire system defective.
- D. Run AC power wiring separately from signal cable.

3.8 SPLICE INSTALLATION

- A. Mechanically and electrically secure splices and terminations.

- B. Where Government determines that unsatisfactory splices or terminations have been installed, remove devices and install approved devices at no additional cost to Government.

3.9 CONTROL, COMMUNICATION AND SIGNAL WIRING INSTALLATION

- A. Unless otherwise specified, install wiring and connect to equipment and devices to perform required functions as shown on drawings and specified.
- B. Except where otherwise required, install separate power supply circuit for each system so malfunctions in any system will not impact other systems.
- C. Where separate power supply circuits are not shown on drawings, connect systems to nearest panelboards of suitable voltages, which are intended to supply such systems and have suitable spare circuit breakers or space for installation.
- D. Install red warning indicator on branch circuit breaker handle for power supply circuit for each system to prevent accidental de-energizing of systems.
- E. System Voltages: 120 Volts or lower where shown on drawings or as required by NFPA 70.

3.10 CONTROL, COMMUNICATION AND SIGNAL SYSTEM IDENTIFICATION

- A. Install permanent wire marker on each wire at each termination.
 - 1. Markings: Permanent and legible after cleaning.
- B. Label wires with identifying numbers and letters on wire markers matching identification on wiring diagrams used for installing systems.
- C. In each handhole, install embossed brass tags to identify system served and function.

3.11 NETWORK EQUIPMENT

- A. Active network equipment shall not be part of the project, unless, requested item is approved by A/E to insure project cost accountability code is fully identified and not overspent.
- B. VA Quantico Regional Processing Center must approve installation and removal of network hardware equipment. Perform such work only with prior approval from VA Quantico Regional Processing Center.
- C. Each aforementioned suggested equipment item must be approved by the Facility OI&T Service for acceptability.

3.12 NETWORK EQUIPMENT ENVIRONMENT

- A. Locate punch down areas (location of data communication racks) where shown on drawings and where directed by A/E and VA Quantico Regional Processing Center.
- B. Provide the following:
 - 1. 1000BaseT, Category 6 certified rack-mounted modular RJ45 punch down block/panel (24/48 ports) for jacks meeting ANSI/EIA/TIA 568-D category 6 standards.
 - 2. 480 mm wide by 2100 mm high (19 inch wide by 84 inch high) steel data communication rack with three rack mounted cantilever shelves 480 mm wide by 450 mm deep (19 inches wide by 18 inches deep).
 - 3. Heavy-duty power strip (minimum 5 outlets) with surge suppression.
- C. Provide jacks on punch down block/panel corresponding to jacks at wall device faceplate.
- D. Where network equipment is located in secure room or large closet, provide dry powder extinguisher, suitable for electrical fires, within room. Provide adequate ventilation by method that does not compromise closet or room security.

3.13 NETWORK CONFIGURATION RESTRAINTS

- A. Segment comprises four pair Category 6 cable.
- B. Connect pin to one wire.
- C. Maximum Link Length: 90 m (295 feet).
- D. Maximum Channel Length: 100 m (328 feet).
- E. Maximum Number of Stations Per Segment: 1.

3.14 CABLING SYSTEM INSTALLATION - GENERAL

- A. Provide cable and connecting hardware meeting or exceeding Category 6 specifications, with pairs terminated according to ANSI/EIA/TIA T568-D wiring scheme.
- B. Provide complete cabling system including patch panels, horizontal cables, transition blocks, vertical cabling, modular jacks, system cables, patch cables, cable management, and comprehensive labeling system.

3.15 TCO OUTLETS

- A. Minimum of 2 TCO outlets.
 - 1. Top: 1 or 2 voice outlets.
 - 2. Middle: 1 or 2 data outlets.

3. Bottom: up to 2 blank outlet sockets with covers.
- B. Legibly label each jack at wall device faceplate corresponding to patch panel jack label.
- C. Conform to TDM and OI&T DG.
- D. Minimum number of UTP outlets to be installed in each type of workspace:
 1. Framed Partition Construction: Provide flush-mounted single-gang outlet boxes with two-port base plates and applicable wall device faceplates with cable installed behind gypsum board.
 2. Masonry and Concrete and Existing Wall Construction: Provide surface-mounted single-gang outlet boxes with two-port base plates and applicable wall device faceplates and cable installed in plastic wall mold equipped with protective insulator or sleeve.
 3. Modular Furniture: Locate data outlet in furniture baseboard, where networked equipment, such as computers, printers, and other devices, will be located. Provide flush-mounted single gang outlet boxes with two-port base plates and applicable wall device faceplates. If flush-mounted single-gang outlet boxes cannot be used, provide modular surface mount boxes with two-port inserts. Install cable runs in modular furniture through furniture wire baseboard ducts/conduit.

3.16 HORIZONTAL CABLING

- A. Horizontal Wiring: Star topology connecting each network outlet jack to jack on patch panel rack in communications enclosure or room.
- B. Cable: Unshielded twisted pair.

3.17 CABLE INSTALLATION

- A. Install cable interconnecting network outlet to patch panel in one continuous length with no intermediate joins, splices or taps.
- B. Terminate cables on horizontal distribution panel or patch panel to permit additional cables to be terminated without disturbing previously installed cables.
- C. Provide two cable runs for each data outlet and device location terminating in punch down block or panel at punch down area. Maximum 24 cables may be cable tied together.

- D. Leave 2 m (6 feet) loop of cable within or on approach to each communications room and enclosure to facilitate cable future re-termination. Coil and support cable slack neatly and practically.
- E. Leave 0.5 m (20 inches) loop of cable in trunking approach to each network outlet to facilitate cable future re-termination. Terminate wire pair with maximum 13 mm (1/2 inch) untwisting at termination to connecting hardware.
- F. Install cables bends with minimum eight times cable diameter or as specified by cable manufacturer, whichever is greater. Install cable without stress caused by tension in suspended cable runs and tightly strapped bundles.
- G. Cable bundles are not acceptable to rub on, or be unduly compressed against, any building infrastructure, building equipment, cable tray, equipment racking, or other cable support.
- H. Cable bundles are not acceptable to obstruct installation and removal of equipment in equipment racks.
- I. Provide the following minimum separations where UTP cables are run parallel with electrical cables:

| Circuit Rating Unshielded Power and Data | | Shielded Power and Data |
|--|------------------------|-------------------------|
| Less than 1 KVA | 300 mm (12 inches) | 25 mm (1 inch) |
| 1 KVA to 2 KVA | 450 mm (18 inches) | 50 mm (2 inches) |
| 2 KVA to 5 KVA | 600 mm (24 inches) | 150 mm (6 inches) |
| Greater than 5 KVA | 1500 mm (60 inches) | 300 mm (12 inches) |

- J. Minimum 1 m (39 inches) separation where UTP cables are run in proximity of electrical motors or transformers.
- K. Where minimum distances specified above cannot be applied due to lack of available space, enclose data cables in rigid or flexible steel conduit. Bond conduit to ground. Provide continuity to ground at steel cabling enclosure material installations.

3.18 PATCH CABLES

- A. Copper Patch Cable: Unshielded twisted pair.
- B. Fiber Patch Cable: Same type, single mode, used to connect buildings.
- C. Terminate each patch lead in RJ45 connectors (male) meeting or exceeding Category 6 specification.
- D. Provide one 2 m (6 feet) long copper patch cable with RJ45 connectors (male) for every cable run installed into patch panel to allow connectivity between patch panel and VA supplied switch.
- E. Provide one 7.5 m (25 feet) long copper patch cable with RJ45 connectors (male) for every cable run terminated at user and device work location to allow connectivity from networked device, such as computer, printer, and other devices, to wall jack.
- F. Provide two 7.5 m (25 feet) long fiber patch cables with SC connectors. Mode to match type connecting building. Cables allow connectivity from fiber demarcation point to switch. Ensure fiber demarcation point is within this distance to switch.

3.19 INTER-BUILDING CABLING

- A. Connecting Maintenance and Other Local Buildings With Administration Building:
 - 1. Maximum Distance Between Cable Terminations:
 - a. Less than 100 m (328 feet): Use unshielded twisted pair.
 - b. Greater than 100 m (328 feet): Use single-mode 6 strand 8 by 125 micron fiber optic cable.
 - 2. Install minimum 6 strands fiber optic cable in conduit. Terminate fiber at both ends in a fiber termination box with SC connectors. Install bends with long radius conduit.
 - 3. Fiber Optic Cable Hardware: VA Quantico Regional Processing Center will supply Cisco Catalyst Switch for installation by Contractor on an approval basis. Contact COR to arrange delivery.
 - a. Single-mode:
 - 1) SMF uplink Single-mode Fiber 8.3 by 125 microns SC Connectors
 - b. Option: 2950G-24 with SX uplink 220m (gigabit).
 - 4. Provide minimum 25 pair Cat 5e TWP cable, in underground conduit, between each building and terminated as described herein.
 - 5. Provide minimum pairs strands in underground conduit as described herein and on the project drawings.

6. NCA utilizes Cisco Aironet Wireless Bridge and Air Fortress Security Gateway.
7. Document wireless installations for Quantico Regional Processing Center including configurations, passwords, and diagrams.

3.20 FIBER NETWORK INSTALLATION

A. Configuration Constraints:

1. Single-Mode Segment Length: Maximum 5 km (3 miles).

B. Installation Constraints:

1. Minimum Bend Radius During Installation: 20 times cable outside diameter.
2. Minimum Bend Radius As Installed: 10 times cable outside diameter or manufacturer's specification, whichever is greater.
3. Pulling Force During Installation: Not to exceed manufacturer's specified maximum.
4. Cable Slack:
 - a. Within pits: Minimum 2 m (6.5 feet).
 - b. At termination location: Minimum 2 m (6.5 feet).
 - c. Within termination enclosure: Minimum 0.5 m (1.5 feet).
5. Provide fiber cable terminations with SC connectors. Provide patch cord protector at wall or rack mount enclosure installations.

3.21 TWP NETWORK INSTALLATION

3.22 FIELD QUALITY CONTROL

A. Fiber TIP Cabling System Testing:

1. Perform 100 percent Insertion Loss (light source and power meter) testing of terminated fibers in both directions at 850 nm for multimode cables and 1310 nm for single mode cables.
2. Perform OTDR tests at high wavelength, if distance is greater than 500 m (545 yards) at 1310 nm for multimode cables and greater than 1000 m (1090 yards) at 1550 nm for single mode cables.
3. Optical loss: Maximum 5 dB covering total loss between two corresponding optical ports and must include allowances for losses due to fiber, connectors, passive optical components, splices and any margin for maintenance.
4. Submit copies of test results to VA Quantico Regional Processing Center on completion of project.

B. TWP TIP Cabling System Testing:

1. Perform testing with building electrical services operating, including lighting, power, air conditioning plant and lift services, where applicable.
2. Test wiring to verify continuity, integrity and polarity of cable according to specified pin and pair grouping assignments.
3. Submit the following cable installation documentation:
 - a. Cable type.
 - b. Route followed.
 - c. Pit locations, where applicable.
 - d. Building names.
 - e. Diagrams.
 - f. Configurations of any equipment.
 - g. Table of losses for each core.
4. Submit minimum two copies of documentation. Submit one copy to:
 - a. Director, VA National Cemetery for which work is being performed.
5. Submit installation documentation at completion of cabling system installation.
6. Certify that cabling system meets UTP cabling system requirements for Category 6 performance levels.

C. Acceptance Testing:

1. Verify system components are functioning.
 - a. Perform visual check and record presence of required components and devices.
 - b. Test each item status by physically pushing and pulling; pushing in and out, and up and down.
2. Test each item for following conditions:
 - a. Properly installed.
 - b. Properly terminated.
 - c. Terminations and plugs are provided.
 - d. Cabinet Door function.
 - e. Cabinet connections provided.
 - f. Cabinet mounted properly and OSHA clearances provided.
3. Compare TIP cabling test results and select random cables to test.
4. Note discrepancies on test report.
5. Verify As-Built System Drawings.

Black Hills National Cemetery
Renovate and Expand Administration and Maintenance Buildings
20901 Pleasant Valley Drive
Sturgis, SD 57785

NCA Project # 884CM3015
10/31/22
Bid Documents

6. Verify System Manuals.

3.23 CLEANING

- A. Remove and legally dispose of debris and excess material from project site.

- - - E N D - - -

**SECTION 27 11 00
COMMUNICATIONS EQUIPMENT ROOM FITTINGS**

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Voice and Digital TIP Cable Distribution System including, but not be limited to, equipment cabinets, interface enclosures, and relay racks, necessary combiners, traps, and filters, and necessary passive devices such as splitters, couplers, cable "patch," "punch down," and cross-connector blocks or devices, voice and data distribution sub-systems, and associated hardware.
2. System includes, but is not limited to, telecommunication rooms (TR), telecommunications outlets (TCO), copper and fiber optic distribution cables, connectors, "patch" cables, and "break out" devices.

- B. See Section 27 05 00, COMMON WORK RESULTS FOR COMMUNICATIONS for requirements governing work of this section.

1.2 RELATED REQUIREMENTS

- A. General electrical requirements and items common to more than one Division 27 section: Section 27 05 00, COMMON WORK RESULTS FOR COMMUNICATIONS.
- B. Electrical Components: Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS.
- C. Labeling: Section 27 10 00, STRUCTURED CABLING.

1.3 APPLICABLE PUBLICATIONS

- A. Comply with references to extent specified in this section.
- B. National Fire Protection Association (NFPA):
 1. 70-17 - National Electrical Code.
- C. Federal Communications Commission (FCC) Publications: Standards for telephone equipment and systems.

1.4 SUBMITTALS

- A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Submittal Drawings:

1. Pictorial layouts of each MTC, IMTC, and RTCs; MCCS, IMCCS, VCCS, and HCCS termination cabinets, each distribution cabinet layout drawing, and TCO as each is installed and configured.
2. Engineering drawings, showing calculated signal levels at EPBX output, each input and output distribution point, proposed TCO values, and signal level at each TCO multipin, fiber optic, jack.

C. Environmental Requirements: Confirm environmental specifications for physical telecommunications areas. Identify requirements for initial and expanded system configurations for the following:

1. Floor loading for batteries and cabinets.
2. Minimum floor space and ceiling heights.
3. Minimum door size for equipment passage.
4. Power requirements: Voltage, amperage, phases, and circuit quantities required.
5. Air conditioning, heating, and humidity requirements, including ambient temperature and relative humidity operating ranges required to prevent equipment damage.
6. Air conditioning requirements expressed in BTU per hour, based on adequate dissipation of generated heat to maintain required room and equipment standards.
7. Proposed floor plan, based on expanded system configuration of proposed EPBX for this FACILITY.
8. Conduit size requirement among main TR, computer, and console rooms.
9. Main trunk line and riser pathways, cable duct, and conduit requirements between each MTC, TR, and TCO.

D. System Narrative Description:

1. List equipment to be provided, (a.k.a. Bill of Materials (BOM)) including quantity, manufacturer, and model number of each item. The following is minimum equipment required by system:

| QUANTITY | UNIT |
|-------------|-----------------------|
| As required | Cabinet Assemblies |
| As required | Environmental Cabinet |

| QUANTITY | UNIT |
|-------------------|--|
| As required | Distribution/Interface Cabinet |
| As required | Trouble Annunciator Panel |
| As required | Lightning Protection System |
| As required | Wire Management System/Equipment |
| As required | Telecommunications Outlets (TCO) |
| As Required | Distribution Cables |
| As required | TCO Connection Cables |
| As required | System Connectors |
| As required | Terminators |
| As required | Telecommunications Closets (TR) |
| As required | Environmental Requirements |
| 1 ea. | Installation Kit |
| List and itemized | Other required items |
| As-required | Separate List Containing Each Equipment Spares |

E. Test Equipment List:

1. Provide test equipment required to test system according to parameters specified. Unless otherwise stated, test equipment is not considered part of system. Provide test equipment of accuracy better than parameters to be tested.
2. Test equipment includes calibration tag of acceptable calibration service dated maximum 12 months before test. Minimum submittal includes manufacturer and model number of the following equipment:
 - a. Spectrum Analyzer.

- b. Signal Level Meter.
- c. Volt-Ohm Meter.
- d. Time Domain Reflectometer (TDR) with strip chart recorder (Data and Optical Measuring).
- e. Bit Error Test Set (BERT).
- f. Camera, minimum 60 pictures, develop immediately to include appropriate test equipment adapters. Video camera in VHS format is acceptable alternative.

F. Samples:

1. TCO Wall Outlet:
2. Data CCS patch panel, punch block or connection device with RJ45 connectors installed.
3. Telephone CCS system with IDC and RJ45 connectors and cable terminal equipment installed.
4. Fiber optic CCS patch panel or breakout box with cable management equipment and "ST" connectors installed.
5. 610 mm (2 ft.) section of each copper cable with cable sweep tags and connectors installed.
6. 610 mm (2 ft.) section of each fiber optic cable with cable sweep tags and connectors installed.

G. Surveys: Submit the following surveys that depict various system features and capacities in addition to on-site survey requirements. Each survey to be in writing and contain the following minimum information (formats are suggestions and are acceptable for initial Technical Submittal survey requirements):

1. Cable Distribution System Design Plan: Design plan for entire cable distribution system, including specific cable count coinciding with total growth items. Provide System's entire cable requirements and engineer a distribution system requirement plan using the following minimum format:
 - a. UTP (and STP) Requirements/Column Explanation:

| Column | Explanation |
|------------------------------|---|
| FROM BUILDING | Identifies the building by number, title, or location, and main signal closet or intermediate signal closet cabling is provided from. |
| BUILDING | Identifies the building by number, title, or location cabling is to be provided in. |
| TO BUILDING IMC | Identifies building main terminal signal closet, by room number or location, to which cabling is provided to, in, and from. |
| FLOOR | Identifies the floor by number (i.e. 1st, 2nd, etc.) cabling and TCOs are to be provided. |
| TR ROOM NUMBER | Identifies the floor signal closet room, by room number, which cabling is to be provided. |
| ROOM NUMBER | Identifies the room, by number, from which cabling and TCOs to be provided. |
| NUMBER OF CABLE PAIR | Identifies the number of cable pair required to be provided on each floor designated OR the number of cable pair (VA Owned) to be retained. |
| NUMBER OF STRANDS USED/SPARE | Identifies the number of strands provided in each run. |

b. Fiber Optic Cabling Requirements/Column Explanation:

| Column | Explanation |
|-----------------|---|
| FROM BUILDING | Identifies the building by number, title, or location, and main signal closet or intermediate signal closet cabling is provided from. |
| TO BUILDING IMC | Identifies building, by number, title, or location, to which cabling is provided. |
| FLOOR | Identifies the floor by number (i.e. 1st, 2nd, etc.). |

| Column | Explanation |
|-------------------|---|
| TR ROOM NUMBER | Identifies the room, by number, from which cabling to be installed. |
| NUMBER OF STRANDS | Identifies the number of strands in each run of fiber optic cable. |
| INSTALLED METHOD | Identifies the method of installation. |
| NOTES | Identifies a note number for a special feature or equipment. |
| BUILDING MTC | Identifies the building by number or title. |

1.5 WARRANTY

- A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. System Requirements:
1. System designed and supported by manufacturer, provides continuous inter and intra-Facility voice and data and analog signals with capacity sized so loss of connectivity to external systems does not affect Facilities operation in specific designated locations:
 - a. Minimum Connections: Capable of inter-connecting and functioning fully with existing Local Telephone Exchange (LEC) Networks, Federal Telephone System (FTS) Inter-city Networks, Inter-exchange Carriers, Integrated Services Digital Network (ISDN), Electronic Private Branch Exchange (EPBX) switches, asynchronous/synchronous data terminals and circuits including Automatic Transfer Mode (ATM), Frame Relay, local area networks (LAN), and other service providers as required by facility and approved by A/E.
 - b. Voice and data cable distribution system based on physical "Star" Topology. Provide Analog RF coaxial cable distribution system in "home run" configuration from each associated riser TR to identified locations and as shown on drawings.
 - c. Compatible with and able to provide direct digital connection to trunk level equipment including, but not limited to, directly

accessing trunk level equipment including the telephone system, audio paging, Industry Standard "T" and "DS" carrier services and external protocol converters. Also include connections to "T" and "DS" access/equipment or Customer Service Units (CSU) used in FTS and other trunk applications. Provide T-1 access/equipment (or CSU), as required for use, in FTS and other trunk applications by system design when this equipment is not included in existing telephone system and will be deactivated by the installation of the System. Provide T-1 equipment required to terminate and operate the quantity of circuits designated. Connect CSU's to System's emergency battery power supply. System to be fully capable of operating in Industry Standard "DS" protocol and provide protocol service when required.

2. Minimum Subsystem Requirements: Independent sub-systems comprise of complete and functional voice and digital telecommunications cabling system: "Main" (MTC), "intermediate" (IMTC), and "riser" (RTC) TR's; "vertical" (or "riser") trunk cabling system; vertical cross-connection (VCC) cabling systems, and TCO's with minimum three (3) RJ-45 jacks for appropriate telephone, Data connections, and additional jacks, connectors, drop and patch cords, terminators, and adapters provided:

- a. Telecommunication Toom (TR):

- 1) Minimum one for MTC, each building IMTC, and each RTC per building floor location. Provide additional TR's in large buildings, where horizontal distance to farthest voice and digital work area exceeds 90 m (295 feet). Maximum DC resistance per cable pair, 28.6 Ohms per 305 m (1,000 feet). Centrally locate each TR to cover maximum amount of local floor space. TR's house in cabinets or enclosures, on relay racks, and on backboards, various telecommunication data equipment, controllers, multiplexers, bridges, routers, LAN hubs, telephone cross-connecting, active and passive equipment.

- 2) TR's may house fire alarm, video, public address, radio entertainment, intercom, and radio paging equipment. Regardless of method of installation, terminate mounting, termination, or cross-connecting used, vertical copper and fiber optic cables on appropriate cross-connection systems (CCS) containing patch panels, punch blocks, and breakout devices provided in enclosures and tested. cable or wire management system to be a part of each CCS.
 - a) Provide minimum three 110-120 Volt AC active quad outlets, each with "U" grounded receptacles at minimum of one outlet for each front, side and back wall. For larger building TR applications, provide minimum one additional quad AC outlet for every 800 sq. m (8,000 sq. ft.) of useable floor space. Equally space additional outlets along the wall.
 - b) Provide climate control in each TR 24 hours a day, seven days per week and 52 week per year to prevent failure of electronic components and for mission critical functional applications. Contracting Officer's Representative (COR) will provide minimum climate control requirements.

2.2 SYSTEM PERFORMANCE

- A. Minimum System support for the following voice and data operations for minimum Category 6 Certified Telecommunication Service:
 1. Interchange (or interface) capabilities:
 - a. Basic Rate (BRI).
 - b. Primary Rate (PRI).
 2. ISDN measured at:
 - a. Narrow Band BRI:
 - 1) B Channel: 64 kilo-Bits per second (kBps), minimum.
 - 2) D Channel: 16 kBps, minimum.
 - 3) H Channel: 384 kBps, minimum.
 - b. Narrow Band PRI:
 - 1) B Channel: 64 kBps, minimum.
 - 2) D Channel: 64 kBps, minimum.
 - 3) H Channel: 1,920 kBps, minimum.

- c. Wide (or Broad) Band Channels: 140 mega (m)-Bps, minimum, capable to 565 mBps at "T" reference.
- B. Minimum System support for the following operating parameters:
1. EPBX connection:
 - a. System speed: Minimum 1.0 gBps per second.
 - b. Impedance: 600 Ohms.
 - c. Cross Modulation: -60 deci-Bel (dB).
 - d. Hum Modulation: -55 dB.
 - e. System data error: Minimum 10 to the -10 Bps.
 - f. Loss: Measured at frame output with reference Zero (0) decibel measured (dBm) at 1,000 Hertz (Hz) applied to frame input.
 - 1) Trunk to station: Maximum 1.5 dB.
 - 2) Station to station: Maximum 3.0 dB.
 - 3) Internal switch crosstalk: -60 dB when signal of + 10 decibel measured (dBm), 500-2,500 Hz range is applied to primary path.
 - 4) Idle channel noise: 25 dBm "C" or 3.0 dBm "O" above reference (terminated) ground noise, whichever is greater.
 - 5) Traffic Grade of Service for Voice and Data:
 - 6) Minimum service grade of P-01 with average traffic load of 7.0 CCS per station per hour and traffic overload in data circuits will not interfere with, nor degrade, voice service.
 - 7) Average CCS per voice station: Maintain average CCS capacity per voice station at 7.0 CCS when EPBX is expanded up to projected maximum growth as stated herein.
 2. Telecommunications Outlet (TCO):
 - a. Voice:
 - 1) Isolation (outlet-outlet): 24 dB.
 - 2) Impedance: 600 Ohms, balanced (BAL).
 - 3) Signal Level: 0 decibel per mili-Volt (dBmV) + 0.1 dBmV.
 - 4) System speed: Minimum 100 mBps.
 - 5) System data error: Minimum 10 to the -6 Bps.
 - b. Data:
 - 1) Isolation (outlet-outlet): 24 dB.
 - 2) Impedance: 600 Ohms, BAL.
 - 3) Signal Level: 0 dBmV + 0.1 dBmV.
 - 4) System speed: Minimum 120 mBps.

5) System data error: Minimum 10 to the -8 Bps.

2.3 PRODUCTS - GENERAL

- A. Provide system components from one manufacturer.
1. Equipment: New and manufacturer's current model of standard products, meet or exceed specifications.
 2. Provide proper size and type of cable duct and conduit and wiring.
 3. Provide interfacing cable connections for telephone systems with System.
 4. Active Electronic Component Equipment: Solid state components, rated for continuous duty service, and comply with FCC standards for telephone equipment, systems, and service.
 5. Passive Distribution Equipment: Meet or exceed minus 80 dB radiation shielding specifications.
 6. Telephone Cable Systems without Adapters: Terminate interconnecting twisted pair, fiber-optic cables on equipment terminal boards, punch blocks, breakout boxes, splice blocks, and unused equipment ports/taps according to manufacturer's instructions. Do not leave unused or spare cable unterminated, unconnected, loose or unsecured.
 7. Color Code Distribution Wiring: Conform to Telephone Industry standard, EIA/TIA, and this specification, whichever is most stringent. Legibly and permanently label equipment, cable duct and conduit, enclosures, wiring, terminals, and cables, as shown on record drawings, to facilitate installation and maintenance. Refer to Section 27 10 00, STRUCTURED CABLING.
 8. Connectors:
 - a. Plug-in Connectors: Connect equipment, except coaxial cables and interface points. Coaxial cable distribution points and RF transmission lines to use coaxial cable connections recommended by cable manufacturer and approved by System manufacturer.
 - b. Barrier Terminal Screw Type Connectors: Use Base- band cable systems, at a minimum.

c. Acceptable Alternative:

- 1) Crimp Type Connectors: Installed with ratchet type installation tool, as long as cable dress, pairs, shielding, grounding, and connections and labeling are provided same as barrier terminal strip connectors. No tape, wire nuts, or solder type connections are permitted.
9. Equipment Faceplates: Stainless steel, anodized aluminum, or UL approved cycolac plastic.
10. Provide noise filters and surge protectors for each equipment interface cabinet, switch equipment cabinet, control console, local, and remote active equipment locations.
11. Underground Warning Tape: Standard, 0.1 mm (4 mil polyethylene), 76 mm (3 inch) wide non-detectable type, color as follows:
 - a. Red with black letters imprinted "CAUTION BURIED ELECTRIC LINE BELOW."
 - b. Orange with black letters imprinted "CAUTION BURIED TELEPHONE LINE BELOW."
 - c. Orange with black letters imprinted "CAUTION BURIED FIBER OPTIC LINE BELOW."

B. Equipment Functional Characteristics:

| FUNCTIONS | CHARACTERISTICS |
|-----------------------|--------------------------------|
| Input Voltage | 105 to 130 VAC |
| Power Line Frequency | 60 Hz \pm 2.0 Hz |
| Operating Temperature | 0 to 50 degrees Centigrade (C) |
| Humidity | 80 percent minimum rating |

C. Equipment Standards and Testing:

1. Supplies and materials, listed, labeled or certified by UL or a nationally recognized testing laboratory. Refer to Section 27 05 00, COMMON WORK RESULTS FOR COMMUNICATIONS.
2. Active and passive equipment required by System design and approved technical submittal, comply with each UL standard bearing UL seal in effect as of technical submittal date (or date when COR approved system equipment necessary to be replaced) was technically reviewed and approved by VA.

3. NRTL listed with seal or seal of testing laboratory that warrants complicity with required NRTL Standards.

2.4 EQUIPMENT

A. Cabinet with Internal Equipment Mounting Rack: Refer to Section 27 05 00 COMMON WORK RESULTS FOR COMMUNICATIONS.

B. Cross-Connection System (CCS) Equipment Breakout, Termination Connector (or Bulkhead), and Patch Panels:

1. Connector Panels: Solid aluminum, custom designed, flat smooth, 3.175 mm (1/8 inches) thick, Mount bulkhead equipment connectors on panel to connect cabinet equipment's signal, control, and coaxial cables through panel. Panel color to match cabinet installed.

a. Voice (or Telephone):

- 1) CSS, minimum Industry Standard type 110 punch blocks for voice or telephone, and control wiring in lieu of patch panels, certified for Category six service. IDC punch blocks (with internal RJ45 jacks) are acceptable for use in CCS, design for Category six telecommunications service; size and type of UTP cable used as specified. Secure punch block strips according to manufacturer-designed physical anchoring unit on wall location in MTC, IMTC, RTC, and TR. Console, cabinet, rail, panel, etc. mounting is allowed according to manufacturer's instructions and as approved by COR. Punch blocks may not be used for Class II or 120 Volt AC power wiring.

2) Technical Characteristics:

| | |
|-----------------------------|---|
| Number of horizontal rows | 100, minimum |
| Number of terminals per row | 4, minimum |
| Terminal protector | required for each used or unused terminal |
| Insulation splicing | required between each row of terminals |

b. Digital or High-Speed Data:

- 1) CSS, patch panel with modular female RJ45 jacks installed in rows, designed for Category six telecommunications service and size and type of UTP or STP cable used.

Each panel to be 480 mm (19 inches) horizontal EIA rack mountable dimensions with EIA standard spaced vertical mounting holes.

2) Technical Characteristics:

| | |
|---------------------------|---------------------------------------|
| Number of horizontal rows | 2, minimum |
| Number of jacks per row | 24, minimum |
| Type of jacks | RJ45 |
| Terminal protector | required for each used or unused jack |
| Insulation | required between each row of jacks |

c. Fiber Optic:

1) Use Interface Cabinet or Panel with pre-punched chassis mounting holes arranged in two horizontal rows.

2) Technical Characteristics:

| | |
|------------------------|--|
| Height | Two rack units (RUs), 88 mm (3 1/2 inches) minimum |
| Width | 484 mm (19 1/16 inches), EIA minimum |
| Number of connections | 12 pairs, minimum |
| Connectors | |
| Audio Service | Use RCA 6.35 mm (1/4 inch) Phono, XL or Barrier Strips, surface mounted with spade lugs (punch block or wire wrap type strips are acceptable alternatives for barrier strips when system design is maintained and approved by COR) |
| Control Signal Service | Barrier strips surface mounted with spade lugs (punch block or wire wrap type strips are acceptable alternates for barrier strips when system design is maintained and approved by COR) |

| | |
|------------------------------|--|
| Height | Two rack units (RUs), 88 mm (3 1/2 inches) minimum |
| Low Voltage power (class II) | Barrier strips with spade lugs and clear full length plastic cover, surfaced mounted |
| Fiber optic | "LC" female |
| | |

d. Mounting Strips and Blocks:

- 1) Barrier Strips: Approved for AC power, data, voice, and control cable or wires.
 - a) Accommodate size and type of audio spade (or fork type) lugs used with insulating and separating strips between terminals, for securing separate wires.
 - b) Provide each cable or wire end with audio spade lug connected to individual screw terminal on barrier strip.
 - c) Surface secure barrier strips to console, cabinet, rail, panel, etc.
 - d) Do not connect signal barrier strips to 120 Volt AC power wires.
- 2) Technical Characteristics:

| | |
|----------------------------|---|
| Terminal size | 6-32, minimum |
| Terminal Count | Any combination |
| Wire size | .52 sq. mm (20 AWG), minimum |
| Voltage handling | 100 V, minimum |
| Protective connector cover | Required for Class II and 120 Volt AC power connections |

2. Solderless Connectors (or Fork Connectors): Crimp-on insulated lug to fit 6-32 minimum screw terminal. Install fork connector using standard lug-crimping tool.
3. Punch Blocks: Minimum Industry Standard 110 type punch blocks, approved for data, voice, and control wiring, designed for size and type of wire used. Secure punch block strips to console, cabinet,

rail, panel, etc. Punch blocks may not be used for Class II or 120 Volt AC power wiring.

4. Wire Wrap Strips: Industry Standard wire wrap strips minimum 16.5 mm (0.065 inch), approved for data, voice and control wiring. Secure wire wrap strips to cabinet, rail, panel, etc. Wire wrap strips are not acceptable for Class II or 120 Volt AC power wiring.

C. Wire Management System and Equipment:

1. Wire Management System: Management center of cable system, CCS, and TR; performs as platform to house peripheral equipment in standard relay rack or equipment cabinet. Install cables and connections at rear of each system interface to IDC and patch panels, punch blocks, wire wrap strips, and barrier strip.
2. Wire Management Equipment: Focal point of each wire management system, providing orderly interface between outside and inside wires and cables (where used), distribution and interface wires and cables, interconnection wires and cables and associated equipment, jumper cables, and providing uniform connection media for system fire retardant wires and cables and other subsystems; compatible and interface with cable tray, duct, wireway, or conduit used in system; interconnection or distribution wires and cables to enter system at top (or from wireway in floor) via overhead protection system and uniformly routed down either side (or both at same time) of frame's side protection system then laterally via anchoring or routing shelf for termination on rear of each respective terminating assembly. Each system to be custom configured to meet System design and user needs.

PART 3 - EXECUTION

3.1 INSTALLATION

A. System Installation:

1. Comply with accepted industry standards, manufacturer's instructions, requirements of this section, and in manner that does not constitute a safety hazard. Ensure installation personnel understands and comply requirements.

2. Install suitable filters, traps, directional couplers, splitters, TR's, and pads for minimizing interference and balancing System. Items used for balancing and minimizing interference to pass telephone and data, and light wave signals in frequency bands selected, in direction specified, with low loss, and high isolation, and minimal delay of specified frequencies and signals. Provide equipment necessary to meet the requirements of System performance standards.
 3. Connect passive equipment according to manufacturer's instructions.
 4. Where TCOs are installed adjacent to each other, install one outlet for each instrument.
 5. Terminate lines to facilitate future System expansion. Provide minimum one spare 25 pair cable at each distribution point on each floor.
 6. Terminate vertical copper and fiber optic cables so future changes only require modifications of EPBX or signal closet equipment.
 7. Provide terminating resistors or devices to terminate unused system branches, outlets, equipment ports.
 8. Install outdoor equipment, weatherproof or in weatherproof enclosures with hinged doors and locks with two keys.
 9. Install indoor equipment in metal cabinets with hinged doors and locks with two keys.
- B. Conduit and Signal Ducts: Raceway Installation; See Section 27 05 33, CONDUITS AND BACKBOXES FOR COMMUNICATIONS SYSTEMS.
1. Conduit:
 - a. Install with latest installation practices and materials. Provide conduit, junction boxes, connectors, sleeves, weatherheads, pitch pockets, and associated sealing materials not specifically identified in this section as GFE. Sleeve and seal conduit penetrations of walls, ceilings, floors, interstitial space, fire barriers, etc. Minimum conduit size, 19 mm (3/4 inch).
 - b. Install cables in separate conduit and signal ducts (exception to separate conduit requirement to allow telephone cables to be installed in partitioned cable tray with data cables may be granted in writing by COR, if requested).

Provide conduits according to Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS, and NFPA 70 Article 800 for Communications systems, at a minimum.

- c. Conduit (including GFE) fill maximum 40 percent. Equip each conduit end during installation with protective insulator or sleeve, connection nut or clamp. Install electrical power conduit according to NFPA 70. Run AC power conduit separate from signal conduit.
 - d. Ensure PA and Radio Paging Systems (as identified by NFPA 70 Section 517) are completely separated and protected from other systems.
2. Signal Duct or Cable Duct:
- a. Use existing signal duct, cable duct, and/or cable tray, when identified and approved by COR.
 - b. Approved signal and cable duct, minimum 100 mm by 100 mm (4 inches by 4 inches) inside diameter with removable tops or sides, as required. Provide protective sleeves, guides or barriers on sharp corners, openings, anchors, bolts or screw ends, junction, interface and connection points.
- C. Connectors: Circuits, transmission lines, and signal extensions to have continuity, correct connection and polarity. Maintain uniform polarity between points in system.
1. Wires:
 - a. Neatly form wire ends and secure insulation on each wire with heat shrink tubing, where insulation has been cut. No tape will be permitted.
 - b. Install audio spade lugs on each wire end (including spare or unused) and connect to screw terminals of appropriate size barrier strips. Provide AC barrier strips with protective cover to prevent accidental contact with wires carrying live AC current. Punch blocks are approved for signal, not AC wires. Wire Nut or "Scotch Lock" connectors are not acceptable for signal wire installation.
 2. Cables: Design each connector for specific size cable being used and install with manufacturer's approved installation tool.

3. Line or Microphone Audio: Install each connector according to cable or connector manufacturer's instructions using manufacturer's approved installation tool. Install connectors to provide and maintain the following audio signal polarity:
 - a. XLR type connectors Signal or positive conductor is pin 3; common or neutral conductor is pin 2; ground conductor is pin 1.
 - b. Two and three conductor 6 mm (1/4 inch) Signal or positive conductor is tip; neutral or 3 mm (1/8 inch) phono plugs conductor is ring and ground or shield and jacks conductor is sleeve.
4. Speaker Line Audio:
 - a. Install connector according to cable, transformer or speaker manufacturer's instructions using manufacturer's approved installation tool. Ensure each speaker is properly phased and connected in same manner throughout System using two conductor type wires.
 - b. Color code one of the conductors to aid in establishing speaker signal polarity. Solder permanently each speaker line or audio spade lug connected to each appropriate speaker or line matching transformer connection terminal. Speaker line connection to each audio amplifier to use audio spade lugs.
- D. AC Power: Run AC power wiring separately from signal cable.
- E. Grounding:
 1. Grounding and Bonding: See Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.
 2. General: Ground all Contractor Installed Equipment and identified Government Furnished Equipment (GFE). Total ground resistance, 0.1 Ohm or less.
 - a. Install lightning arrestors and grounding according to NFPA 70 and as specified.
 - b. Provide gas protection devices on circuits and cable pairs serving building distribution frames located in buildings other than building in which is located or in any area served by an unprotected distribution system (manhole, aerial, etc.). Install gas protection devices at nearest point of entrance in buildings where protection is required and on same circuits on MDF in telephone switch room.

- c. Do not AC neutral in power panel or receptacle outlet for communication system ground.

F. Equipment Assembly:

1. Cabinets:

- a. Install rack (including freestanding radio relay) mounted equipment requiring adjustment or observation, in enclosure's equipment adjustable mounting racks. Mount heavy equipment with rack slides or rails allowing servicing from front of enclosure. Heavy equipment support should not be dependent from front panel mounting screws. Provide equipment with sufficient cable slack to permit servicing by removal of installed equipment from front of enclosure. Install 44 mm (1 3/4 inch) high color matched blank panel (spacer) between each piece of equipment (active or passive). Equip each console or cabinet with quiet fan and non-disposable air filter.
- b. Install enclosures and racks plumb and square, permanently attached to building structure and held firmly in place. Provide 380 mm (15 inches) of front vertical space opening for additional equipment.
- c. Connect signal connector, patch, and bulkhead panels (audio, data, control, analog video, etc.) so that outputs from each source, device or system component enters panel at top row of jacks, beginning left to right as viewed from front, and called "inputs". Each connection to a load, device or system component to exit panel at bottom row of jacks, beginning left to right as viewed the front, and called "outputs".
 - 1) Install equipment located indoors in metal racks or enclosures with hinged doors to allow access for maintenance without causing interference to other nearby equipment.
 - 2) Cables to enter equipment racks or enclosures to allow doors or access panels to open and close without disturbing or damaging cables.
 - 3) Securely mount distribution hardware to allow access to connections for testing and provide sufficient room for doors or access panels to open and close without disturbing cables.

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3.2 FIELD QUALITY CONTROL

- A. Field Tests: Performed by testing laboratory specified in Section 01 45 29, TESTING LABORATORY SERVICES.
- B. See Section 27 05 00 COMMON WORK RESULTS FOR COMMUNICATIONS.

- - - E N D - - -

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 REQUIREMENTS. A Commissioning Agent (CxA) appointed by the VA will manage the commissioning process.

1.2 RELATED WORK

- A. Section 01 00 01 GENERAL REQUIREMENTS (MAJOR NCA PROJECTS)
- B. Section 01 00 02 GENERAL REQUIREMENTS (MINOR NCA PROJECTS).
- C. Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.
- D. 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 Resident Engineer. The Contractor shall review and comment on the tests prior to approval. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The Commissioning Agent will witness and document the testing. The Contractor shall sign the test reports to verify tests were performed. See Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS, for additional details.

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3.5 TRAINING OF VA PERSONNEL

- A. Training of the VA operation and maintenance personnel is required in cooperation with the Resident Engineer and Commissioning Agent. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. Contractor shall submit training agendas and trainer resumes in accordance with the requirements of Section 01 91 00. The instruction shall be scheduled in coordination with the VA Resident Engineer after submission and approval of formal training plans. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS and Division 28 Sections for additional Contractor training requirements.

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

99SECTION 28 10 00
ACCESS CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. New state-of-the-art fully functioning physical access and control system (PACS) installed in VA's National Cemetery (NCA) to regulate access to restricted buildings, building areas. Project Number: 884CM3015.
2. Door position sensors reporting to intrusion detection system, only when PACS is not managed by host facility.

1.2 RELATED REQUIREMENTS

- A. Firestopping: Section 07 84 00, FIRESTOPPING.
- B. Penetration Sealants: Section 07 92 00, JOINT SEALANTS.
- C. Door Position Sensor Preparation: Section 08 11 13, HOLLOW METAL DOORS AND FRAMES and Section 08 14 00, INTERIOR WOOD DOORS.
- D. Electric Locks and Strikes: Section 08 71 00, DOOR HARDWARE.
- E. Electrical Power Wiring: Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- F. Electrical Power Conductors: Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW).
- G. Electrical Power System Grounding: Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
- H. Electrical Power System: Section 26 05 33, RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS and Section 26 27 26, WIRING DEVICES.
- I. Lightning Protection: Section 26 41 00, FACILITY LIGHTNING PROTECTION.
- J. Perimeter Lighting: Section 26 56 00, EXTERIOR LIGHTING.
- K. Communications General Requirements: Section 27 05 00, COMMON WORK RESULTS FOR COMMUNICATIONS.
- L. Communications System: Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS, Section 27 05 33, CONDUITS AND BACKBOXES FOR COMMUNICATIONS SYSTEMS, and Section 27 10 00, STRUCTURED CABLING.
- M. Weapons Storage Surveillance: Section 28 20 00, VIDEO SURVEILLANCE.
- N. Alarm Systems: Section 28 31 00, INTRUSION DETECTION.

1.3 APPLICABLE PUBLICATIONS

- A. Comply with references to extent specified in this section.

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- B. American National Standards Institute/Security Industry Association (ANSI/SIA):
 - 1. AC-01-1996.10 - Access Control Standard Protocol for the 26-bit Wiegand TM Reader Interface.
 - 2. AC-03-2000.06 - Access Control Guideline Dye Sublimation Printing Practices for PVC Access Control Cards.
- C. Federal Information Processing Standards (FIPS):
 - 1. FIPS 201-2 - Personal Identity Verification (PIV) of Federal Employees and Contractors.
- D. Government Accountability Office (GAO):
 - 1. 03-8-02 - Security Responsibilities for Federally Owned and Leased Facilities.
- E. Government Services Administration (GSA):
 - 1. APL - PACS Approved Products List.
- F. International Organization for Standardization/Independent Electrical Contractors (ISO/IEC):
 - 1. 7810-03 - Identification Cards - Physical Characteristics.
 - 2. 7811 - Identification cards - Integrated circuit cards - Part 3: Cards with contacts - Electrical interface and transmission protocols.
 - 3. 7816 - Identification cards - Integrated circuit cards, most current date for each part.
 - 4. 14443 - RFID cards; Contactless Proximity Cards Operating at 13.56 MHz in up to 5 Inches Distance, most current date for each part.
 - 5. 15693 - RFID cards; Contactless Vicinity Cards Operating at 13.56 MHz in up to 50 Inches Distance, most current date for each part.
- G. National Electrical Manufacturers Association (NEMA):
 - 1. 250-14 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- H. National Fire Protection Association (NFPA):
 - 1. 70-14 - National Electrical Code.
- I. National Institute of Standards and Technology (NIST):
 - 1. IR 6887 V2.1 - Government Smart Card Interoperability Specification.
 - 2. Special Pub 800-96 - PIV Card Reader Interoperability Guidelines.

- J. Master Painters Institute (MPI):
 - 1. No. 18 - Primer, Zinc Rich, Organic.
- K. Telecommunications Industry Association(TIA):
 - 1. 232-F - Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange.
 - 2. 485-A - Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems.
- L. UL LLC (UL):
 - 1. Listed - Online Certifications Directory.
 - 2. 294-13 - Access Control System Units.
 - 3. 827-14 - Central Station Alarm Services.
 - 4. 1076-95 - Proprietary Burglar Alarm Units and Systems.
 - 5. 1981-14 - Central Station Automation System.
- M. United States Access Board (USAB):
 - 1. ABA - Architectural Barriers Act Accessibility Standards.
- N. United States Department of Homeland Security (HLS):
 - 1. HSPD 12-04 - Policy for a Common Identification Standard for Federal Employees and Contractors.
- O. United States Department of Veterans Affairs (VA):
 - 1. VA Construction and Facilities Management (CFM):
 - a. DG OIT - Office of Information & Technology, 2011.
 - b. DM Electrical - Electrical Design Manual, 2015.
 - c. DM Telecom - Telecommunications & Special Telecommunications Systems Design Manual, 2016.
 - d. PSDM - Physical Security Design Manual for VA Life-Safety Protected Facilities.
 - 2. VA Office of Security and Law Enforcement (SLA):
 - a. Directive 0730-12 - Security and Law Enforcement.
 - b. VA Office of Information and Technology (OI&T):
 - 1) Handbook 6100-10 - Telecommunications: Cyber and Information Security Office of Cyber and Information Security.
 - 2) Handbook 6330-93 - Directives Management Procedures.
 - 3) Handbook 6500-15 - Risk Management Framework for VA Information Systems - Tier 3: VA Information Security Program.

1.4 PREINSTALLATION MEETINGS

- A. Conduct preinstallation meeting at project site minimum 30 days before beginning Work of this section.
 1. Required Participants:
 - a. Contracting Officer's Representative.
 - b. VA AHJ SMCS 07A2, for special communications systems.
 - c. Architect/Engineer.
 - d. Inspection and Testing Agency.
 - e. Contractor.
 - f. Installer.
 - g. Field representative.
 - h. Other installers responsible for adjacent and intersecting work, including electrical installer.
 2. Meeting Agenda: Distribute agenda to participants minimum 3 days before meeting.
 - a. Installation schedule.
 - b. Installation sequence.
 - c. Preparatory work.
 - d. Protection before, during, and after installation.
 - e. Installation.
 - f. Terminations.
 - g. Transitions and connections to other work.
 - h. Inspecting and testing.
 - i. Other items affecting successful completion.
 3. Document and distribute meeting minutes to participants to record decisions affecting installation.

1.5 SUBMITTALS

- A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
 1. Submittal Drawings and As-Built Drawings: Four sets paper format Architectural F size. Two sets electronic format.
- B. Submittal Drawings:
 1. Show size, configuration, and fabrication and installation details.
 2. Cover Sheet:
 - a. Identify each drawing included in submittal.
 - b. Show facility name, building name, floor, and sheet number.

- c. Include security abbreviations and symbols lists.
 - d. Reference general notes included in submittal.
 - e. Specification and scope of work pages for individual security systems.
 - f. Include detailed device identification table.
3. Floor Plans and Site Plans:
- a. Show drawing scale in metric and English units.
 - b. Show each device identification and location.
 - c. Show control and power wiring.
 - d. Show pull box and conduit locations, sizes, and fill capacities.
 - e. Include general and drawing specific notes.
4. Riser Diagram:
- a. Include sequence of operation.
 - b. Show relationship of integrated components on one diagram.
 - c. Show number, size, identification, and maximum lengths of interconnecting wires.
 - d. Include wiring schedule showing conductor type, wiring drawing symbol, manufacturer's name, and part number.
5. System Drawing for Each Security System:
- a. Show equipment, including panels and devices, and system layout.
 - b. Show point-to-point wiring.
 - c. Identify wire types.
 - d. Show device locations on floor plans.
 - e. Include general and drawing specific notes.
6. System Equipment Schedule: Show the following:
- a. Device ID.
 - b. Device Location.
 - c. Mounting type.
 - d. Power supply or circuit breaker and power panel number.
 - e. Door number, door type, locking mechanism and control device.
7. Detail and Elevation Drawings: Show installation details.
- C. System Operational Description: Submit detailed description of system operation, performance, and interface with other entities, equipment, and systems.
- D. Manufacturer's Literature and Data:
1. Description of each product.
 2. Installation instructions.

- E. Equipment Lists: As bill of materials.
 - 1. Show quantities for each specified product.
 - 2. Identify products included on GSA Approved Products List and approval status.
- F. Submit manufacture's certification of UL LLC (UL) listing as specified.
- G. Qualifications: Substantiate qualifications comply with specifications.
 - 1. PACS integrator with project experience list.
 - 2. Responsible design professional approved by AHJ SMCS 07A2.
 - 3. Installer with project experience list.
 - 4. Factory authorized representative.
 - 5. Field representative with project experience list.
- H. Delegated Design Drawings and Calculations: Each signed, dated, and sealed by BICSI RCDD certified responsible design professional.
 - 1. Identify deviations from details shown on drawings.
- I. Field conditions report indicating differing conditions.
- J. Field survey report identifying equipment by manufacturer and model number wherever possible indicating:
 - 1. Non-functioning equipment, proposed replacement equipment, and replacement cost.
 - 2. Existing equipment reuse, removal, and replacement schedule.
 - 3. Existing equipment connection and disconnecting schedule, including times for system interruption.
- K. Acceptance Test Plan: Submit minimum 30 days before testing.
 - 1. Include individual component and subsystem acceptance testing procedures.
 - 2. Include integrated system test ensuring proper operation.
- L. Field Representative:
 - 1. Observation reports and supplemental instructions issued.
 - 2. Installation certification.
- M. Field Quality Control Reports: Four copies. Submit minimum 15 working days before scheduled acceptance test.
 - 1. System pretest recorded measurements.
 - 2. Certifications system is acceptance test ready.

- N. Operation and Maintenance Data: Four sets. Submit minimum 15 working days before scheduled performance tests.
 - 1. Start-up, maintenance, troubleshooting, emergency, and shut-down instructions for each operational product.
 - 2. Demonstration and training video recordings.
- O. As-Built Drawings: Submit minimum 15 working days before scheduled performance tests.
 - 1. Wiring diagrams showing labels, inputs, outputs, and room locations.
 - 2. Electronic Format: Match NCA specified AutoCAD version.

1.6 QUALITY ASSURANCE

- A. PACS Integrator: System designer and installer.
 - 1. Regularly integrates PACS and specified products.
 - 2. Employs licensed design professional with current BICSI RCDD certification responsible for PACS design.
 - 3. Integrated PACS and 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: BICSI RCDD certified and licensed security contractor. Manufacturer authorized representative.
 - 1. Regularly installs specified products.
 - 2. Installed specified products with satisfactory service on five similar installations for minimum five years.
 - a. Project Experience List: Provide contact names and addresses for completed projects.
- C. Factory Authorized Representative: As directed by Contracting Officer's Representative.
- D. Field Representative: BICSI certified Registered Communications Distribution Designer (RCDD) experienced with specified components and system.
 - 1. Project Experience List: Provide contact names and addresses for completed projects.
- E. Installer Qualifications: Product manufacturer. Manufacturer authorized representative.
 - 1. Regularly installs specified products.

2. Installed specified products with satisfactory service on five similar installations for minimum five years.
 - a. Project Experience List: Provide contact names and addresses for completed projects.

1.7 FIELD CONDITIONS

- A. Existing Conditions: Review drawings and specifications with existing site conditions.
 1. Report discrepancies affecting system design and installation and propose solution.
 2. Request Contracting Officer's Representative's approval for proposed solution.

1.8 WARRANTY

- A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. PACS Integration:
 1. Designed by approved BICSI RCDD.
 2. Installed and tested by contractor with manufacturer guidance.
 3. Acceptance tested and commissioned by AHJ SMCS 07A2.
- B. PACS: Standalone, local access controls connected to remote VA Medical Center central station providing system software and access privileges database management intrusion detection and video surveillance functions.
 1. Protocol: Internet, addressable, and programmable.
 2. Interface: Computer, via VA FTS and Telco Tie Lines or current federal communications media.
- C. System Components Including but not limited to:
 1. Interface cabinet for hard wired existing system extension.
 2. Head end cabinet for standalone system.
 3. Control and communications panels.
 4. Electronic security management system fully compatible with existing Host VAMC Security Management System.
 5. Card readers at restricted access entry points.
 6. Credential cards.

7. Picture ID and badging station.
 8. Door position indicators.
 9. Portal control devices.
 10. Entry Control Device.
 11. Electronic door hardware.
 12. Power supplies.
 13. Power and control wiring, raceways, and grounding.
- D. Access Control Locations:
1. Administration Building:
 - a. Employee entrances.
 - b. Secure records storage.
 - c. Telephone, MCR, and telecom rooms.
 - d. Electrical rooms.
 - e. Other areas as shown on the project drawings.
 2. Maintenance Building:
 - a. Main building entry.
 - b. Other areas as shown on the project drawings.
 3. Other Facilities:
 - a. Water storage and water well areas.
 - b. Other areas as shown on the project drawings.
- E. Integrate intrusion detection and video surveillance into PACS. See Section 28 31 00, INTRUSION DETECTION and Section 28 20 00, VIDEO SURVEILLANCE.
1. Camera Security Monitoring System:
 - a. Provide 24 hour perimeter and building entry points and emergency exits using fixed color cameras.
 - b. Provide 24-hour camera monitoring, controlling, and recording capability.
 - c. Automatically display camera viewing access point in alarm state.
 - d. Additional System Requirements: See Section 28 20 00, VIDEO SURVEILLANCE.
 2. Intrusion Detection System (IDS):
 - a. Monitor door position sensors.
 - b. Provide 24-hour IDS monitoring and controlling capability.
 - c. Activate audible alarm when IDS device signals alarm.

- d. Additional System Requirements: See Section 28 31 00, INTRUSION DETECTION.
- 3. Integrate security subsystems via computer programming or direct hardwiring.
- 4. Comply with manufacturer requirements for correct system operations. Ensure system integration computers meet or exceed system software minimum system requirements.
- F. Locate PACS components according to accessibility standards.
 - 1. Ease of Use: Design, install and program PACS for ease of operation, programming, servicing, maintaining, testing, and upgrading.

2.2 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.
- B. Design PACS and system components complying with specified performance:
 - 1. Standard Compliance: UL 294.
 - 2. Personal Identity Verification: FIPS 201, HLS HSPD 12, NIST IR 6887, and NIST Special Pub 800 compliant.
 - 3. Duty Rating: Continuous service.
 - 4. Totally functional, without degradation, to host or secondary control/management systems.
 - 5. Environment Rating: NFPA 70.
 - a. Exterior Locations: Wet.
 - b. Maintenance Building Interior Locations: Damp.
 - c. Other Interior Locations: Dry.
 - d. Hazardous Locations: NFPA 70; Class II, Division 1, Group F rated.
 - 6. Electrical Power: 120 Volts AC, 60 Hz.
 - 7. Control Power: 12 Volts AC and 12 Volts DC.
 - 8. Backup Power: 96-hour duration, on primary power loss.

2.3 PRODUCTS - GENERAL

- A. Products: GSA APL approved.
- B. Provide control and communications panels from same manufacturer ensuring compatibility.

2.4 INTERFACE, HEAD END, CONTROL, AND COMMUNICATIONS PANELS

- A. Panels: Expandable, network capable, expandable, providing entire facility access control through primary interface head end panel.
 - 1. Indoor Locations: NEMA 250; Type 1.
 - 2. Outdoor Locations: NEMA 250; Type 4X .
 - 3. Mounting: Wall.
 - 4. Access Doors: Locking, front only; operable without disturbing and damaging internal wiring.
 - 5. Ventilation: Electric fan, non-disposable air filter and enclosure openings required to dissipate heat from panel modules.
 - 6. Signal Wiring Strips:
 - a. Input Strip: Top row, receiving output signal from connected devices.
 - b. Output Strip: Bottom row transmitting input signal to connected devices.
 - 7. Power outlet strip.
 - 8. Bulkhead connector panel.
 - 9. Computer Access: Password protected.
 - 10. Database: Single, integrated, relational type.
 - 11. Operating System:
 - a. Microsoft Windows 10.
 - b. Linux embedded OS, browser based thin-client.
 - 12. Programming Source Code: Single, unified 32-bit program interfacing with panel modules.
 - 13. Panel Modules: Programmable; general control, access control, alarm monitoring, credential management, digital video, and intrusion detection.
- B. Client Applications: Web enabled using panel database.
 - 1. Operating System Support:
 - a. Microsoft: Windows 10.

2.5 PANEL MODULES

- A. General Control Module:
 - 1. Process access control and alarm monitoring operations.
 - a. Access Request Response Time: Maximum 0.5 seconds when connected to 64 card readers.

2. Store access levels, hardware configuration, and alarm outputs. Transmit alarm condition to remote client workstation designated by Contracting Officer's Representative.
3. Functional and Operational Requirements:
 - a. Communications: Electronically supervised, minimum 115,200 bps. Support direct-connect and remote dial-up.
 - 1) Downstream Multi-Drop: TIA 485; card readers and control panel.
 - 2) Downstream Serial: TIA 232.
 - 3) Upstream: TIA 485; full duplex, system head-end UL 1076 Grade AA communication channel.
 - 4) Electronically Supervised Communications with system software.
 - b. Memory: Minimum eight MB.
 - 1) Cardholders: Store minimum 5,000.
 - 2) Events: Store minimum 10,000.
 - c. Local Area Network (LAN): RJ45 (10/100baseT) Ethernet Interface Token Ring, four MB connectivity.
 - d. Support multiple PIV card technologies.
 - 1) Support minimum eight card formats and facility codes.
 - 2) Integrate with card readers.
 - e. Issue Code Support for both Magnetic and Wiegand Card Formats.
 - f. Individual Shunt Times.
 - g. PIN Codes: Maximum nine-digit.
 - h. LED Status Indicators: Show component and communication status.
- B. Access Control Module:
 1. Control Capacity: Minimum 16 openings.
 2. Input and Output: Programmable relays.
 3. Input Relays: UL 294 and UL 1076; analog, monitoring and reporting alarm conditions, power faults, and tampers.
 - a. Normal Operation: Monitor control relays for alarm condition.
 - b. Alarm Operation: Activate programmed alarm outputs.
 - c. Functional and Operational Requirements:
 - 1) Scan zone alarm contact status minimum 120 times per second.
 - 2) Processor: Low power complementary-symmetry/metal-oxide semiconductor (CMOS) type.
 - 3) Filtered data for noise rejection to prevent false alarms.

- 4) Alarm Inputs: Unsupervised.
 - 5) Supervised Inputs: Minimum 16.
 - 6) Tamper and Power Status: Two dedicated inputs.
4. Output Relays: Control output device in response to:
- a. Input alarms.
 - b. Commands from system operator.
 - c. Time zone control automatic operation.
 - d. Functional and Operational Requirements:
 - 1) Individual Relay Pulsing: Programmable, predetermined duration.
 - 2) System Operator Command Responses: Pulse, on, off, and normal state reset.
 - 3) Output Rating: 5 Amps, 30 Volts DC.

2.6 ELECTRONIC SECURITY MANAGEMENT SYSTEM (SMS)

- A. System Configuration Functions: Any combination of the following:
1. Personnel enrollment and badging.
 2. Alarm monitoring.
 3. Administrative.
 4. Digital video management.
 5. Intrusion detection.
- B. Expandability: Support unlimited number of individual module or integrated client workstations.
- C. Network Connectivity: Connect access control devices and Intelligent System Controllers (ISC) to each networked Windows based access control system workstation.
- D. Reporting Capability: Compose, file, maintain, update, and print reports.
1. Individual Reports: Report employee's name, office location, phone number or direct extension, and normal hours of operation, and detail listing of employee's daily access controlled events.
 2. System Reports: Report information on daily, weekly, and monthly basis including events, alarms, and other activity associated with system users.
 3. Report Format: Tabular, chronologic by date and time.

E. Network Protocol and Topology Capability:

1. Transmission Control Protocol (TCP)/IP.
2. Novell Netware (IPX/SPX).
3. Banyan VINES.
4. IBM LAN Server (NetBEUI).
5. Microsoft LAN Manager (NetBEUI).
6. Network File System (NFS) Networks.
7. Remote Access Service (RAS) via ISDN, x.25, and standard phone lines.

F. Subsystem Control: Provide full interface and control of following subsystems:

1. Public key infrastructure.
2. Card management.
3. Identity and access management.
4. Personal identity verification.

G. System Features and Compatibilities:

1. Local and remote operation via LAN, WAN, internet, or intranet only at MCR.
2. Event and alarm monitoring.
3. Database partitioning.
4. Ability to fully integrate with security subsystems.
5. Enhanced monitoring station with split screen views.
6. Alternate and extended shunt by door.
7. Escort management.
8. Enhanced IT-based password protection.
9. N-man rule and occupancy restrictions.
10. Open journal data format for enhanced reporting.
11. Automated personnel import.
12. ODBC support.
13. Windows 2000 Professional, Windows Server 2003, Windows XP Professionals for Servers.
14. Field-level audit trail.
15. Cardholder access events.

- H. Provide network server and client workstations as approved by OI&T during project design.

| NETWORK SERVER | |
|-----------------------|--|
| Processor | 1.8 GHz, Intel Pentium/Dual Processor |
| Free HD space | 300 gB |
| Memory | 4.0 gB |
| Network card | 10/100 base-T |
| CD/ROM drive | 20X |
| Monitor/video adaptor | 27" SVGA/HDTV (1024 X 768) |
| Operating system | Windows 2000/2003/2007 Professional, Windows Server 2003/Windows XP Professional as approved by host VAMC OI&T |
| Ports | 2 Serial; 1 Parallel, 4 USB |
| Back-up | Tape/CD-RW |
| Modem | 56.7 kbps (must be specifically approved by Host VAMC's OI&T) |
| CLIENT WORKSTATION | |
| Processor | 1.5 GHz Intel Pentium/dual core |
| Free HD Space | 200 gB |
| Memory | 2.0 gB |
| CD-ROM Drive | 20X |
| Network/Video adapter | 22" HDTV/SVGA (1024 X 768) |
| Operating System | Windows 2000/3000/7000 Professional/XP Professional (host VAMC OI&T) |

- I. Un-Interruptible Power Supplies (UPS):
1. COTS full electrical/electronic supervision notification network capable; rack mounting.
 2. Capacity: Minimum 1 hour for routine outages and 2 hours for emergency systems under full load.
 3. Capacity: Sized based on the final design by the contractor.

2.7 PIV CARDS

- A. PIV Cards: Provided by host station Security Service.

2.8 CARD READERS - GENERAL

- A. Card Readers: FIPS 201 and ISO/IEC 14443, A or B compliant; programmable, addressable, and wired.
 - 1. Control locking door hardware. See Section 087100, DOOR HARDWARE.
 - 2. Report to control panel for recording door access:
 - a. Time and date.
 - b. Individual identification.
 - c. Door location.
 - 3. Connected by home run to main panel.
 - 4. Card Reader Type: card and PIN.
 - 5. Output: Wiegand, RS-232, TIA 485 or TCP/IP.
- B. Housing: Aluminum bezel with wide card entry lead-in.
- C. Electronics: Read head and sender encoding control signals.
- D. Status Lights: LED indicating card reader status and access status.
- E. Off-Line Operation: Programmable; locked, unlocked, or facility code operation when main control panel communication is lost.
- F. Access Status Audible Indicator:
 - 1. Access Granted: Two tones or beeps.
 - 2. Access Denied: Three tones or beeps.
- G. Inputs: Minimum two, programmable.
- H. Outputs: Minimum two, programmable.
- I. Keypads: Integral with card reader alphanumeric arranged in ASCII code ordinal sequence with tactile and audible feedback when buttons are pressed.
 - 1. Display: LED; access status and user prompts.
 - a. Status Indication:
 - 1) Power on and off.
 - 2) Access granted.
 - 3) Access denied.
 - b. Limit keypad display viewing angles, measured normal to keypad surface centerlines.
 - 1) Horizontal Limit: Maximum 5 degrees.
 - 2) Vertical Limit: Maximum 15 degrees.
 - 2. Output: Signal control panel.
 - a. Response Time: Maximum 800 milliseconds after last keypad entry.
 - 3. Power Consumption: Maximum 150 Watts.

4. Wall Mounting: Surface. See drawings.
 - a. Exterior Locations: Weatherproof.
5. Duress Signal: Report emergency when special code is entered.

2.9 PORTAL CONTROL DEVICES

- A. Assist System by:
 1. Monitoring door status.
 2. Allowing exit via push button, request to exit, or panic/crash bar.
 3. Providing system override via keypad or key bypass.
 4. Assisting door operations using automatic openers and closures.
 5. Providing secondary means of access to space via keypad.
 6. Monitoring via main control panel.
 7. Providing secondary means of access control within secure area.
- B. Push-Button Switches: Momentary contact; back lighted push buttons, and stainless steel switch enclosures.
 1. Contacts: Double-break silver contacts making 720 VA at 60 Amperes and breaking 720 VA at 10 Amperes.
 2. Guard Control: Provide interface board including buttons to remotely release access controlled doors. Label buttons identifying controlled doors.
- C. Key Bypass: Provide cylinders for locks and exit devices. See Section 087100, DOOR HARDWARE.

2.10 DOOR STATUS INDICATORS

- A. Door Position Sensors: Surface or flush mounted, wide-gap type. Monitor and report OPEN and CLOSED door status.
 1. Access Control Switches: Double pole, double throw switches; reporting independently to access control system and intrusion detection system.
 2. Gap Operating Range: 0 to 50 mm (0 to 2 inches).
- B. Request-to-Exit Devices (RX):
 1. RX Device: Infrared sensor and push button to de-energize each electromagnetically locked door allowing free exit.
 2. Infrared Sensors:
 3. Alarm output: 2ea. - form "C" Relay contacts.
 4. Indicators: 1ea. - Activation LED.
 5. Power Requirements: 12 or 24 Volt DC; 26 mA at 12 Volt DC.

2.11 ENTRY CONTROL DEVICES

- A. Electric Strikes: See Section 087100, DOOR HARDWARE.

2.12 POWER SUPPLIES

- A. UL Listed; capable of powering two entry control devices, continuously, without failure.
1. Input Power: 110 Volt AC, 60 Hz, 2.0 Amperes.
 2. Output Power: 12 Volt DC nominal (13.8 Volt DC) and 24 Volt DC nominal (27.6 Volt DC); filtered and regulated.
 3. Battery: Minimum 14 Ampere-hour at full load, rechargeable.
 4. Output Current: Maximum 10.0 Amperes at 13.8 Volt DC and 5.0 Amperes at 27.6 Volt DC.
 5. Primary Fuse: 6.3 Ampere, non-removable.
 6. Battery Fuse: 12 Ampere, 3ASG.
 7. Battery Charging Circuit: Manufacturer's standard.

2.13 LABELS

- A. Labeling Abbreviations: Use accepted industry standards consistent with submittal drawings and recorded in as-built drawings.
- B. Wire Labels: Permanent, with contrasting identification alpha or numeric, identifying each cable according to system submittal drawings.
- C. Equipment and AC Power Labels: Permanent with contrasting plastic laminate or Bakelite material.

2.14 WIRING

- A. Grounding and Bonding Materials: See Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.
- B. Raceways: See Section 27 05 33, CONDUITS AND BACKBOXES FOR COMMUNICATIONS SYSTEMS.
- C. Wires: See Section 27 10 00, STRUCTURED CABLING.

2.15 INSTALLATION KIT

- A. Include, at minimum, connectors and terminals, labeling systems, audio spade lugs, barrier strips, punch blocks, wire wrap terminals, heat shrink tubing, cable ties, solder, hangers, clamps, bolts, conduit, cable duct, cable tray, and other items required for neat and secure installation.
1. Terminate wires in spade lug and barrier strip, wire wrap terminal or punch block.

2. Unfinished and unlabeled wire connections are not allowed.
 3. Deliver unused and partially opened installation kit boxes, coaxial, fiber-optic, and twisted pair cable reels, conduit, cable tray, cable duct bundles, wire rolls, and physical installation hardware to Contracting Officer's Representative.
- B. System Grounding Kit: Include cable and installation hardware required to connect head end equipment, power supplies, and following components to earth ground via internal building wiring, according to NFPA 70.
1. Coaxial cable shields.
 2. Control cable shields.
 3. Data cable shields.
 4. Equipment racks.
 5. Equipment cabinets.
 6. Conduits.
 7. Cable duct blocks.
 8. Cable trays.
 9. Power panels.
 10. Connector panels.
- C. Coaxial Cable Kit: Include coaxial connectors, cable tying straps, heat shrink tabbing, hangers, clamps, and other items required for neat and secure installation.
- D. Wire and Cable Kit: Include connectors and terminals, audio spade lugs, barrier straps, punch blocks, wire wrap strips, heat shrink tubing, tie wraps, solder, hangers, clamps, labels and other items required for neat and secure installation.
- E. Conduit, Cable Duct, and Cable Tray Kit: Include conduit, duct, trays, junction boxes, backboxes, cover plates, feed through nipples, hangers, clamps, and other hardware required for neat and secure conduit, cable duct, and cable tray installation according to NFPA 70.
- F. Equipment Interface Kit: Include equipment, cable, mounting hardware, and materials to interface systems with subsystems according to manufacturer's instructions.
- G. Labeling Kit: Include labels, tools, stencils, and materials to label each subsystem according to manufacturer's instructions and as-built drawings.

- H. Documentation Kit: Include items, computer discs, as-built drawings, equipment, operation and maintenance manuals, and manufacturer's publications to fully document installed system.

2.16 ACCESSORIES

- A. Sealant: See Section 079200, JOINT SEALANTS.
- B. Provide connectors, terminators, and other accessories required for operable system.
- C. Galvanizing Repair Paint: MPI No. 18.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Field survey, test and inspect existing door equipment and signal lines intended to be incorporated into the SYSTEM.
 - 1. Door equipment and wiring usable without modification may be reused with Contracting Officer's Representative's approval.
- B. Obtain Contracting Officer's Representative's approval minimum 3 days before interrupting existing system service.
- C. Protect existing construction and completed work from damage.
 - 1. Repair damage caused by construction operations.
- D. Remove existing door equipment and wiring to permit new installation.
 - 1. Retain existing serviceable door equipment indicated for reuse.
 - 2. Dispose of other removed materials.

3.2 INSTALLATION - GENERAL

- A. Install products according to UL 294, 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 INSTALLATION - EQUIPMENT

- A. Configure components with service points to pinpoint system trouble in less than 15 minutes.
- B. Ensure components are fully compatible as a system and can be integrated with associated and remote security subsystems, whether system is stand-alone, hardwired, or networked to meet requirements of AHJ SMCS 07A2.

- C. Install system components including Government furnished equipment, and appurtenances according to manufacturer's instructions. Provide necessary connectors, terminators, interconnections, services, and adjustments required for operable system.
- D. Connect existing door equipment, wiring, and devices shown on drawings.
- E. Raceway Penetrations:
 - 1. Enter control panels through panel bottom.
 - 2. Seal penetrations located outdoors. Seal penetrations through building exterior enclosure.
 - 3. Firestop penetrations through fire rated assemblies. See Section 07 84 00, FIRESTOPPING.
 - 4. Terminate conduit riser in hot-dip galvanized metal cable terminator. Fill terminator with sealant recommended by cable manufacturer.
- F. Control Panels:
 - 1. Install control panels plumb and level, securely attached to wall.
 - a. Mount panels allowing servicing and testing access.
 - 2. Connect wiring to control modules.
 - 3. Program control modules to provide specified functions.
- G. SMS:
 - 1. Coordinate with VA agency's IT personnel to place computer on local area network or intranet with security system protection levels ensuring only authorized VA personnel have access to system.
 - 2. Program and set-up SMS ensuring full operation.
- H. Card Readers:
 - 1. Install card readers. Connect wiring.
 - 2. Program card reader.
- I. Door Status Indicators:
 - 1. Install door position switches. Connect wiring.
 - 2. Install RX devices. Locate RX switches away from glazed openings; maximum 1800 mm (6 feet) from door.
- J. Install entry control devices. See Section 087100, DOOR HARDWARE. Connect wiring.
- K. Video Surveillance System Integration: Program SMS to automatically display designated video surveillance camera when an access control system device signals alarm state.

- L. Touch up damaged factory finishes.
 - 1. Repair galvanized surfaces with galvanized repair paint.

3.4 INSTALLATION - WIRING

- A. Wiring: See Section 28 05 13, CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY.
- B. Grounding and Bonding: See Section 28 05 26, GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY.
- C. Raceway Installation: See Section 28 05 33, RACEWAYS AND BOXES FOR ELECTRONIC SAFETY AND SECURITY.

3.5 LABELING

- A. Cable and Wires: Install labels on cables at each termination, pull box, and break in conductor run.
 - 1. Labels: Permanent, with contrasting identification alpha or numeric, identifying each cable according to system submittal drawings.
- B. Equipment: Label equipment, and equipment inputs and outputs.
 - 1. Permanently affix labels to equipment face with metal screws, permanent mounting devices, or cement.
 - 2. Label equipment corresponding to control source. Label remote control equipment corresponding to controlled equipment.
- C. AC Power: Label power panel circuit breaker identifying connected access control panel.
 - 1. Permanently affix labels to equipment face with metal screws, permanent mounting devices or cement.
- D. Conduit: Label access control system conduit with permanent marking devices or spray painted stenciling, maximum 3000 mm (10 feet) spacing.

3.6 SYSTEM START-UP

- A. Before powering system, verify installation is complete, including:
 - 1. Equipment is set up according to Manufacturer's instructions.
 - 2. Visual inspection ensuring installed equipment is not defective and wiring connections are tight.
 - 3. System wiring continuity and resistance.
 - 4. Grounding and transient protection systems are installed and connected.
 - 5. Power supplies are correct voltage and frequency.

- B. Completing system startup does not relieve Contractor of responsibility for incorrect installation, defective equipment items, and Contractor caused resulting collateral damage.

3.7 FIELD QUALITY CONTROL

- A. Field Tests: Performed by testing laboratory specified in Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Field Representative Services:
 - 1. Observe preparation and initial construction.
 - 2. Provide technical assistance and recommendations.
 - 3. The Contractor shall also be available on an as needed basis to provide assistance with follow-up phases of quality control.
 - 4. Observe system start-up, testing, and certification.
 - 5. Certify system is fully operational according to contract requirements.
- C. Upon 30 - 50 Percent System Completion:
 - 1. Certify completed work before continuing installation.
 - 2. Verify components are UL Listed and labeled, and installation is NFPA 70 and NFPA 101 compliant.
 - 3. Mechanical Inspection: Performed by factory authorized representative verifying proper installation; witnessed and recorded by Contracting Officer's Representative.
 - 4. Perform full acceptance test.
- D. Upon 65 - 80 Percent System Completion: Repeat inspections and tests as required by Contracting Officer's Representative.
- E. System Protection during Testing: See Section 27 05 00 - COMMON WORK RESULTS FOR COMMUNICATIONS.
- F. Acceptance Testing:
 - 1. Verify system components are authorizing proper credentials at access controlled doors and system alarms are functioning.
 - a. Perform visual check and record presence of required access controlled opening components and devices.
 - b. Test each opening while in locked status by physically pushing and pulling on door, in and out, and up and down.
 - c. Validate door remains in locked position with no visible gaps forming between door and frame at any point along the opening edges.

- d. Door position sensor shall not alarm.
- 2. Test each opening and system response for following conditions:
 - a. Authorized credential presented.
 - b. Unauthorized credential presented.
 - c. Wrong pin entered.
 - d. Door held open.
 - e. Door forced.
- 3. Validate tamper switch operation for following devices:
 - a. Door position switch. Signal alarm when door strike edge moves maximum 25 mm (1 inch) from closed and latched position.
 - b. Control panels.
 - c. Card readers.
- 4. Observe and verify SMS system operation including:
 - a. System transaction records.
 - b. System alarm and tamper reports.
 - c. Graphical map accuracy.
 - d. Alarm generation to alarm reporting latency period.
 - e. Alarm text indication accuracy.
- G. Test Conclusion: See FAR clause 52.246 21, "Warranty of Construction."
- H. Post System Testing - Cleaning: See Section 27 05 00 - COMMON WORK RESULTS FOR COMMUNICATIONS.

3.8 TRAINING

- A. The Contractor will provide training. The training method shall agree with the precepts of an accepted training methodology such as the Systems Approach to Training that is used by the DoD. No Ad Hoc training will be considered acceptable. Student(s) will be provided printed training materials as well as a CD/DVD copy of the classes. The training must provide the student(s) the ability to: set up the system, maintain the system, trouble shoot problems, recognize system/component failures as well as any nuanced customization of the system for the specific location.
- B. Training on each installed system [IE components] will minimally include:
 - 1. Physical Access Control (PACS)
 - a. Management of Access Levels
 - b. Management of Card Holder Records

- c. Management of Time zone/Reader Modes
 - d. Rebooting the system(s)
 - e. Basic understanding of software "patch" changes that may impact VA specific Information Technology protocols. (Example would be patching that may clash with Windows environs or virus protection software)
2. Visitor Management
- a. Management of Visitor Management tools
3. Overall system(s) maintenance.
- a. Those steps necessary for the basic understanding of: lifecycle maintenance of system to include factors such as: yearly support agreements, impact of power surges/loss as well as those endemic pieces of knowledge that include preventive maintenance considerations and or tasks.
- C. The contractor will provide instruction giving the students sufficient training to be able to effectively operate the system and recognize problems as they arise. All training must include guided practical application exercises to ensure student(s) understanding. Certification of the training/curriculum/rosters will be provided to the COR/CO upon training task completion.

- - - E N D - - -

**SECTION 28 20 00
VIDEO SURVEILLANCE**

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Closed circuit television system.
- B. See Section 27 05 00, COMMON WORK RESULTS FOR COMMUNICATIONS for requirements governing work of this section.

1.2 RELATED REQUIREMENTS

- A. For firestopping application and use, Section 07 84 00, FIRESTOPPING.
- B. For labeling and signs, Section 10 14 00, SIGNAGE.
- C. Section 26 05 11For power cables, Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW).
- D. Section 26 05 26Section 26 05 33For alarm systems, Section 28 16 11, INTRUSION DETECTION SYSTEM (IDS).
- E. For General Requirements, Section 01 00 01, GENERAL REQUIREMENTS.

1.3 APPLICABLE PUBLICATIONS

- A. Comply with references to extent specified in this section.
- B. American National Standards Institute (ANSI)/Electronic Industries Alliance (EIA):
 - 1. 330-09 - Electrical Performance Standards for CCTV Cameras.
- C. Institute of Electrical and Electronics Engineers (IEEE):
 - 1. C62.41-02 - IEEE Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
 - 2. 802.3af-08 - Power over Ethernet Standard.
- D. National Electrical Contractors Association (NECA):
 - 1. 303-2005 - Installing Closed Circuit Television (CCTV) Systems.
- E. National Electrical Manufacturers Association (NEMA):
 - 1. 250-14 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- F. National Fire Protection Association (NFPA):
 - 1. 70-17 - National Electrical Code (NEC).
- G. Federal Information Processing Standard (FIPS):
 - 1. 140-2-02 - Security Requirements for Cryptographic Modules.
- H. UL LLC (UL):
 - 1. 983-06 - Standard for Surveillance Camera Units.

2. 2044-08 - Standard for Surveillance Closed Circuit Television Equipment.

I. United States Department of Veterans Affairs (VA):

1. VA Construction and Facilities Management (CFM):

a. DM Electrical - Electrical Design Manual, 2015.

1.4 SUBMITTALS

A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

1.5 WARRANTY

A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."

PART 2 - PRODUCTS

2.1 SYSTEM REQUIREMENTS

A. CCTV system to comply with UL 2044 and operate on 120 Volt AC; 60 Hz power system, with backup power system that will provide minimum 96 hours run time in the event of power failure.

B. Design, engineer, install, and test CCTV System to ensure components are fully compatible as a system and can be integrated with associated security subsystems, whether system is stand-alone or complete network.

C. Integrate CCTV System where appropriate with security subsystems:

1. PACS:

a. Provide 24-hour coverage of all entry points to perimeter and agency buildings and all emergency exits utilizing fixed color camera.

b. Record cameras on 24-hour basis.

c. Programmed go into alarm state when an emergency exit is opened, and notify Access Control System and Database Management of an alarm event.

2. IDS:

a. Provide recorded alarm event via color camera connected to IDS system by direct hardwire or security system computer network.

b. Record cameras on 24 hours basis.

c. Be programmed to go into alarm state when an IDS device is put into an alarm state, and notify Police and Engineering.

- d. For additional CCTV System requirements as they relate to the IDS, refer to Section 28 31 00, INTRUSION DETECTION.
3. Security Access Detection:
 - a. Provide full coverage of vehicle and lobby entrance screening areas utilizing fixed color camera.
 - b. Record cameras on 24 hours basis.
 - c. Provide CCTV System with facial recognition software to assist in identifying individuals for current and future purposes.
4. EPPS:
 - a. Provide recorded alarm event via color camera connected to EPPS system by direct hardwire or security system computer network.
 - b. Record cameras on 24 hours basis.
 - c. Be programmed to go into alarm state when emergency call box or duress alarm/panic device is activated, and notify Access Control System and Database Management of an alarm event.
- D. Integration with these security subsystems to be achieved by computer programming or direct hardwiring of systems.
- E. For programming purposes refer to manufacturer's instructions for correct system operations. Ensure computers being utilized for system integration meet or exceed minimum system requirements outlined on system's software packages.
- F. Complete CCTV System to be comprised of, but not limited to, the following components:
 1. Cameras.
 2. Lenses.
 3. Video Display Equipment.
 4. Camera Housings and Mounts.
 5. Controlling Equipment.
 6. Recording Devices.
 7. Wiring and Cables.
- G. Visit site and verify that site conditions are in agreement and compliance with design package. Submit report of all changes to site or conditions that will affect system performance to Contracting Officer's Representative (COR). Do not take any corrective action without written permission received from COR.

H. Existing Equipment:

1. Connect to and utilize existing video equipment, video and control signal transmission lines, and devices as outlined in design package. Video equipment and signal lines that are usable in their original configuration without modification may be reused with COR approval.
2. Perform field survey, including testing and inspection of all existing video equipment and signal lines intended to be incorporated into CCTV System, and provide report to COR as part of site survey report. For those items considered nonfunctioning, provide (with report) specification sheets, or written functional requirements to support findings and estimated cost to correct deficiency. As part of report, include schedule for connection to all existing equipment.
3. Make written requests and obtain approval before disconnecting any signal lines and equipment, and creating equipment downtime. Proceed with such work only after receiving COR approval of requests. If any device fails after work has commenced on that device, signal or control line, diagnose failure and perform necessary equipment corrections.
4. Contractor will be held responsible for repair costs due to Contractor negligence, abuse, or incorrect installation of equipment.
5. Provide COR with full list of all equipment to be removed or replaced, including description and serial/manufacturer numbers, where possible. Dispose of all equipment that has been removed or replaced based upon COR approval after reviewing equipment removal list. In all areas where equipment is removed or replaced, repair those areas to match current existing conditions.

- I. Enclosure Penetrations: All enclosure penetrations will be from bottom of enclosure unless system design requires penetrations from other directions. For penetrations of interior enclosures involving transitions of conduit from interior to exterior, seal penetrations on exterior enclosures with rubber silicone sealant to preclude water infiltration and comply with Section 07 84 00, FIRESTOPPING. Terminate conduit riser in hot-dipped galvanized metal cable terminator.

Fill terminator with approved sealant as recommended by cable manufacturer without damaging cable.

- J. Cold Galvanizing: Coat field welds and brazing on factory galvanized boxes, enclosures, and conduits with cold galvanized paint containing at least 95 percent zinc by weight.
- K. Interconnection of Console Video Equipment: Connect signal paths between video equipment as specified by OEM.
- L. Provide cables of sufficient lengths for rack mounted equipment on slide mounts to allow full extension of slide rails from rack.

2.2 EQUIPMENT

- A. See Section 27 05 00 COMMON WORK RESULTS FOR COMMUNICATIONS.
- B. Custom Control Console (CCC) and cabinets:
 - 1. Meets system's specific requirements in PCR, ECR, and EMCR.
- C. Provide CCTV system meeting following requirements:
 - 1. Cameras: UL 983 compliant.
 - 2. Charge coupled device (CCD) cameras conforming to National Television System Committee (NTSC) formatting.
 - 3. Fixed color cameras and primary choice for monitoring following activities described below. Pan/Tilt/Zoom (P/T/Z) cameras to be color and utilized to compliment fixed cameras.
 - 4. System powered by 12 Volts direct current (VDC) or 24 VAC. Power supplies, to be Class 2 and UL compliant and have back-up power source to ensure cameras are still operational in event of loss of primary power to CCTV System.
 - 5. Rated for continuous operation under the following environmental conditions:
 - a. Ambient temperatures of minus 10 degrees C (14 degrees F) to 55 degrees C (131 degrees F) utilizing equipment that will provide automatic heating and cooling.
 - b. Humidity, wind gusts, ice loading, and seismic conditions specified or encountered for locations where CCTV cameras will be utilized.
 - 6. Home run to monitoring and recording device via controlling device such as matrix switcher or network server and monitored on 24-hour basis at designated Access Control System and Database Management location.

7. Each function and activity to be addressed within system by unique twenty (20) character user defined name. Use of codes or mnemonics identifying CCTV action is not acceptable.
8. Furnished with built-in video motion detection that automatically monitors and processes information from each camera. Camera motion detection will detect motion within camera's field of view and provide automatic visual, remote alarms, and motion-artifacts as result of detected motion as follows:
 - a. Motion-detection settings to include adjustable object size and velocity, as well as selectable detection area of 132 zones in twelve (12) by eleven (11) grid.
 - b. Sensors to accept video signals from CCTV cameras and, when synchronizing is required, be in composite synchronization.
 - c. Sensor processors that detect motion by digitizing multiple pixels within each video scene and by comparing pixel gray scale to previously stored reference. Number of pixels digitized depends on application. System designer should consider cost effectiveness since digitizing large number of pixels could increase cost dramatically with little additional actual detection capability for specific application.
 - d. Alarm will be initiated when comparison varies by six (6) percent or more.
9. Design, provide, and post appropriate signage to notify people that an area is under camera surveillance.
10. Dummy or fake cameras will not be utilized.
11. Programmed to digitally flip from color to black and white at dusk and vice-versa at dawn.
12. Fitted with auto-iris lenses to ensure image is maintained in low light.
13. Lightning protection to be IEEE C62.41 compliant and provided for all cameras. Surge protectors or lightning grid may be utilized. Ensure lightning protection equipment is compliant with NFPA 70 (Article 780). Use of fuses and circuit breakers as lightning protection is not acceptable.
14. For camera as part of CCTV network, provide video encoder to convert National Television Systems Committee (NTSC) signal to Moving Picture Experts Group (MPEG) format.

15. Utilize Multi-sensor cameras to complement fixed cameras, not as primary means of monitoring activity. Refer to the project drawings for additional information.
16. Fixed Color Cameras Technical Characteristics:

| | |
|--------------------------|---------------------------------|
| Imaging Device | 1/3 inch interline transfer CCD |
| Picture Elements | NTSC 510 (H) x 492 (V) |
| Scanning System | NTSC 525 lines, 21 interlace |
| Synchronization System | AC line lock/internal |
| Horizontal Resolution | 330 TV lines |
| Iris Control | Selectable on/off |
| Electronic Shutter Range | NTSC 1/60-1/100,000 second |
| Auto Iris Lens Type | DC/video drive (auto sensing) |
| Minimum Illumination | 0.6 lux |
| Signal to Noise Ratio | Greater than 50 dB |
| Automatic Gain Control | On/off switchable |
| Backlight Compensation | On/off switchable |
| Auto White Balance | On/off switchable |
| Video Output | 1 Vp-p, 75 ohms |
| Power Consumption | Less than 5 watts |
| Video Connector | BNC |
| Lens Mount | C/CS mount (adjustable) |

17. Refer to the project drawings for additional camera requirements.

2.3 CAMERAS

- A. General Requirements:
 1. UL 983 compliant.
 2. Conform to National Television System Committee (NTSC) format.
- B. Power over Ethernet (PoE) Cameras:
 1. General Requirements:
 - a. IEEE 802.3af compliant.
 - b. Utilized only as part of CCTV Network and not integrated with standard analog or digital CCTV System equipment.
 - c. Utilized for interior and exterior purposes.
 - d. Routed to controlling device via network switcher or direct connection to network server.

- e. Hybrid design with both Internet Protocol (IP) output and monitor video output which produces picture equivalent to analog camera, and allows simultaneous output of both.
 - f. Provide minimum 200,000 effective pixels with built-in complementary color filter for accurate color with no image lag or distortion.
 - g. Programmable IP address that allows installation of multiple units in same Local Area Network (LAN) environment.
 - h. Incorporate minimum of Transmission Control Protocol (TCP)/IP, User Datagram Protocol (UDP), Hypertext Transfer Protocol (HTTP), File Transfer Protocol (FTP), Internet Control Message Protocol (ICMP0), Address Resolution Protocol (ARP), Real-Time Transport Protocol (RTP), Dynamic Host Configuration Protocol (DHCP), Network Time Protocol (NTP), Simple Mail Transfer Protocol (SMTP), Internet Group Management Protocol (IGMP), and Differentiated Service Code Point (DSCP) protocols for various network applications.
2. Provide Category (CAT)-V cable as primary source for carrying signals maximum 100 m (300 ft.) from switch hub or network server. If any camera is installed over 100 m (300 ft.) from controlling device then the following will be required:
- a. Local or remote 12 Volt DC or 24 Volt AC power source from Class 2, UL compliant power supply.
 - b. Signal converter to convert from CAT-V cable over to fiber optic or standard signal cable. Signal will be required to convert back to CAT-V cable at controlling device using signal converter card.
3. Technical Characteristics:

| | |
|------------------|--|
| Video Standards | MPEG-4; M-JPEG |
| Video Data Rate | 9.6 Kbps - 6 Mbps Constant & variable |
| Image Resolution | 768x494 (NTSC) |
| Video Resolution | 704 x 576/480 (4CIF: 25/30 IPS) 704 x 288/240 (2CIF: 25/30 IPS) 352 x 288/240 (CIF: 25/30 IPS) 176 x 144/120 (QCIF: 25/30 IPS) |

| | |
|--------------------------------|---|
| Video Standards | MPEG-4; M-JPEG |
| Select Frame Rate | 1-25/30 IPS (PAL/NTSC); Field/frame based coding |
| Network Protocols | RTP, Telnet, UDP, TCP, IP, HTTP, IGMP, ICMP |
| Software Update | Flash ROM, remote programmable |
| Configuration | Via web browser, built-in web server interfaces |
| Video Out | 1x Analog composite: NTSC or PAL; BNC connector 75 Ohm |
| Sensitivity | 1 0.65 lux (color) 0.26 lux (NightSense) |
| Minimum Illumination | 0.30 lux (color)0.12 lux(NightSense) |
| Video Signal-to-Noise Ratio | 50 dB |
| Video Signal Gain | 21 dB, (max) Electronic Shutter Automatic, up to 1/150000 sec. (NTSC) |
| Alarm In | Automatic sensing (2500 - 9000 K) |
| Input Voltage | +5 V nominal, +40 Volt DC max VDC: 11-36 V (700 mA) VAC: 12-28 V (700 mA) PoE: IEEE 802.3af compliant |

2.4 LENSES

A. General Requirements:

1. Provides maximum coverage of area being monitored by camera.
2. Provide lenses 8.5 mm (0.33 inches) to fit CCD fixed camera.
3. Glass with coated optics.
4. Mounts compatible with camera selected.
5. Packaged and furnished with camera.
6. Maximum f-stop of f/1.3 for fixed lenses, and maximum f-stop of f/1.6 for variable focus lenses.
7. Equipped with auto-iris mechanism.
8. Sufficient circle of illumination to cover image sensor evenly.

9. Not to be used on camera with image format larger than lens is designed to cover.

10. Pre-set capability.

B. Manual Variable Focus:

1. Provide manual variable focus lenses in large areas being monitored such as perimeter fence lines, vehicle entry points, parking areas, and areas indicated on Drawings.

2. Manual variable focus lenses to allow for setting virtually any angle of field, which maximizes surveillance effects.

3. Technical Characteristics:

| | |
|------------------------------|-----------------------|
| Image format | 1/3 inch |
| Focal length | 5-50mm |
| Iris range | F1.4 to close |
| Focus range | 1m (3.3 ft.) |
| Back focus distance | 10.05 mm (0.4 inches) |
| Angle view Wide (1/3 inches) | 53.4 x 40.1 |
| Angle view Tele (1/3 inches) | 5.3 x 4.1 |
| Iris control | manual |
| Focus ctrl | manual |
| Zoom ctrl | manual |

C. Auto Iris Fixed:

1. Provide auto iris fixed lenses in areas where small specific point of reference is monitored such as doorways, elevators, and locations indicated on Drawings.

2. Provide focal length calculation using focal length calculator or focal length chart provided by lens manufacturer.

3. Technical Characteristics:

| | | | |
|---------------|--------------|--------------|--------------|
| Image format | 1/3 inch | 1/3 inch | 1/3 inch |
| Focal length | 2.8 mm | 4 mm | 8 mm |
| Iris range | F1.2 - 200 | F1.2 - 200 | F1.2 - 200 |
| Min. Object | 0.3 m (1 ft) | 0.3 m (1 ft) | 0.3 m (1 ft) |
| Lens mount | CS-mount | CS-mount | CS-mount |
| Angle of view | 94 X 72 | 64 X 49 | 33 x 25 |
| Focus control | Manual | Manual | manual |

2.5 VIDEO DISPLAY EQUIPMENT

1. Video display equipment to consist of color monitors and be able to display analog, digital, and other images in NTSC or MPEG format associated with operation of Security Management System (SMS). Other requirements include the following:
 - a. Front panel controls for power on/off, horizontal and vertical hold, brightness, and contrast.
 - b. Accept multiple inputs, directly or indirectly.
 - c. Capable of observing and programming CCTV System.
 - d. Installation cannot be witnessed by general public.
2. Color Video Monitors Technical Characteristics:

| | |
|-----------------------|-------------------------------------|
| Sync Format | PAL/NTSC |
| Display Tube | 90-degree deflection angle |
| Horizontal Resolution | 250 TVL minimum, 300 TVL typical |
| Video Input | 1.0 Vp-p, 75 Ohm |
| Front Panel Controls | Volume, Contrast, Brightness, Color |
| Connectors | BNC |

3. Liquid Crystal Display (LCD) Flat Panel Display Monitor:
 - a. Technical Characteristics:

| | |
|---------------------|---|
| Sync Format | PAL/NTSC |
| LCD Panel | TFT LCD |
| Resolution | 1280 x 1024 pixels; 500 TV |
| Contrast Ratio (CR) | 500: 1 |
| Viewing Angle | 140 degree horizontal, 130 degree vertical |
| Video Input | (CVBS) 1.0 Vp-p (0.5-1.5 Vp-p), 75 Ohm Y/C (S-video) 0.7 Vp-p, 0.3 Vp-p, 75 Ohm |
| Video 1 | Composite video two (2) BNC (1 in, 1 out) |
| Video 2 | Composite video two (2) BNC (1 in, 1 out) |

| | |
|---------------|--|
| Sync Format | PAL/NTSC |
| Y/C (S-video) | two (2) mini-dins, 4-pin (1 in, 1 out) |

2.6 CAMERA HOUSINGS AND MOUNTS

A. Environmentally Sealed:

1. General Requirements:

- a. Provides condensation free environment for correct camera operation.
- b. Operate in 100 percent condensing humidity atmosphere.
- c. Equipped with fill valve for introduction of nitrogen into housing to eliminate existing atmospheric air and pressurize housing to create moisture free conditions.
- d. Equipped with overpressure valve to prevent damage to housing by over pressurization.
- e. Equipped with humidity indicator, visible at all times, to ensure correct atmospheric conditions.
- f. Maximum housing leak rate of 13.8kPa (2 lbs./sq.in.) at sea level in 90-day period.
- g. Camera mounts or supports as required for correct positioning of camera and lens.
- h. White housing and sunshield.

2. Provide all electrical and signal cables required for correct operations in hardened carrier system from controller to camera.
3. Provide adjustable mounting brackets for housing weight of camera and housing unit.
4. Camera and mount accessibility required for maintenance and service purposes.

B. Indoor Mounts:

1. Ceiling Mounts:

- a. Fasten enclosure and mount to finished or suspended ceiling.
- b. Do not support enclosure mount from ceiling metal suspension system. Provide support according to mount manufacturer's instructions.
- c. Suspended ceiling mounts to be low profile and suitable for replacement of 610 mm by 610 mm (2 foot by 2 foot) ceiling panels.

2. Wall Mounts:
 - a. Enclosure installation to match existing décor, placed at unobtrusive height, unable to cause personal harm, and prevent tampering and vandalism.
 - b. Provide mounts with manual pan/tilt head for 360 degree horizontal and vertical positioning from horizontal position and locking bar or screw to maintain its fixed position once adjusted.
- C. Domes:
 1. Domes to be pendant mount, pole mount, ceiling mount, surface mount, or corner mounted equipment.
 - a. Interior Dome Construction:
 - 1) Lower portion that provides camera viewing to be black opaque acrylic and have light attenuation factor of maximum 1 f-stop.
 - 2) Housing to be equipped with integral pan/tilt capabilities complete with wiring, wiring harness, connectors, receiver/driver, pan/tilt control system, pre-position cards, or other hardware and equipment as required for fully functional pan/tilt dome.
 - b. Exterior Domes Construction:
 - 1) Lower portion that provides camera viewing to be black opaque acrylic and have light attenuation factor of maximum 1 f-stop.
 - 2) Housing to be dust and water tight, and fully operational in 100 percent condensing humidity.
- D. Exterior Wall Mounts:
 1. Provide mounts with adjustable head for camera mounting.
 - a. Head adjustable for minimum plus and minus 90 degrees of pan, and minimum plus and minus 45 degrees of tilt.
 2. Constructed of aluminum, stainless steel, or steel with corrosion-resistant finish.
 - a. Install mounts at height that allows for maximum coverage of area being monitored.
- E. Explosion Proof Housing:
 1. Housing to meet or exceed all requirements of NEMA 250 for Type 4 enclosures for hazardous locations.

2. Provide mounting brackets as specified for camera and lens.

2.7 CONTROLLING EQUIPMENT

- A. Controlling equipment to be utilized to call up, operate, and program cameras associated CCTV System components:
 1. Operates cameras locally and remotely. Utilize matrix switcher or network server as CCTV System controller.
 2. Fit controller into standard 47.5 cm (19 inch) equipment rack.
 3. Provide control and programming keyboards with its own type of switcher. Keyboards to meet the following:
 - a. Located at each monitoring station.
 - b. Addressable for programming purposes.
 - c. Provide interface between operator and CCTV System.
 - d. Provide full control and programming of switcher.
 - e. Minimum controls:
 - 1) Programming.
 - 2) Switching.
 - 3) Lens function.
 - 4) Pan/Tilt/Zoom.
 - 5) Environmental housing.
 - 6) Annotation.
 4. Network Server:
 - a. Allow for transmission of live video, data, and audio over existing Ethernet network or dedicated security system network, requiring IP address or Internet Explorer 5.5 or higher, or work as analog-to-Ethernet "bridge" controlling matrices, multiplexers, and pan/tilt/zoom cameras. Network to operate in box-to-box configuration allowing for encoded video to be decoded and displayed on analog monitor.
 - b. If CCTV System network will be utilized as primary means of monitoring, operating, and recording cameras then the following equipment will be required:
 - 1) System Server.
 - 2) Computer Workstation.
 - 3) Recording Device.
 - 4) Encoder/Decoder.
 - 5) Monitor.

- 6) Hub/Switch.
- 7) Router.
- 8) Encryptor.
- c. Servers to provide overall control, programming, monitoring, and recording of cameras and associated devices within CCTV System.
- d. Equipment on network to be IP addressable.
- e. CCTV System network is required to meet or exceed the following design and performance specifications:
 - 1) Two MPEG-4 video streams for total of 40 images per second.
 - 2) PC Software that manages installation and maintenance of hardware transmitters and receivers on network.
 - 3) Video Source that supports NTSC video source to computer network will be addressed.
 - 4) Receivers used to display video on standard analog NTSC or PAL monitor will be addressed.
- f. System supporting the following network protocols:
 - 1) Internet connections: RTP, Real Time Control Protocol (RTCP), UDP, IP, TCP, ICMP, HTTP, Simple Network Management Protocol (SNMP), IGMP, DHCP, and ARP.
 - 2) Video Display: MPEG-4, M-JPEG in server push mode only.
 - 3) Have ability to adjust bandwidth, image quality and image rate.
 - 4) Support image sizes of 704 by 576 pixels or 352 by 288 pixels.
 - 5) Have audio coding format of G.711 or G.728.
 - 6) Provide video frame rate of minimum 30 images per second.
 - 7) Support LAN Interface Ethernet 10/100BaseT and be auto sensing.
 - 8) Have LAN Data Rate of 9.6 Kbps to 5.0 Mbps.
 - 9) Utilize data interface RS-232/RS-422/RS-485.
- g. All connections within system to be via CAT-V cable and RJ-45 jacks. If analog equipment is used as part of system, then encoder or decoder will be utilized to convert analog signal to digital one.
- h. CCTV network system to conform to all VA agency wide security standards for administrator and operator use.
- i. Server Technical Characteristics:

| | |
|---------------------|---|
| Hardware | Personal Computer |
| CPU | Pentium IV, 3.0 GHz or better |
| Hard Disk Interface | IDE or better |
| RAM | 256 MB |
| OS | Windows XP Home/XP Professional |
| Graphic Card | NVIDIA GeForce 6600 NVIDIA Quadro FX 1400 ATI RADEON X600/X800 or better |
| Ethernet Card | 100 Mb |
| Software | DirectX 9.0c |
| Free Memory | 120 MB |

j. Network Switch Technical Characteristics:

| | |
|-----------------------|---|
| Protocol and standard | IEEE802.3 IEEE802.3u IEEE802.3ab |
| Ports | 24 10/100/1000M auto-negotiation RJ-45 ports with auto MDI/MDI-X |
| Network media | Cat 5 UTP for 1,000Mbps Cat 3 UTP for 10Mbps |
| Transmission method | store-and-forward |
| LED | indicator power, act/link, speed |

k. Router Technical Characteristics:

| | |
|-------------------|---|
| Network Standards | IEEE 802.3, 802.3u 10Base-T Ethernet (WAN) 100Base-T Ethernet (LAN) IEEE 802.3x Flow Control IEEE802.1p Priority Queue ANS/IEEE 802.3 NWay auto-negotiation |
| Protocol | CSMA/CD, TCP, IP, UDP, PPPoE, AND DHCP (client and server) |
| VPN Supported | PPTP, IPsec pass-through |
| Management | Browser |
| Ports | 4 x 10/100Base-T Auto sensing RJ45 ports, and an auto uplink RJ45ports 1 x 10Base-T RJ45 port, WAN |

| | |
|-------------------|---|
| Network Standards | IEEE 802.3, 802.3u 10Base-T Ethernet (WAN) 100Base-T Ethernet (LAN) IEEE 802.3x Flow Control IEEE802.1p Priority Queue ANS/IEEE 802.3 NWay auto-negotiation |
| LEDs | Power, WAN Activity, LAN Link (10/100), LAN Activity |

1. Encryptor Technical Characteristics:

| | |
|---------------------|--|
| Cryptography | Standard - Triple DES 168-bit (ANSI 9.52) Rijndael - AES (128, 192, 256) |
| Performance | Throughput (end-to-end) @ 100 Mbps line speed: greater than 188 Mbps full duplex (large frames) greater than 200 kfps full duplex (small frames) Latency (end-to-end) @ 100 Mbps |
| Key Management | Automatic KEK/DEK Exchange Using Signed Diffie-Hellman Unit Authentication Using X.509 Certificates |
| Physical Interfaces | 10BaseT or 10/100BaseT Ethernet (Host and Network Ports) 10BaseT Ethernet Management Port Back and Front-Panel Serial Control Port |
| Device Management | THALES Element Manager, Front Panel Viewer, and Certificate Manager 10Base T (RJ-45) or 9-pin Serial Control Port SNMP Network Monitoring |
| Security Features | Tamper Proof Cryptographic Envelope Tamper Evident Chassis Hardware Random Number Generator |
| Management | Channel Encrypted Using Same Algorithm as Data Traffic |

| | |
|----------------------------|---|
| Cryptography | Standard - Triple DES 168-bit (ANSI 9.52) Rijndael - AES (128, 192, 256) |
| Security Certifications | FIPS 140-2 Level 3 CAPS Baseline and Enhanced Grades Common Criteria EAL4 and EAL5 (under evaluation) |
| Regulatory | EN60950, FCC, UL, CE, EN 50082-1, and EN 55022 |

2.8 RECORDING DEVICES

- A. Cameras on CCTV System to be recorded in real time using Digital Video Recorder (DVR), Network Video Recorder (NVR), or Time Lapse Video Recorder (VCR). Type of recording device utilized to be determined by size and type of CCTV System designed and installed, and to what extent system is to be utilized.
- B. Provide rack-mounted recording devices.
 - 1. Size: 47.5 cm (19 inch).
- C. DVR's and NVR's viewable over Intranet or Internet will be routed through encryptor meeting the following requirements:
 - 1. Comply with FIPS PUB 140-2.
 - 2. Support TCP/IP.
 - 3. Directly interfaces to low-cost commercial routers.
 - 4. Provide packet-based crypto synchronization.
 - 5. Encrypt source and destination IP addresses.
 - 6. Support web browser based management requiring no additional software.
 - 7. Have high data sustained throughput - 1.544 Mbps (T1) full duplex data rate.
 - 8. Provide for both bridging and routing network architecture support.
 - 9. Support Electronic Key Management System (EKMS) compatible.
 - 10. Have remote management ability.
 - 11. Automatically reconfigure when secure network or wide area network changes.
 - 12. Network Video Recorder (NVR):
 - a. Ability to record video to hard drive-based digital storage medium in MPEG format and meet the following minimum requirements:

- 1) Record at minimum 30 IPS.
- 2) Have minimum eight (8) to 16 looping inputs.
- 3) Have minimum eight (8) to 16 alarm inputs and two (2) relay outputs.
- 4) Provide instantaneous playback of all recorded images.
- 5) IP addressable, if part of CCTV network.
- 6) Built-in digital motion detection with masking and sensitivity adjustments.
- 7) Easy playback and forward/reverse search capabilities.
- 8) Complete audit trail database, with minimum six-month history tracking all events related to alarm; specifically who, what, where and when.
- 9) NVR management capability providing automatic video routing to back-up spare recorder in case of failure.
- 10) Accessible locally and remotely via Internet, Intranet, or personal digital assistant (PDA).
- 11) Records all alarm events in real time, ensuring 60 seconds before and after event are included in recording.
- 12) Utilize RS-232 or fiber optic connections for integration with SMS computer station via remote port on network hub.
- 13) Allow for independently adjustable frame rate settings.
- 14) Be compatible with matrix switcher utilized to operate cameras.

b. Technical Characteristics:

| | |
|------------------|--|
| Hardware/CPU | Pentium III Xeon or IV, 1.8 GHz |
| HDD Interface | IDE or better; optional: SCSI II, SCSI Ultra, or Fiber Channel |
| RAM | 1024 MB |
| Operating System | Windows 2000/XP Professional/Server 2003 Standard |
| Graphic | Card VGA |
| Ethernet Card | 100/1000 MB |
| Memory | 20 MB |
| Software Setup | Centralized setup from each authorized PC; access via VIDOS or integrated web server |

| | |
|-------------------------|---|
| Hardware/CPU | Pentium III Xeon or IV, 1.8 GHz |
| Storage Media | All storage media possible (e.g., HD, RAID), depending on operating system |
| Storage Mode | Linear mode, ring mode (capacity-based) |
| Recording Configuration | Camera name assignment, bandwidth limit, frame rate, video quality |
| Recording Content | Video and/or audio data |
| Search Parameters | Time, date, event |
| Playback | Playback via VIDOS over any IP network (LAN/WAN) simultaneous recording, playback, and backup |
| Network Interface | Ethernet (RJ-45, 10/100M) |
| Network Protocol | TCP/IP, DHCP, HTTP, UDP |
| Network Capabilities | Live/Playback/P/T/Z control |
| Recording Rate | 30 ips for 720 x 240 (NTSC) |
| Password Protection | Menu Setup, Remote Access |
| Recording Capacity | 160 (1 or 2 fixed HDD) 1 CD-RW |
| Power Interrupt | Auto recovered to recording mode |

2.9 WIRES AND CABLES

A. General Requirements:

1. Wires and cables to meet or exceed manufacturer's recommendation for power and signal.
2. Carried in enclosed conduit system, utilizing electromagnetic tubing (EMT) to include equivalent in flexible metal, rigid galvanized steel (RGS) to include equivalent of liquid tight, polyvinylchloride (PVC) Schedule 40 or 80.
3. Conduits to be sized and installed according to NFPA 70. Security system signal and power cables that traverse or originate in high security office space to be contained in EMT or RGS conduit.
4. Conduit, pull boxes, and junction boxes to be marked with colored permanent tape or paint that allow it to be distinguished from other conduit and infrastructure.
5. Conduit fills not to exceed 50 percent, unless otherwise documented.
6. Pull string to be pulled along and provided with signal and power cables to assist in future installations.

7. Apply firestopping materials at locations where there is wall penetration or core drilling is conducted for conduit installation.
8. Do not place high voltage and signal cables same conduit and keep separate up to connection point. High voltage for security system is defined as any cable or sets of cables carrying 30 VDC/VAC or higher.
9. For equipment carrying digital data between Access Control System and Database Management or at remote monitoring station, provide minimum 20 AWG and stranded copper wire for each conductor. Cable or each individual conductor within cable to have shield that provides 100 percent coverage. Cables with single overall shield to have tinned copper shield drain wire.
10. Cables and conductors, except fiber optic cables, that act as control, communication, or signal lines to include surge protection. Provide surge protection at equipment end and additional triple electrode gas surge protectors rated for application on each wire line circuit to be installed within 1 m (3 ft.) of building cable entrance. Test inputs and outputs in both normal and common mode using the following wave forms:
 - a. 10 microsecond rise time by 1000 microsecond pulse width waveform with peak Voltage of 1500 volts and peak current of 60 Amperes.
 - b. 8 microsecond rise time by 20 microsecond pulse width wave form with peak Voltage of 1000 Volts and peak current of 500 Amperes.
 - c. Prevent surge suppression device from attenuating or reducing video or sync signal under normal conditions. Do not use fuses and relays for surge protection.

B. Signal Cables:

1. Signal wiring for PoE cameras depends on distance camera is being installed from hub or server.
2. If camera is up to 90 m (300 ft.) from hub or server, provide shielded UTP category 5 (CAT-V) cable with standard RJ-45 connector at each end. Cable to comply with Power over Ethernet, IEEE802.3af, Standard.
3. If camera is over 90 m (300 ft.) from hub or server, provide multimode fiber optic cable, minimum 62 microns.

4. Provide separate cable for power.
5. CAT-5 Technical Characteristics:

| | |
|------------------------------|-------------------------|
| Number of Pairs | 4 |
| Total Number of Conductors | 8 |
| AWG | 24 |
| Stranding | Solid |
| Conductor Material | BC - Bare Copper |
| Insulation Material | PO - Polyolefin |
| Overall Nominal Diameter | 6 mm (0.230 inches) |
| IEC Specification | 11801 Category 5 |
| TIA/EIA Specification | 568-B.2 Category 5e |
| Max. Capacitance Unbalance | (pF/100 m) 150 pF/100 m |
| Nom. Velocity of Propagation | 70 percent |
| Max. Delay | (ns/100 m) 538 @ 100MHz |
| Max. Delay Skew | (ns/100m) 45 ns/100 m |
| Max. Conductor DC Resistance | 9.38 Ohms/100 |
| Max. DCR Unbalance@ 20°C | 3 percent |
| Max. Operating Voltage | UL 300 V RMS |

6. Fiber Optic Cables Technical Characteristics:

| | |
|----------------------------|---------------------------|
| Fiber Type | 62.5 Micron |
| Number of Fibers | 4 |
| Core Diameter 6 | 2.5 +/- 2.5 microns |
| Core Non-Circularity | 5 percent Maximum |
| Clad Diameter | 125 +/- 2 microns |
| Clad Non-Circularity | 1 percent Maximum |
| Core-clad Offset | 1.5 Microns Maximum |
| Primary Coating Material | Acrylate |
| Primary Coating Diameter | 245 +/- 10 microns |
| Secondary Coating Material | Engineering Thermoplastic |
| Secondary Coating Diameter | 900 +/- 50 microns |
| Strength Member Material | Aramid Yarn |
| Outer Jacket Material | PVC |
| Outer Jacket Color | Orange |

| | |
|--------------------------|------------------------|
| Fiber Type | 62.5 Micron |
| Overall Diameter | 5 mm (0.200 inches) |
| Numerical Aperture | .275 |
| Maximum Gigabit Ethernet | 300 meters (985 feet) |
| Maximum Gigabit Ethernet | 550 meters (1804 feet) |

C. Power Cables:

1. Sized accordingly and complying with NFPA 70. High Voltage power cables to be minimum three conductors, 14 AWG, stranded, and coated with non-conductive polyvinylchloride (PVC) jacket. Low Voltage cables to be minimum 18 AWG, stranded and non-conductive polyvinylchloride (PVC) jacket.
2. Power cables to be provided for all CCTV System components that require 110 Volt AC 60 Hz or 220 Volt AC 50 Hz input. Connect each feed to dedicated circuit breaker at security system power panel.
3. Protect equipment connected to AC power from surges. Equipment protection to withstand surge test waveforms described in IEEE C62.41. Fuses are not acceptable for surge protection.
4. Provide power supplies rated for 110 or 220 VAC, 50 or 60 Hz, and complying with Section 26 05 21 LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW).
5. Low Voltage Power Cables:
 - a. Minimum 18 AWG, stranded with polyvinylchloride outer jacket.
 - b. Determine cable size by basic voltage over distance calculation and comply with NFPA 70 requirements for low Voltage cables.

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 COR consideration.
- B. Install systems according to NECA 303, manufacturer and related documents and references, for each type of security subsystem designed, engineered and installed.

3.2 INSTALLATION - EQUIPMENT

- A. Configure components with appropriate service points to pinpoint system trouble in less than 30 minutes.
- B. Install system components, including Government furnished equipment, and appurtenances according to manufacturer's instructions, and provide necessary connectors, terminators, interconnections, services, and adjustments required for complete and operable system.
- C. Cameras:
 - 1. Install cameras with focal length lens as indicated for each zone.
 - 2. Connect power and signal lines to cameras.
 - 3. Set cameras with fixed iris lenses to f-stop to give full video level.
 - 4. Aim camera to give field of view as required to cover alarm zone.
 - 5. Aim fixed mounted cameras installed outdoors facing rising or setting sun sufficiently below horizon to preclude camera looking directly at the sun.
 - 6. Focus lens to give sharp picture (to include checking for day and night focus and image quality) over entire field of view; and synchronize all cameras so picture does not roll on monitor when cameras are selected. Dome cameras to have all preset positions defined and installed.
- D. Video Recording Equipment:
 - 1. Install video recording equipment as shown in construction documents, and as specified by OEM.
 - 2. Connect video signal inputs and outputs as shown on drawings and specified.
 - 3. Connect alarm signal inputs and outputs as shown on drawings and specified.
 - 4. Connect video recording equipment to AC power.
- E. Camera Housings, Mounts, and Poles:
 - 1. Install camera housings and mounts as specified by manufacturer and as shown on drawings. Provide mounting hardware sized appropriately to secure each camera, housing and mount for maximum wind and ice loading encountered at site.
 - 2. Provide foundation for each camera pole as specified and shown on drawings.

3. Provide ground rod for each camera pole and connect camera pole to ground rod as specified in Division 26 Sections and VA Electrical Manual 730.
4. Provide electrical and signal transmission cabling to mount location via hardened carrier system from Access Control System and Database Management to device.
5. Connect signal lines and AC power to housing interfaces.
6. Connect pole wiring harness to camera.

3.3 TRAINING

- A. The Contractor will provide training. The training method shall agree with the precepts of an accepted training methodology such as the Systems Approach to Training that is used by the DoD. No Ad Hoc training will be considered acceptable. Student(s) will be provided printed training materials as well as a CD/DVD copy of the classes. The training must provide the student(s) the ability to: set up the system, maintain the system, trouble shoot problems, recognize system/component failures as well as any nuanced customization of the system for the specific location.
- B. Training on each installed system [IE components] will minimally include:
 1. CCTV
 - a. Management of Recording Devices
 - b. Trouble shooting cameras (Basic understanding)
 - c. Search/Obtain Video Recordings
 - 1) How to isolate and capture videography for exportation to both a portable device/disk/server file
 - d. Video Analytics
 2. Overall system(s) maintenance.
 - a. Those steps necessary for the basic understanding of: lifecycle maintenance of system to include factors such as: yearly support agreements, impact of power surges/loss as well as those endemic pieces of knowledge that include preventive maintenance considerations and or tasks.
- C. The contractor will provide instruction giving the students sufficient training to be able to effectively operate the system and recognize problems as they arise. All training must include guided practical

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application exercises to ensure student(s) understanding. Certification of the training/curriculum/rosters will be provided to the COR/CO upon training task completion.

- - - E N D - - -

**SECTION 28 31 00
INTRUSION DETECTION**

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. New state-of-the-art fully functioning Intrusion Detection System (IDS) installed in VA's National Cemetery (NCA) to protect buildings, building areas, and grounds. Project Number: 884CM3015.
 - 2. IDS sensors reports to host facility intrusion detection system systems' intrusion detection system when PACS is not managed by host facility.
- B. See Section 27 05 00, COMMON WORK RESULTS FOR COMMUNICATIONS for requirements governing work of this section.

1.2 RELATED REQUIREMENTS

- A. General electrical requirements: Section 27 05 00, COMMON WORK RESULTS FOR COMMUNICATIONS.
- B. Access Control Integration: Section 28 10 00, ACCESS CONTROL.
- C. Security Cameras: Section 28 20 00, VIDEO SURVEILLANCE.

1.3 APPLICABLE PUBLICATIONS

- A. Comply with references to extent specified in this section.
- B. American National Standards Institute/Security Industry Association (ANSI/SIA):
 - 1. PIR-01-00 - Passive Infrared Motion Detector Standard - Features for Enhancing False Alarm Immunity.
 - 2. CP-01-14 - Control Panel Standard - Features for False Alarm Reduction.
- C. National Electrical Manufacturers Association (NEMA):
 - 1. 250-14 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- D. UL LLC (UL):
 - 1. Listed - Online Certifications Directory.
 - 2. 464-16 - Audible Signaling Devices for Fire Alarm and Signaling Systems, Including Accessories.
 - 3. 639-07 - Intrusion-Detection Units.

1.4 SUBMITTALS

- A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

1.5 WARRANTY

- A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

- A. Intrusion detection system and system components complying with specified performance:
1. Systems Success Probability: Minimum 95 percent.
 - a. False Alarm: Maximum one false alarm per 30 days, per sensor zone, averaged by total number of zones.
 - b. Nuisance Alarm:
 - 1) Initial Installation: Maximum one alarm per seven days, per zone during first 60 days after installation and acceptance.
 - 2) Adjusted Installation: Maximum one alarm per 30 days after sensor adjustment.
 2. Detect line fault and power loss for supervised cabling.
 - a. Line Fault Detection: Communication links active mode line fault detection. Provide graphic resolutions for systems level Fault isolation as for intrusion detection.
 - 1) Alarm: Distinguishable from other alarms.
 - b. Power Loss Detection: Detect temporary and permanent power loss and annunciate affected components.
 3. Sensor Standard Compliance: UL 639.
 4. Audible Annunciation: UL 464.
 5. Duty Rating: Continuous service.

2.2 CONTROL PANELS

- A. Control Panel: ANSI CP-01; providing programming, monitoring, accessing, securing, and troubleshooting capabilities.
1. Report alarms to Section 28 10 00, ACCESS CONTROL PACS via computer interface or direct connection to alarm control panel.

2. Provide multifunctional keypad and input and output modules for alarm zone expansion, interfacing with additional security subsystems, programming, monitoring, and controlling IDS.
3. Programming Outputs:
 - a. 2 Ampere alarm power at 12 Volts DC.
 - b. 1.4 Ampere auxiliary power at 12 Volts DC.
 - c. Four alarm output patterns.
 - d. Programmable bell test.
 - e. Programmable bell shut-off timer.
4. System Response:
 - a. Selectable point response time.
 - b. Cross point capability.
 - c. Alarm verification.
 - d. Watch mode.
 - e. Scheduled events arm, disarm, bypass and un-bypass points, control relays, and control authority levels.
5. User Interface:
 - a. Supervises up to eight command points (e.g. Up to 16 unsupervised keypads can be used).
 - b. Provides custom keypad text.
 - c. Addresses full function command menu including custom functions.
 - d. Allows user authority by defined area and 16-character name.
 - e. Provides 14 custom authority control levels allowing user's authority to change, add, delete pass codes, disarm, bypass points, and start system tests.

B. Control Panel Technical Characteristics:

| | |
|--|---------------------------------|
| Input Voltage via 110 Volts AC or 220 Volts AC Step-down Transformer | 16 or 18 Volts AC |
| Operating Voltage | 12 Volts DC |
| Output Voltage | 12 Volts DC 2 Ampere maximum |
| Direct Hardwire Zones | 7 |
| Partitions | 8 |
| Multifunctional Keypads | 16 (2 per partition) |

| | |
|--|-------------------|
| Input Voltage via 110 Volts AC or 220 Volts AC Step-down Transformer | 16 or 18 Volts AC |
| Communications Port | RJ-11 |

- C. Keypad: Multifunctional user interface for arming, disarming, monitoring, troubleshooting, and programming alarm control panel.
1. Multiple function keypads suitable for remote mounting, maximum 1333 m (4000 ft.), distant from control panel.
 2. Indicators: Light emitting diodes (LED) for individually distinguishable intrusion alarm and system trouble conditions by zone.
 3. Display: Alphanumeric English language display, with keypad programmability, and EE-PROM memory.
 4. Entry and Exit Zones: Minimum four; selectable with programmable time delay.
 5. Keypad activated complete system test.
 6. Capability for opening and closing reports to remote monitoring location.
 7. Adjustable entry and exit delay times.
 8. Capability for minimum two multiple function keypads.
 9. Capability to shunt or bypass selected interior zones while arming perimeter protection and remaining interior zones.
 10. Capability for minimum seven assignable pass-codes keypad programmable from suppressed master code.
 11. Keypad Technical Characteristics:

| | |
|------------------------------|---|
| Connections | 4-wire flying lead for data and power |
| Operating Temperature | 0 to 50 degrees C (32 to 122 degrees F) |
| Display Window | 8-point LED |
| Indicators: Illuminated keys | Armed Status-LED |
| | Point Status-LED |
| | Command Mode-LED |
| | Power-LED |
| Voltage | Nominal 12 Volts DC |

- D. Input Module: Connect detection devices to control panel. Minimum technical characteristics:

| | |
|-----------------------|---|
| Operating Voltage | 8.5 to 14.5 Volts DC Nominal |
| Zone Inputs | Style A (Class B) Supervised |
| Operating Temperature | 0 to 40 degrees C (32 to 140 degrees F) |

- E. Output Module: Interface control panel with other security subsystems. Minimum technical characteristics:

| | |
|-----------------------|---|
| Operating Voltage | 8.5 to 14.5 Volts DC Nominal |
| Output Relays | "Form C" Dry Relay Contracts |
| Relay Contact Rating | 4A @ 24 Volts DC |
| | 4A @ 24 Volts AC |
| | 1A @ 70 Volts AC |
| Operating Temperature | 0 to 40 degrees C F (32 to 140 degrees) |

- F. Communications Port: Minimum RJ 45 for connection to remote computer for programming, monitoring, and troubleshooting. RJ 45 is acceptable option for IDS control panels.

2.3 INTERIOR DETECTION DEVICES (SENSORS)

- A. Interior Sensors Environmental Range: Remain operational throughout specified ranges.

| | |
|--|---|
| Temperatures - Conditioned Spaces | 0 to 50 degrees C (32 to 120 degrees F) |
| Temperatures - Unconditioned Spaces | -18 to 50 degrees C (0 to 120 degrees F) |
| Pressure | Sea Level to 4573 m (15,000 feet) above sea level |
| Relative Humidity | 5 to 95 percent |
| Fungus | Components of non-fungus nutrient materials |
| Acoustical Noise Suitability | Minimum 100 decibels |

- B. Balanced Magnetic Switches (BMS): Contain minimum 2 encapsulated reed switches.
1. Mounting:
 - a. Recessed wherever possible.
 - b. Surface mounted only where recessed is not possible.
 2. Alarms:
 - a. Signal alarm when magnet and switch are separated maximum 25 mm (1 inch).
 - b. Signal tamper alarm when field between magnet and switch is disturbed without magnet and switch separation.
 3. Provide current protective device, rated to limit current to 80 percent of switch capacity.
 4. Surface Mounted Exterior BMS Enclosure: Weatherproof.
 5. BMS Field Adjustments: None for fixed space between magnet and switch housing.
 6. BMS Technical Characteristics:

| | |
|-------------------------|--|
| Maximum current | 0.25 Amperes |
| Maximum Voltage | 30 Volts DC |
| Maximum power | 3.0 W (without internal terminating resistors). 1.0 W (with internal terminating resistors). |
| Components | Two pre-adjusted reed switches or Three triple biased high security balance magnet switches |
| Output contacts | Transfer type SPDT |
| Contact rating | 0.5 Amperes, 28 Volts DC |
| Switch mechanism | Internally adjustable 6 to 13 mm (1/4 to 1/2 inch) |
| Wiring | Two wires #22 American Wire Gauge (AWG), 900 or 3300 mm (3 or 11 feet) attached cable |
| Activation lifetime | 1,000,000 activations |
| Enclosure | Nonferrous materials |
| Tamper alarm activation | Cover opened 3 mm (1/8 inch) and inaccessible until actuated |

- C. Passive Infrared Motion Sensors (PIR): ANSI PIR-01; Detect intruder by monitoring infrared energy within protected zone. Signal alarm when motion and temperature changes are detected.
1. Provide multiple detection zones distributed at various angles and distances.
 2. Provide passive sensors; requiring no transmitted energy for detection.
 3. Detect infrared energy emitted at wavelengths corresponding to human body and other objects at ambient temperatures.
 4. Do not signal alarm in response to general area thermal variations and radio frequency interference.
 5. Do not signal alarm for temperature changes due to HVAC systems cycling on or off.
 6. House sensors in tamper-alarmed enclosure.
 7. Provide motion analyzer processing, adjustable lens, and walk test LEDs visible from any angle.
 8. Provide means of signaling alarm condition during installation and calibration. Provide means of disabling indication within sensor enclosure.
 9. Provide motion monitoring verification circuit to signal trouble or alarm when motion is not detected for extended period.
 10. PIR Technical Characteristics:

| | |
|--|---|
| Power | 6 to 12 Volt DC 25 mA continuous current draw 38 mA peaks |
| Alarm Velocity | 1500 mm (5 feet) at a velocity of 30 mm/s (0.1 ft./s), and one step per second, assuming 150 mm (6 inches) per step. Also, faster than 30 mm/s (0.1 feet/s), up to 3000 mm/s (10 feet/s) |
| Maximum detection range | Minimum 10.6 m (35 feet) |
| Frequency range- non activation or setup use | 26 to 950 MHz using 50 Watt transmitter located 300 mm (1 foot) from unit or attached wiring |

| | |
|----------------------------|---|
| Power | 6 to 12 Volt DC 25 mA continuous current draw 38 mA peaks |
| Infrared detection | 1.6 degrees C (3 degrees F) different from 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 to 5.4 m (8 to 18 feet) |
| Sensitivity adjustments | Three levels |

- D. CCTV Video Motion Detection Sensors: See Section 28 20 00, VIDEO SURVEILLANCE.
- E. Tamper Alarm Switches: Corrosion-resistant switches to monitor and detect potential sensor, control panel, and enclosure tampering.
1. Provide at enclosures including cabinets, housings, boxes, raceways, and fittings with hinged doors or removable covers containing circuits and power supplies.
 2. Annunciate tamper alarms clearly distinguishable from IDS alarms.
 3. Mount tamper switches out of direct line of sight.
 - a. Alarm Signal Time: Minimum 1 second after enclosure is opened or panel removal is attempted.
 4. Signal alarm when enclosure doors and covers are removed maximum 6 mm (1/4 inch) from closed position unless otherwise indicated.
 5. Tamper Switches:
 - a. Push/pull automatic reset type.
 - b. Inaccessible until switch is activated.
 - c. Spring-loaded and held in closed position by door or cover.
 - d. Wired to break circuit when door or cover is removed with each sensor annunciated individually at central reporting processor.

6. Fail-Safe Mode: Provide capability to detect and annunciate diminished functional capabilities and perform self-tests. Annunciate fail-safe alarms clearly distinguishable from other alarms.

2.4 ENCLOSURES

- A. Mount control panels, input and output modules, and power supplies within metal enclosures.
- B. Enclosures: NEMA 250; UL Listed, lockable with tamper alarm switch monitored by control panel.
 1. Indoor Locations: Type 1.
 2. Outdoor Locations: Type 4X.

2.5 ACCESSORIES

- 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. Clean substrates. Remove contaminants capable of affecting subsequently installed product's performance.

3.2 INSTALLATION - GENERAL

- A. Provide necessary connectors, terminators, interconnections, services, and adjustments required for complete and operable system.
- B. Protect underground and overhead wiring circuits at both ends against lightening and power surges to central alarm reporting and display unit.
 1. Provide primary detection devices, such as three electrode gas-type surge arresters, and secondary protectors to reduce dangerous voltages to cause no damage. Fuses are not acceptable as protection devices.
 2. Provide fail-safe gas tube type surge arresters on exposed IDS data circuits.
 3. Protect against transient spikes up to 1000 Volts peak voltage with one-microsecond rise time and 100-microsecond decay time, without causing false alarms with automatic and self-restoring device.

4. Provide circuits designed and installed for maximum 25 Ohms resistance to ground.

C. Cleaning and Adjustments:

1. After installation, clean each system component of dust, dirt, grease, or oil incurred during installation in accordance to manufacturer's instructions.
2. Prepare for system activation according to manufacturer's instructions for adjustment, alignment, or synchronization. Prepare each component according to component's installation, operations, and maintenance instructions.

3.3 BMS SURFACE MOUNTED

- A. Provide surface mounted BMS housing with capability to receive threaded conduit.
- B. Secure housing covers to be not easily removed.
 1. Secure cast aluminum housing covers with stainless steel screws.
 2. Protect BMS housings from unauthorized access by cover operated, corrosion-resistant tamper device.
- C. Install conductors from BMS to alarm circuits in flexible armored cord constructed from corrosion-resistant metal.
 1. Terminate both ends of armored cord in junction box or other enclosure.
 2. Mechanically secure armored cord ends to junction boxes by clamps or bushings.
 3. Provide lug terminals for conductors at both ends of armored cord.
 4. Install conductors and armored cord without inducing mechanical strain as door is moved from fully open to closed position.
 5. Signal alarm when short circuit is applied to armored cord.
- D. For exterior application on double gates, mount both BMS elements on gate. Provide electrical connection with flexible armored cord constructed from corrosion-resistant metal.

3.4 BMS RECESSED MOUNTED

- A. Mount ball bearing door trips within vault door headers so when locking mechanism is secured, door bolt engages actuator, mechanically closing switch.
- B. Ensure door bolt locking mechanisms are fully engaged before ball bearing door trip is activated.

- C. Provide circuit jumpers from door.

3.5 PASSIVE INFRARED DETECTORS (PIR)

- A. Focus protective beam in a straight line.
- B. Install transmitters and receivers so light beam distance is maximum 80 percent of manufacturer's maximum recommended rating.
- C. Use mirrors to extend light beam or to establish light beam network, provided mirrors do not reduce rated maximum system range by more than 50 percent.
- D. Outdoor Mirrors and Photoelectric Sources: Self-heated to eliminate condensation and housed in weatherproof enclosures.

3.6 TAUT-WIRE

- A. Cover housing for switch assembly with neoprene cap to retain center bolt (lever arm), functions as a lever to translate movement of attached horizontal wire into contact closure. When neoprene cap is firmly seated on cup-shaped polycarbonate housing, cap functions as fulcrum for lever (bolt).
- B. Thread upper exposed end of lever to accommodate clamping to horizontal wire. Fashion lower end of lever to serve as movable electrical contact, held suspended in small cup-shaped contact floating in plastic putty material.
- C. Plastic putty must retain elasticity under varying temperature conditions and provide sensor switch with self-adjusting property to ignore small, very slow changes in lever alignment and to react to fast changes only, as caused by manual deflection or cutting of wires.
- D. Provide metal slider strips having slots through which barbed wires pass. Install rivet to prevent wires from leaving slots. Use slider strip to translate normal forces to barbed wire and to sensor horizontal displacement.
- E. Install one slider strip pair, upper and lower, on every fence post except where sensor posts or anchor strips are installed.
- F. Separation between slider elements along fence to be 3000 mm (10 feet).
- G. Attach sensor wires to existing, specially installed fence posts, called anchor posts, located equidistant on both sides of sensor posts and at ends of sensor zone run.

H. Provide steel plate anchor strip on which fastening plates are installed. Weld or mechanically attach anchor strip to anchor post and ends of tensed barbed wires wrapped around fastening plates.

1. Install plates to break off upon attempts to climb on fastening plates and on attached barbed wires; creating alarm and making it impossible to defeat system by climbing at anchor post.

3.7 TAMPER SWITCHES

- A. Install tamper switches to initiate alarm signal when panel, box, or component housing door or cover is moved or opened.
- B. Locate tamper switches within enclosures, cabinets, housings, boxes, raceways, and fittings to prevent direct line of sight to internal components and to prevent tampering with switch or circuitry.
- C. Conceal tamper switch mounting hardware so switch location within enclosure cannot be determined from exterior.

3.8 TRAINING

- A. The Contractor will provide training. The training method shall agree with the precepts of an accepted training methodology such as the Systems Approach to Training that is used by the DoD. No Ad Hoc training will be considered acceptable. Student(s) will be provided printed training materials as well as a CD/DVD copy of the classes. The training must provide the student(s) the ability to: set up the system, maintain the system, trouble shoot problems, recognize system/component failures as well as any nuanced customization of the system for the specific location.
- B. Training on each installed system [IE components] will minimally include:
 1. Duress Systems
 - a. Schema of Duress Location
 - b. Management of Alarms
 - 1) Basic trouble shooting and re-set of software or associated components.
 2. Visitor Management
 - a. Management of Visitor Management tools

3. Overall system(s) maintenance.

- a. Those steps necessary for the basic understanding of: lifecycle maintenance of system to include factors such as: yearly support agreements, impact of power surges/loss as well as those endemic pieces of knowledge that include preventive maintenance considerations and or tasks.

- C. The contractor will provide instruction giving the students sufficient training to be able to effectively operate the system and recognize problems as they arise.

All training must include guided practical application exercises to ensure student(s) understanding. Certification of the training/curriculum/rosters will be provided to the COR/CO upon training task completion.

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SECTION 28 46 00
FIRE DETECTION AND ALARM

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section of the specifications includes the furnishing, installation, and connection of the fire alarm equipment to form a complete coordinated system ready for operation. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, control units, fire safety control devices, annunciators, power supplies, and wiring as shown on the drawings and specified.
- B. Fire alarm systems shall comply with requirements of 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 Contracting Officer or his authorized representative. Installers shall have a minimum of two years' experience installing fire alarm systems.
- C. Fire alarm signals:
 - 1. Building Administration and Maintenance Building Office shall have a general evacuation fire alarm signal in accordance with ASA S3.41 to notify all occupants in the respective building to evacuate.
- D. Alarm signals (by device), supervisory signals (by device) and system trouble signals (by device not reporting) shall be distinctly transmitted to the main fire alarm system control unit located in the Administration Building
- E. The main fire alarm control unit shall automatically transmit alarm signals to a listed central station using a digital alarm communicator transmitter in accordance with NFPA 72.

1.2 SCOPE

- A. 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.
- B. A new 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.
- C. Existing fire alarm bells, chimes, door holders, 120VAC duct smoke detectors, 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, reused by the Contractor shall be equipped with an addressable interface device compatible with the new equipment being installed.
- E. Existing reused equipment shall be covered as new equipment under the Warranty specified herein.
- F. Basic Performance:
 - 1. Alarm and trouble signals from each building fire alarm control panel shall be digitally encoded by UL listed electronic devices onto a multiplexed communication system.
 - 2. Response time between alarm initiation (contact closure) and recording at the main fire alarm control unit (appearance on alphanumeric read out) shall not exceed five (5) seconds.
 - 3. The signaling line circuits (SLC) between building fire alarm control units shall be wired Style 7 in accordance with NFPA 72. Isolation shall be provided so that no more than one building can be lost due to a short circuit fault.
 - 4. Initiating device circuits (IDC) shall be wired Style C in accordance with NFPA 72.

5. Signaling line circuits (SLC) within buildings shall be wired Style 4 in accordance with NFPA 72. Individual signaling line circuits shall be limited to covering 22,500 square feet of floor space or 3 floors whichever is less.
6. Notification appliance circuits (NAC) shall be wired Style Y in accordance with NFPA 72.

1.3 RELATED WORK

- A. Section 01 00 00, GENERAL REQUIREMENTS: Restoration of existing surfaces.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES: Procedures for submittals.
- C. Section 07 84 00, FIRESTOPPING: Fire proofing wall penetrations.
- D. Section 08 71 00, DOOR HARDWARE: Combination Closer-Holder.
- E. Section 09 91 00, PAINTING: Painting for equipment and existing surfaces.
- F. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements for items which are common to other Division 26 sections.
- G. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits and boxes for cables/wiring.
- H. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW: Cables/wiring.

1.4 SUBMITTALS

- A. General: Submit 4 copies and 1 reproducible 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 software and include all contractors information. Layering shall be by VA criteria as provided by the Contracting Officer's Technical Representative (RESIDENT ENGINEER/COTR). 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, HVAC shutdown 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 RESIDENT ENGINEER/COTR one (1) set of reproducible, as-built drawings, two blue-line copies and one (1) set of the as-built drawing computer files using AutoCAD Release 14 or later. As-built drawings (floor plans) shall show all new and existing conduit used for the fire alarm system.

C. Manuals:

1. Submit simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals including technical data sheets for all items used in the system, power requirements, device wiring diagrams, dimensions, and information for ordering replacement parts.
 - a. Wiring diagrams shall have their terminals identified to facilitate installation, operation, expansion and maintenance.
 - b. Wiring diagrams shall indicate internal wiring for each item of equipment and the interconnections between the items of equipment.
 - c. Include complete listing of all software used and installation and operation instructions including the input/output matrix chart.
 - d. Provide a clear and concise description of operation that gives, in detail, the information required to properly operate, inspect, test and maintain the equipment and system. Provide all manufacturers' installation limitations including but not limited to circuit length limitations.
 - e. Complete listing of all digitized voice messages.
 - f. Provide standby battery calculations under normal operating and alarm modes. Battery calculations shall include the magnets for holding the doors open for one minute.
 - g. Include information indicating who will provide emergency service and perform post contract maintenance.
 - h. Provide a replacement parts list with current prices. Include a list of recommended spare parts, tools, and instruments for testing and maintenance purposes.
 - i. A computerized preventive maintenance schedule for all equipment. The schedule shall be provided on disk in a computer format acceptable to the VA facility and shall describe the protocol for preventive maintenance of all equipment. The schedule shall include the required times for systematic examination, adjustment and cleaning of all equipment. A print out of the schedule shall also be provided in the manual. Provide the disk in a pocket within the manual.

- j. Furnish manuals in 3 ring loose-leaf binder or manufacturer's standard binder.
 - k. A print out for all devices proposed on each signaling line circuit with spare capacity indicated.
2. Two weeks prior to final inspection, deliver four copies of the final updated maintenance and operating manual to the RESIDENT ENGINEER/COTR.
- a. The manual shall be updated to include any information necessitated by the maintenance and operating manual approval.
 - b. Complete "As installed" wiring and schematic diagrams shall be included that shows all items of equipment and their interconnecting wiring. Show all final terminal identifications.
 - c. Complete listing of all programming information, including all control events per device including an updated input/output matrix.
 - d. Certificate of Installation as required by NFPA 72 for each building. The certificate shall identify any variations from the National Fire Alarm Code.
 - e. Certificate from equipment manufacturer assuring compliance with all manufacturers installation requirements and satisfactory system operation.
- D. Certifications:
- 1. Together with the shop drawing submittal, submit the technician's NICET level III fire alarm certification as well as certification from the control unit manufacturer that the proposed performer of contract maintenance is an authorized representative of the major equipment manufacturer. Include in the certification the names and addresses of the proposed supervisor of installation and the proposed performer of contract maintenance. Also include the name and title of the manufacturer's representative who makes the certification.
 - 2. Together with the shop drawing submittal, submit a certification from either the control unit manufacturer or the manufacturer of each component (e.g., smoke detector) that the components being furnished are compatible with the control unit.

3. Together with the shop drawing submittal, submit a certification from the major equipment manufacturer that the wiring and connection diagrams meet this specification, UL and NFPA 72 requirements.

1.5 WARRANTY

- A. Warrant all work performed and all material and equipment furnished under this contract subject to the terms of "Warranty of Construction," FAR clause 52.246-21 except that warranty period is five (5) years

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.
- B. National Fire Protection Association (NFPA):
 - 70-2011National Electrical Code (NEC).
 - 72-2010National Fire Alarm and Signaling Code.
 - 90A-2009Installation of Air Conditioning and Ventilating Systems.
 - 101-2012Life Safety Code
- C. Underwriters Laboratories, Inc. (UL):
 - 2000-2011.....Fire Protection Equipment Directory
- D. Factory Mutual Research Corp (FM): Approval Guide, 2009 Edition
- E. American National Standards Institute (ANSI):
 - S3.41-2008Audible Emergency Evacuation Signal
- F. International Code Council, International Building Code (IBC) 2012 Edition

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS, GENERAL

- A. Existing equipment may be reused only where indicated on the drawings.
- B. Except as indicated in paragraph A above, All equipment and components shall be new and the manufacturer's current model. All equipment shall be tested and listed by Underwriters Laboratories, Inc. or Factory Mutual Research Corporation for use as part of a fire alarm system. The authorized representative of the manufacturer of the major equipment shall certify that the installation complies with all manufacturers' requirements and that satisfactory total system operation has been achieved.

2.2 CONDUIT, BOXES, AND WIRE

- A. Conduit shall be in accordance with Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS and as follows:
1. All new and reused conduit shall be installed in accordance with NFPA 70.
 2. Conduit fill shall not exceed 40 percent of interior cross-sectional area.
 3. All new conduit shall be 19 mm (3/4 inch) minimum.
- B. Wire:
1. All existing wiring shall be removed and new wiring installed in a conduit or raceway.
 2. Wiring shall be in accordance with NEC article 760, Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW), and as recommended by the manufacturer of the fire alarm system. All wires shall be color coded. Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 18 AWG for initiating device circuits and 14 AWG for notification device circuits.
 3. 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.
 4. Any fire alarm system wiring that extends outside of a building shall have additional power surge protection to protect equipment from physical damage and false signals due to lightning, voltage and current induced transients. Protection devices shall be shown on the submittal drawings and shall be UL listed or in accordance with written manufacturer's requirements.
 5. All wire or cable used in underground conduits including those in concrete shall be listed for wet locations.
- C. Terminal Boxes, Junction Boxes, and Cabinets:
1. Shall be galvanized steel in accordance with UL requirements.
 2. All new and reused boxes shall be sized and installed in accordance with NFPA 70.

3. New and existing 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 19 mm (3/4 inch) 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 RESIDENT ENGINEER/COTR.

2.3 FIRE ALARM CONTROL UNIT (EXISTING)

A. General:

2. Each power source shall be supervised from the other source for loss of power.
3. All circuits shall be monitored for integrity.
4. Visually and audibly annunciate any trouble condition including, but not limited to main power failure, grounds and system wiring derangement.
5. Transmit digital alarm information to the main fire alarm control unit.

B. Enclosure:

1. The control unit shall be housed in a cabinet suitable for both recessed and surface mounting. Cabinet and front shall be corrosion protected, given a rust-resistant prime coat, and manufacturer's standard finish.
2. Cabinet shall contain all necessary relays, terminals, lamps, and legend plates to provide control for the system.

C. Power Supply:

1. The control unit shall derive its normal power from a 120-volt, 60 Hz dedicated supply connected to the emergency power system. Standby power shall be provided by a 24-volt DC battery as hereinafter specified. The normal power shall be transformed, rectified, coordinated, and interfaced with the standby battery and charger.

2. The door holder power shall be arranged so that momentary or sustained loss of main operating power shall not cause the release of any door.
 3. Power supply for smoke detectors shall be taken from the fire alarm control unit.
 4. Provide protectors to protect the fire alarm equipment from damage due to lightning or voltage and current transients.
 5. Provide new separate and direct ground lines to the outside to protect the equipment from unwanted grounds.
- D. Circuit Supervision: Each alarm initiating device circuit, signaling line circuit, and notification appliance circuit, shall be supervised against the occurrence of a break or ground fault condition in the field wiring. These conditions shall cause a trouble signal to sound in the control unit until manually silenced by an off switch.
- E. Trouble signals:
1. Arrange the trouble signals for automatic reset (non-latching).
 2. System trouble switch off and on lamps shall be visible through the control unit door.
- F. Function Switches: Provide the following switches in addition to any other switches required for the system:
1. Remote Alarm Transmission By-pass Switch: Shall prevent transmission of all signals to the main fire alarm control unit when in the "off" position. A system trouble signal shall be energized when switch is in the off position.
 2. Alarm Off Switch: Shall disconnect power to alarm notification circuits on the local building alarm system. A system trouble signal shall be activated when switch is in the off position.
 3. Trouble Silence Switch: Shall silence the trouble signal whenever the trouble silence switch is operated. This switch shall not reset the trouble signal.
 4. Reset Switch: Shall reset the system after an alarm, provided the initiating device has been reset. The system shall lock in alarm until reset.
 5. Lamp Test Switch: A test switch or other approved convenient means shall be provided to test the indicator lamps.

6. Drill Switch: Shall activate all notification devices without tripping the remote alarm transmitter. This switch is required only for general evacuation systems specified herein.
7. Door Holder By-Pass Switch: Shall prevent doors from releasing during fire alarm tests. A system trouble alarm shall be energized when switch is in the abnormal position.
8. HVAC/Smoke Damper By-Pass: Provide a means to disable HVAC fans from shutting down and/or smoke dampers from closing upon operation of an initiating device designed to interconnect with these devices.

G. Remote Transmissions:

1. Provide capability and equipment for transmission of alarm, supervisory and trouble signals to the main fire alarm control unit.
2. Transmitters shall be compatible with the systems and equipment they are connected to such as timing, operation and other required features.

H. System Expansion: Design the control units and enclosures so that the system can be expanded in the future (to include the addition of twenty percent more alarm initiating, alarm notification and door holder circuits) without disruption or replacement of the existing control unit and secondary power supply.

2.4 ANNUNCIATION (EXISTING)

A. Annunciator, Alphanumeric Type (System):

1. Shall be a supervised, LCD display containing a minimum of two lines of 40 characters for alarm annunciation in clear English text.
2. Message shall identify building number, floor, zone, etc on the first line and device description and status (pull station, smoke detector, or troublecondition) on the second line.
3. The initial alarm received shall be indicated as such.
4. A selector switch shall be provided for viewing subsequent alarm messages.
5. The display shall be UL listed for fire alarm application.
6. Annunciators shall display information for all buildings connected to the system. Local building annunciators, for general evacuation system buildings, shall be permitted when shown on the drawings and approved by the RESIDENT ENGINEER/COTR.

B. Printers:

1. System printers shall be high reliability digital input devices, UL approved, for fire alarm applications. The printers shall operate at a minimum speed of 30 characters per second. The printer shall be continually supervised.
2. Printers shall be programmable to either alarm only or event logging output.
 - a. Alarm printers shall provide a permanent (printed) record of all alarm information that occurs within the fire alarm system. Alarm information shall include the date, time, building number, floor, zone, device type, device address, and condition.
 - b. Event logging printers shall provide a permanent (printed) record of every change of status that occurs within the fire alarm system. Status information shall include date, time, building number, floor, zone, device type, device address and change of status (alarm, trouble, supervisory, reset/return to normal).
3. System printers shall provide tractor drive feed pins for conventional fan fold 213 mm x 275 mm (8-1/2" x 11") paper.
4. The printers shall provide a printing and non-printing self test feature.
5. Power supply for printers shall be taken from and coordinated with the building emergency service.
6. Each printer shall be provided with a stand for the printer and paper.
7. Spare paper and ribbons for printers shall be stocked and maintained as part of the five (5) year guarantee period services in addition to the one installed after the approval of the final acceptance test.

2.5 ALARM NOTIFICATION APPLIANCES

A. Bells:

1. Shall be electric, single-stroke or vibrating, heavy-duty, under-dome, solenoid type.
2. Unless otherwise shown on the drawings, shall be 150 mm (6 inches) diameter and have a minimum nominal rating of 80 dBA at 3000 mm (10 feet).
3. Mount on removable adapter plates on outlet boxes.

4. Bells located outdoors shall be weatherproof type with metal housing and protective grille.
5. Each bell circuit shall have a minimum of twenty percent spare capacity.

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 13 mm (1/2 inch) 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 twenty (20) percent spare capacity.
4. Strobes may be combined with the audible notification appliances specified herein.

C. Fire Alarm Horns:

1. Shall be electric, utilizing solid state electronic technology operating on a nominal 24 VDC.
2. Shall be a minimum nominal rating of 80 dBA at ten feet.
3. Mount on removable adapter plates on conduit boxes.
4. Horns located outdoors shall be of weatherproof type with metal housing and protective grille.
5. Each horn circuit shall have a minimum of twenty (20) percent spare capacity.

2.6 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 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. Heat Detectors:

1. Heat detectors shall be of the addressable restorable rate compensated fixed-temperature spot type.
2. Detectors shall have a minimum smooth ceiling rating of 2500 square feet.

2.7 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.

2.8 ADDRESS REPORTING INTERFACE DEVICE

- A. Shall have unique addresses that reports directly to the building fire alarm panel.
- B. Shall be configurable to monitor normally open or normally closed devices for both alarm and trouble conditions.
- C. Shall have terminal designations clearly differentiating between the circuit to which they are reporting from and the device that they are monitoring.
- D. Shall be UL listed for fire alarm use and compatibility with the panel to which they are connected.
- E. Shall be mounted in weatherproof housings if mounted exterior to a building.

2.9 SMOKE BARRIER DOOR CONTROL

A. Electromagnetic Door Holders:

1. New Door Holders shall be standard wall mounted electromagnetic type. In locations where doors do not come in contact with the wall when in the full open position, an extension post shall be added to the door bracket.
2. Operation shall be by 24-volt DC supplied from a battery located at the fire alarm control unit. Door holders shall be coordinated as to voltage, ampere drain, and voltage drop with the battery, battery charger, wiring and fire alarm system for operation as specified.

- B. A maximum of twelve door holders shall be provided for each circuit.
Door holders shall be wired to allow releasing doors by smoke zone.
- C. Door holder control circuits shall be electrically supervised.
- D. Smoke detectors shall not be incorporated as an integral part of door holders.
- E. Where combination holder-closer units are required to match existing, these devices are furnished and installed as per Section 08 71 00, DOOR HARDWARE. Connection and wiring shall be as herein specified.

2.10 UTILITY LOCKS AND KEYS

- A. All key operated test switches, control units, annunciator panels and lockable cabinets shall be provided with a single standardized utility lock and key.
- B. Key-operated manual fire alarm stations shall have a single standardized lock and key separate from the control equipment.
- C. All keys shall be delivered to the RESIDENT ENGINEER/COTR.

2.11 SPARE AND REPLACEMENT PARTS

- A. Provide spare and replacement parts as follows:
 - 1. Manual pull stations - 5
 - 2. Key operated manual pull stations - 3
 - 3. Heat detectors - 2 of each type
 - 4. Fire alarm strobes - 5
 - 5. Fire alarm bells - 5
 - 7. Smoke detectors - 20
 - 8. Duct smoke detectors with all appurtenances - 1
 - 9. Control equipment utility locksets - 5
 - 10. Control equipment keys - 25
 - 11. 2.5 oz containers aerosol smoke - 12
 - 12. Printer paper - 3 boxes
 - 13. Printer replacement ribbons - 3
 - 14. Monitor modules - 3
 - 15. Control modules - 3
 - 16. Fire alarm SLC cable (same as installed) - 152 m (500 feet)
- B. Keys for key-operated manual pull stations shall be provided 30 days prior to actual installation.
- C. Spare and replacement parts shall be in original packaging and submitted to the RESIDENT ENGINEER/COTR.

- D. Furnish and install a storage cabinet of sufficient size and suitable for storing spare equipment. Doors shall include a pad locking device. Padlock to be provided by the VA. Location of cabinet to be determined by the RESIDENT ENGINEER/COTR.
- E. Provide to the VA, all hardware, software, programming tools, license and documentation necessary to permanently modify the fire alarm system on site. The minimum level of modification includes addition and deletion of devices, circuits, zones and changes to system description, system operation, and digitized evacuation and instructional messages.

2.12 INSTRUCTION CHART

Provide a typeset printed or typewritten instruction card mounted behind a Lexan plastic or glass cover in a stainless steel or aluminum frame with a backplate. Install the frame in a conspicuous location observable from each control unit where operations are performed. The card shall show those steps to be taken by an operator when a signal is received under all conditions, normal, alarm, supervisory, and trouble. Provide an additional copy with the binder for the input output matrix for the sequence of operation. The instructions shall be approved by the RESIDENT ENGINEER/COTR before being posted.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be in accordance with NFPA 70, 72, 90A, and 101 as shown on the drawings, and as recommended by the major equipment manufacturer. Fire alarm wiring shall be installed in conduit. All conduit and wire shall be installed in accordance with Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS , Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW), and all penetrations of smoke and fire barriers shall be protected as required by Section 07 84 00, FIRESTOPPING.
- B. All new conduits, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas. All existing accessible fire alarm conduit not reused shall be removed.
- C. All new or reused exposed conduit shall be painted in accordance with Section 09 91 00, PAINTING to match surrounding finished areas and red in unfinished areas.

- D. 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.
- E. 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 to be approved by the RESIDENT ENGINEER/COTR.
- F. 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.
- G. Strobes shall be flush wall mounted 2,000 mm (80 inches) above the floor or 150 mm (6 inches) below ceiling, whichever is lower. Locate and mount to maintain a minimum 900 mm (36 inches) clearance from side obstructions.
- H. Manual pull stations shall be installed not less than 1050 mm (42 inches) or more than 1200 mm (48 inches) from finished floor to bottom of device and within 1500 mm (60 inches) of a stairway or an exit door.

3.2 TYPICAL OPERATION

- A. Activation of any manual pull station, , heat detector, or smoke detector shall cause the following operations to occur:
 - 2. Continuously sound a temporal pattern general alarm and flash all strobes in the building in alarm until reset at the local fire alarm control unit in Buildings Administration and Maintenance buildings.
 - 3. Release only the magnetic door holders in the smoke zone on the floor from which alarm was initiated after the alert signal.
 - 4. Transmit a separate alarm signal, via the main fire alarm control unit to the fire department.
 - 5. Unlock the electrically locked exit doors within the zone of alarm.
- B. Operation of duct smoke detectors shall cause a system supervisory condition and shut down the ventilation system and close the associated smoke dampers as appropriate.

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 RESIDENT ENGINEER/COTR.
- B. When the systems have been completed and prior to the scheduling of the final inspection, furnish testing equipment and perform the following tests in the presence of the RESIDENT ENGINEER/COTR. When any defects are detected, make repairs or install replacement components, and repeat the tests until such time that the complete fire alarm systems meets all contract requirements. After the system has passed the initial test and been approved by the RESIDENT ENGINEER/COTR, the contractor may request a final inspection.
 - 1. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
 - 2. Test the insulation on all installed cable and wiring by standard methods as recommended by the equipment manufacturer.
 - 3. Open each alarm initiating and notification circuit to see if trouble signal actuates.
 - 4. Ground each alarm initiation and notification circuit and verify response of trouble signals.

3.4 FINAL INSPECTION AND ACCEPTANCE

- A. Prior to final acceptance a minimum 30 day "burn-in" period shall be provided. The purpose shall be to allow equipment to stabilize and potential installation and software problems and equipment malfunctions to be identified and corrected. During this diagnostic period, all system operations and malfunctions shall be recorded. Final acceptance will be made upon successful completion of the "burn-in" period and where the last 14 days is without a system or equipment malfunction.
- B. At the final inspection a factory trained representative of the manufacturer of the major equipment shall repeat the tests in Article 3.3 TESTS and those required by NFPA 72. In addition the representative shall demonstrate that the systems function properly in every respect. The demonstration shall be made in the presence of a VA representative.

3.5 INSTRUCTION

- A. The manufacturer's authorized representative shall provide instruction and training to the VA as follows:
1. Six one-hour sessions to engineering staff, security police and central attendant personnel for simple operation of the system. Two sessions at the start of installation, two sessions at the completion of installation and two sessions 3 months after the completion of installation.
 2. Four two-hour sessions to engineering staff for detailed operation of the system. Two sessions at the completion of installation and two sessions 3 months after the completion of installation.
 3. Three eight-hour sessions to electrical technicians for maintaining, programming, modifying, and repairing the system at the completion of installation and one eight-hour refresher session 3 months after the completion of installation.
- B. The Contractor and/or the Systems Manufacturer's representative shall provide a typewritten "Sequence of Operation" including a trouble shooting guide of the entire system for submittal to the VA. The sequence of operation will be shown for each input in the system in a matrix format and provided in a loose leaf binder. When reading the sequence of operation, the reader will be able to quickly and easily determine what output will occur upon activation of any input in the system. The INPUT/OUTPUT matrix format shall be as shown in Appendix A to NFPA 72.
- C. Furnish the services of a competent instructor for instructing personnel in the programming requirements necessary for system expansion. Such programming shall include addition or deletion of devices, zones, indicating circuits and printer/display text.

- - - END - - -

SECTION 31 20 00
EARTH MOVING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. This section specifies the requirements for furnishing all equipment, materials, labor, tools, and techniques for earthwork including, but not limited to, the following:
1. Site preparation.
 2. Excavation.
 3. Filling and backfilling.
 4. Grading.
 5. Soil Disposal.
 6. Clean Up.
- B. The Project Geotechnical report is included as an appendix to the specification. This report, including the recommendations and requirements shall be considered part of the contract documents. Failure by the Contractor to follow recommendations provided in the Geotechnical Report shall be at the Contractor's risk. No payment shall be made for additional work resulting from failure to follow these recommendations.

Geotechnical Reports Provided by:

American Engineering Testing

Proposed Maintenance Building Addition

Black Hills National Cemetery, Sturgis SD

Date: February 8, 2022

1.2 DEFINITIONS

- A. Unsuitable Materials:
1. Fills: Topsoil; frozen materials; construction materials and materials subject to decomposition; clods of clay and stones larger than 75 mm (3 inches); organic material, including silts, which are unstable; and inorganic materials, including silts, too wet to be stable and any material with a liquid limit and plasticity index exceeding 40 and 15 respectively. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum

- moisture content at time of compaction, as defined by ASTM D 698.
2. Existing Subgrade (Except Footing Subgrade): Same materials as 1.2.A.1, that are not capable of direct support of slabs, pavement, and similar items with possible exception of improvement by compaction, proofrolling, or similar methods.
 3. Existing Subgrade (Footings Only): Same as paragraph 1, but no fill or backfill. If materials differ from reference borings and design requirements, excavate to acceptable strata subject to Resident Engineer's approval.
- B. Building Earthwork: Earthwork operations required in area enclosed by a line located 1500 mm (5 feet) outside of principal building perimeter. It also includes earthwork required for auxiliary structures, buildings, columbaria, memorial walls, and crypt burial sections.
- C. Trench Earthwork: Trenchwork required for utility lines.
- D. Site Earthwork: Earthwork operations required in area outside of a line located 1500 mm (5 feet) outside of principal building perimeter and within new construction area with exceptions noted above.
- E. Degree of compaction: Degree of compaction is expressed as a percentage of maximum density obtained by laboratory test procedure. This percentage of maximum density is obtained through use of data provided from results of field test procedures presented in ASTM D1556.
- F. Fill: Satisfactory soil materials used to raise existing grades. In the Construction Documents, the term "fill" means fill or backfill as appropriate.
- G. Backfill: Soil materials or controlled low strength material used to fill an excavation.
- H. Unauthorized excavation: Removal of materials beyond indicated sub-grade elevations or indicated lines and dimensions without written authorization by the Resident Engineer. No payment will be made for unauthorized excavation or remedial work required to correct unauthorized excavation.
- I. Authorized additional excavation: Removal of additional material authorized by the Resident Engineer based on the determination by the Government's soils testing agency that unsuitable bearing materials are encountered at required sub-grade elevations. Removal of unsuitable material and its replacement as directed will be paid on basis of

Conditions of the Contract relative to changes in work.

- J. Subgrade: The undisturbed earth or the compacted soil layer immediately below granular sub-base, drainage fill, or topsoil materials.
- K. Structure: Buildings, foundations, slabs, tanks, curbs, mechanical and electrical appurtenances, columbaria walls, crypt fields, cremains burial areas or other man-made stationary features constructed above or below the ground surface.
- L. Borrow: Satisfactory soil imported from off-site for use as fill or backfill. On-site borrow may be obtained from over excavation of areas within the grading limits outside a 1:1 slope from limits of proposed current or future structures, roadways or gravesites as approved by the RE/PM. All on site borrow areas shall be backfilled and compacted with on-site nonstructural fill materials.
- M. Drainage course: Layer supporting slab-on-grade used to minimize capillary flow of pore water.
- N. Bedding course: Layer placed over the excavated sub-grade in a trench before laying pipe. Bedding course shall extend up to the spring line of the pipe.
- O. Sub-base Course: Layer placed between the sub-grade and base course for asphalt paving or layer placed between the sub-grade and a concrete pavement or walk.
- P. Utilities include on-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.
- Q. Debris: Debris includes all materials located within the designated work area not covered in the other definitions and shall include but not be limited to items like vehicles, equipment, appliances, building materials or remains thereof, tires, any solid or liquid chemicals or products stored or found in containers or spilled on the ground.
- R. Contaminated soils: Soil that contains contaminates as defined and determined by the Resident Engineer or the Government's testing agency.
- S. Select Fill (Crypt Backfill): Specified soil material to be used over pre-placed Crypts to bring to finished grade.
- T. Approved Subgrade: Subgrade that has been proof-rolled as required and approved for pavement construction by the geotechnical engineer and/or the RE/PM.

1.3 RELATED WORK

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Safety requirements: Section 01 00 00, GENERAL CONDITIONS, Article, ACCIDENT PREVENTION.
- C. Protection of existing utilities, fire protection services, existing equipment, roads, and pavements: Section 01 00 00, GENERAL REQUIREMENTS.
- D. Subsurface Investigation: Section 01 00 00, GENERAL REQUIREMENTS, Article, PHYSICAL DATA.
- E. Erosion Control: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS, and Section 32 90 00, PLANTING.
- F. Site preparation: Section 02 41 00, DEMOLITION.
- G. Paving sub-grade requirements: Section 32 12 16, ASPHALT PAVING.

1.4 CLASSIFICATION OF EXCAVATION

- A. Unclassified Excavation: Removal and disposal of pavements and other man-made obstructions visible on surface; utilities, and other items including underground structures indicated to be demolished and removed; together with any type of materials regardless of character of material and obstructions encountered.

1.5 SUBMITTALS:

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
 - 1. Samples and gradation reports of all imported materials specified in this section proposed for use.
- B. Furnish to Resident Engineer:
 - 1. Contactor shall furnish resumes with all personnel involved in the project including Project Manager, Superintendent, and on-site Engineer. Project Manager and Superintendent should have at least 3 years of experience on projects of similar size.
 - 2. Soil and material samples.
 - a. Classification in accordance with ASTM D2487 for each on-site or borrow soil material proposed for fill, backfill, engineered fill, or structural fill.
 - b. Laboratory compaction curve in accordance with ASTM D 698 for each on site or borrow soil material proposed for fill, backfill,

- engineered fill, or structural fill.
- c. Test reports for compliance with ASTM D 2940 requirements for subbase material.
- d. Pre-excavation photographs and videotape in the vicinity of the existing structures to document existing site features, including surfaces finishes, cracks, or other structural blemishes that might be misconstrued as damage caused by earthwork operations.
- e. The Contractor shall submit a scale plan daily that defines the location, limits, and depths of the area excavated.

1.6 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.
- B. American Association of State Highway and Transportation Officials (AASHTO):
 - T99-01(2004).....Moisture-Density Relations of Soils Using a 2.5 kg (5.5 lb) Rammer and a 305 mm (12 inch) Drop
 - T180-01(2004).....Moisture-Density Relations of Soils using a 4.54 kg (10 lb) Rammer and a 457 mm (18 inch) Drop
- C. American Society for Testing and Materials (ASTM):
 - D448-12.....Standard Classification for Sizes of Aggregate for Road and Bridge Construction
 - D698-12e2.....Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft. lbf/ft³ (600 kN m/m³))
 - D1556-15.....Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
 - D1557-12e1.....Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2700 kN m/m³))
 - D2167-15.....Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method
 - D2487-11.....Standard Classification of Soil for Engineering Purposes (Unified Soil Classification System)

D2922-05.....Standard Test Methods for Density of Soil and
Soil-Aggregate in Place by Nuclear Methods
(Shallow Depth)

D2940-15.....Standard Specifications for Graded Aggregate
Material for Bases or Subbases for Highways or
Airports

D. Society of Automotive Engineers (SAE):

J732-92.....Specification Definitions - Loaders

J1179-02.....Hydraulic Excavator and Backhoe Digging Forces

PART 2 - PRODUCTS

2.1 MATERIALS

General: Follow the geotechnical report for all fill(s), placement, compaction, and testing. If not defined in the geotechnical report then the below definitions shall be followed. Provide borrow soil material when sufficient satisfactory soil materials are not available from excavations. On-site borrow may be obtained from over excavation of areas within the grading limits outside a 1:1 slope from limits of proposed current or future structures, roadways or gravesites as approved by the RE/PM. All on site borrow areas shall be backfilled and compacted with on-site nonstructural fill materials.

A. Fills: Material in compliance with ASTM D2487 Soil Classification Groups GW, GP, GM, SW, SP, SM, SC, CL and ML, or any combination of these groups; free of rock or gravel larger than 75 mm (3 inches) in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter. Material approved from on site or off site sources having a minimum dry density of 1760 kg/m³ (110 pcf), a maximum Plasticity Index of 15, and a maximum Liquid Limit of 40.

B. Engineered Fill/Structural Fill: See geotechnical report. Naturally or artificially graded mixture of compliance with ASTM D2487 Soil Classification Groups GW, GP, GM, SW, SP, SM, SC, and CL, ML, or any combination of these groups, or as approved by the Geotechnical Engineer or material with at least 90 percent passing a 37.5-mm (1 1/2-inch) sieve and not more than 12 percent passing a 75-µm (No. 200) sieve, per ASTM D2940. Any structural fill shall be approved by the geotechnical engineer prior to placement.

C. Bedding: Naturally or artificially graded mixture of natural or crushed

gravel, crushed stone, and natural or crushed sand; ASTM D2940; except with 100 percent passing a 25 mm (1 inch) sieve and not more than 8 percent passing a 75- μ m (No. 200) sieve.

- D. Drainage Fill / Drainage Aggregate: Washed, narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D448; coarse-aggregate grading Size 57; with 100 percent passing a 37.5 mm (1 1/2-inch) sieve and 0 to 5 percent passing a 2.36 mm (No. 8) sieve. Amount of material passing the 200 sieve by wash shall be less than 8%.
- E. Granular Fill:
 - 1. See Geotechnical report.
- F. Aggregate base: Conforming to SDDOT 882.2; Table 1: Aggregate Base Course.

PART 3 - EXECUTION

3.1 SITE PREPARATION

- A. Clearing: Clear within limits of earthwork operations as shown. Work includes removal of trees, shrubs, fences, foundations, incidental structures, paving, debris, trash, and other obstructions. Remove materials from Cemetery Property.
- B. Grubbing: Remove stumps and roots 75 mm (3 inch) and larger diameter. Roots up to 75 mm (3 inch) diameter, and nonperishable solid objects a minimum of 900 mm (3 feet) below subgrade or finished embankment may be left. Cemetery Projects: do not leave material within burial profile up to 2400 mm (8 feet) below finished grade of burial sections.
- C. Trees and Shrubs: Trees and shrubs, not shown for removal, may be removed from areas within 4500 mm (15 feet) of new construction and 2250 mm (7.5 feet) of utility lines when removal is approved in advance by Resident Engineer. Remove materials from Cemetery Property. Trees and shrubs, shown to be transplanted, shall be dug with a ball of earth and burlapped in accordance with latest issue of, "American Standard for Nursery Stock" of the American Association of Nurserymen, Inc. Transplant trees and shrubs to a permanent or temporary position within two hours after digging. Maintain trees and shrubs held in temporary locations by watering as necessary and feeding semiannually with liquid fertilizer with a minimum analysis of 5 percent nitrogen, 10 percent

phosphorus, and 5 percent potash. Maintain plants moved to permanent positions as specified for plants in temporary locations until conclusion of contract. Box, and otherwise protect from damage, existing trees and shrubs which are not shown to be removed in construction area. Immediately repair damage to existing trees and shrubs by trimming, cleaning and painting damaged areas, including roots, in accordance with standard industry horticultural practice for the geographic area and plant species. Do not store building materials closer to trees and shrubs that are to remain, than farthest extension of their limbs.

- D. Stripping Topsoil: Strip topsoil from within limits of earthwork operations as specified. Topsoil shall be a fertile, friable, natural topsoil of loamy character and characteristic of locality. Topsoil shall be capable of growing healthy horticultural crops of grasses. Stockpile topsoil and protect as directed by Resident Engineer. Eliminate foreign materials, such as weeds, roots, stones, subsoil, frozen clods, and similar foreign materials larger than 0.014 m³ (1/2 cubic foot) in volume, from soil as it is stockpiled. Retain topsoil on station. Remove foreign materials larger than 50 mm (2 inches) in any dimension from topsoil used in final grading. Topsoil work, such as stripping, stockpiling, and similar topsoil work shall not, under any circumstances, be carried out when soil is wet so that the composition of the soil will be destroyed. Cemetery Projects: Test the soil for chemicals, pesticides and fertilizers if topsoil is to be removed from lands formerly utilized as farmland, to verify suitability for use as topsoil in the cemetery where new lawn areas are to be established.
- E. Concrete Slabs and Paving: Score deeply or saw cut to insure a neat, straight cut, sections of existing concrete slabs and paving to be removed where excavation or trenching occurs. Extend pavement section to be removed a minimum of 300 mm (12 inches) on each side of widest part of trench excavation and insure final score lines are approximately parallel unless otherwise indicated. Remove material from Cemetery Property.
- F. Lines and Grades: Registered Professional Land Surveyor or Registered Civil Engineer, specified in Section 01 00 00, GENERAL REQUIREMENTS, shall establish lines and grades.

1. Grades shall conform to elevations indicated on plans within the tolerances herein specified. Generally, grades shall be established to provide a smooth surface, free from irregular surface changes. Grading shall comply with compaction requirements and grade cross sections, lines, and elevations indicated. Where spot grades are indicated, the grade shall be established based on interpolation of the elevations between the spot grades while maintaining appropriate transition at structures and paving and uninterrupted drainage flow into inlets.
2. Locations of existing elevations indicated on plans are approximate, from a site survey that measured spot elevations and subsequently generated existing contours and spot elevations. Proposed spot elevations and contour lines have been developed utilizing the existing conditions survey and developed contour lines and may be approximate. Contractor is responsible to notify Resident Engineer of any differences between existing elevations shown on plans and those encountered on site by Surveyor/Engineer described above. Notify Resident Engineer of any differences between existing or constructed grades, as compared to those shown on the plans. No contract adjustments will be made for discrepancies of less than 6 inches.
3. Subsequent to establishment of lines and grades, Contractor will be responsible for any additional cut and/or fill required to ensure that site is graded to conform to elevations indicated on plans.
4. Finish grading is specified in Section 32 90 00, PLANTING.
- G. Disposal: All materials removed from the property shall be disposed of at a legally approved site, for the specific materials, and all removals shall be in accordance with all applicable Federal, State and local regulations. No burning of materials is permitted onsite.

3.2 EXCAVATION

- A. Shoring, Sheeting and Bracing: Shore, brace, or slope, its angle of repose or to an angle considered acceptable by the Resident Engineer, banks of excavations to protect workmen, banks, adjacent paving, structures, and utilities.
 1. Design of the temporary support of excavation system is the responsibility of the Contractor.

2. Construction of the support of excavation system shall not interfere with the permanent structure and may begin only after a review by the Resident Engineer.
 3. Extend shoring and bracing to a minimum of 1500 mm (5 feet) below the bottom of excavation. Shore excavations that are carried below elevations of adjacent existing foundations.
 4. If bearing material of any foundation is disturbed by excavating, improper shoring or removal of existing or temporary shoring, placing of backfill, and similar operations, the Contractor shall provide a concrete fill support under disturbed foundations, as directed by Resident Engineer, at no additional cost to the Government. Do not remove shoring until permanent work in excavation has been inspected and approved by Resident Engineer.
- B. Excavation Drainage: Operate pumping equipment, and/or provide other materials, means and equipment as required to keep excavation free of water and subgrade dry, firm, and undisturbed until approval of permanent work has been received from Resident Engineer. Approval by the Resident Engineer is also required before placement of the permanent work on all subgrades.
- C. Subgrade Protection: Protect subgrades from softening, undermining, washout, or damage by rain or water accumulation. Reroute surface water runoff from excavated areas and not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches. When subgrade for foundations has been disturbed by water, remove disturbed material to firm undisturbed material after water is brought under control. Replace disturbed subgrade in trenches with concrete or material approved by the Resident Engineer. The contractor shall moisture condition or replace wet soils as required to obtain a passing subgrade. Failure to adequately protect the subgrade from moisture or to moisture condition wet soils shall not constitute a DIFFERING SITE CONDITION.
- D. Blasting: Blasting is not permitted.
- E. Proofrolling:
1. After rough grade has been established in cut areas and prior to placement of fill in fill areas under buildings, pavements, and grave sites proofroll exposed subgrade with a fully loaded dump

truck to check for pockets of soft material.

2. Proofrolling shall consist of at least two complete passes with one pass being in a direction perpendicular to preceding one. Remove any areas that deflect, rut, or pump excessively during proof rolling, or that fail to consolidate after successive passes to suitable soils and replaced with compacted fill. Maintain subgrade until succeeding operation has been accomplished.
3. After review and approval by the RE/PM pavement section construction may commence on the approved subgrade.

F. Building Earthwork:

1. Excavation shall be accomplished as required by drawings and specifications.
2. Excavate foundation excavations to solid undisturbed subgrade.
3. Remove loose or soft materials to a solid bottom.
4. Fill excess cut under footings or foundations with 25 MPa (3000 psi) concrete poured separately from the footings.
5. Do not tamp earth for backfilling in footing bottoms, except as specified.
6. Slope grades to direct water away from excavations and to prevent ponding.

G. Trench Earthwork:

1. Utility trenches (except sanitary and storm sewer):
 - a. Excavate to a width as necessary for sheeting and bracing and proper performance of the work.
 - b. Grade bottom of trenches with bell holes scooped out to provide a uniform bearing.
 - c. Support piping on undisturbed earth unless a mechanical support is shown.
 - d. Length of open trench in advance of piping laying shall not be greater than is authorized by Resident Engineer and/or exceed that length which can be completely backfilled at the close of each work day.
2. Sanitary and storm sewer trenches:
 - a. Trench width below a point 150 mm (6 inches) above top of pipe shall be 600 mm (24 inches) maximum for pipe up to and including 300 mm (12 inches) diameter, and four-thirds diameter of pipe

plus 200 mm (8 inches) for pipe larger than 300 mm (12 inches).
Width of trench above that level shall be as necessary for
sheeting and bracing and proper performance of the work.

- b. Bed bottom quadrant of pipe on undisturbed soil or granular fill.
 - 1) Undisturbed: Bell holes shall be no larger than necessary for jointing. Backfill up to a point 300 mm (12 inches) above top of pipe shall be clean earth placed and tamped by hand.
 - 2) Granular Fill: Depth of fill shall be a minimum of 75 mm (3 inches) plus one sixth of pipe diameter below pipe to 300 mm (12 inches) above top of pipe. Place and tamp fill material by hand.
- c. Place and compact as specified remainder of backfill using acceptable excavated materials. Do not use unsuitable materials.
- d. Use granular fill for bedding where rock or rocky materials are excavated. Utilize crushed rock bedding and backfill at areas of soft pipe subgrade (incidental) as determined by the RE/PM.
- d. Length of open trench in advance of piping laying shall not be greater than is authorized by Resident Engineer and/or exceed that length which can be completely backfilled at the close of each work day.

H. Site Earthwork: Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; together with soil, boulders, and other materials not classified as rock or unauthorized excavation. Excavation shall be accomplished as required by drawings and specifications. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 25 mm (1 inch). Extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, complying with OSHA requirements, and for inspections. Remove subgrade materials that are determined by Resident Engineer and/or Geotechnical Engineer as unsuitable, and replace with acceptable material. If there is a question as to whether material is unsuitable or not, the contractor shall obtain samples of the material, under the direction of the Resident Engineer, and the materials shall be examined by an

EARTH MOVING

independent testing laboratory for soil classification to determine whether it is unsuitable or not. When unsuitable material is encountered, and removed, contract price and time will be adjusted in accordance with Articles, DIFFERING SITE CONDITIONS, CHANGES and CHANGES-SUPPLEMENT of the GENERAL REQUIREMENTS as applicable. Adjustments to be based on volume in cut section only. Wet soils that can be moisture conditioned will not be considered a differing site condition.

1. Site Grading:

- a. Provide a smooth transition between adjacent existing grades and new grades.
- b. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- c. Slope grades to direct water away from buildings and to prevent ponds from forming where not designed. Finish subgrades to required elevations within the following tolerances:
 - 1) Lawn or Unpaved Areas: Plus or minus 25 mm (1 inch).
 - 2) Walks: Plus or minus 13 mm (0.5 inch).
 - 3) Pavements: Plus or minus 13 mm (0.5 inch).
- d. Grading Inside Building Lines: Finish subgrade to a tolerance of 13 mm (1/2 inch) when tested with a 3000 mm (10 foot) straightedge.

3.3 FILLING AND BACKFILLING

- A. General: Do not fill or backfill until all debris, water, unsatisfactory soil materials, obstructions, and deleterious materials have been removed from excavation. For fill and backfill, use excavated materials and borrow meeting the criteria specified herein, as applicable. Borrow will be supplied at no additional cost to the Government. Do not use unsuitable excavated materials. Do not backfill until foundation walls have been completed above grade and adequately braced, waterproofing or dampproofing applied, foundation drainage, and pipes coming in contact with backfill have been installed and work inspected and approved by Resident Engineer.
- B. Placing: Place materials in horizontal layers not exceeding 200 mm (8 inches) in loose depth for material compacted by heavy compaction equipment, and not more than 100 mm (4 inches) in loose depth for

material compacted by hand-operated tampers and then compacted. Place backfill and fill materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure. Place no material on surfaces that are muddy, frozen, or contain frost.

- C. Compaction: Compact with approved tamping rollers, sheepfoot rollers, pneumatic tired rollers, steel wheeled rollers, vibrator compactors, or other approved equipment (hand or mechanized) well suited to soil being compacted. Do not operate mechanized vibratory compaction equipment within 3000 mm (10 feet) of new or existing building walls without prior approval of Resident Engineer. Moisten or aerate material as necessary to provide moisture content that will readily facilitate obtaining specified compaction with equipment used. Compact soil to not less than the following percentages of maximum dry density, according to ASTM D698 or ASTM D1557 as specified below:

1. Fills, Embankments, and Backfill

- a. Under proposed structures, building slabs, steps, and paved areas, scarify and recompact top 300 mm (12 inches) of existing subgrade and each layer of backfill or fill material in accordance with ASTM D698 95 percent.
- b. Curbs, curbs and gutters, ASTM D698, 98 percent.
- c. Under Sidewalks, scarify and recompact top 150 mm (6 inches) below subgrade and compact each layer of backfill or fill material in accordance with ASTM D698, 95 percent.
- d. Landscaped areas, top 400 mm (16 inches), ASTM D698, 85 percent.
- e. Landscaped areas, below 400 mm (16 inches) of finished grade, ASTM D698, 90 percent.

2. Natural Ground (Cut or Existing)

- a. Under building slabs, steps and paved areas, top 150 mm (6 inches), ASTM D698, 95 percent.
- b. Curbs, curbs and gutters, top 150 mm (6 inches), ASTM D698, 98 percent.
- c. Under sidewalks, top 150 mm (6 inches), ASTM D698, 95 percent.

3.4 GRADING

- A. General: Uniformly grade the areas within the limits of this section, including adjacent transition areas. Smooth the finished surface within

specified tolerance. Provide uniform levels or slopes between points where elevations are indicated, or between such points and existing finished grades. Provide a smooth transition between abrupt changes in slope.

- B. Cut rough or sloping rock to level beds for foundations. In pipe spaces or other unfinished areas, fill low spots and level off with coarse sand or fine gravel.
- C. Slope backfill outside building away from building walls for a minimum distance of 1800 mm (6 feet).
- D. Finish grade earth floors in pipe basements as shown to a level, uniform slope and leave clean.
- E. Finished grade shall be at least 150 mm (6 inches) below bottom line of window or other building wall openings unless greater depth is shown.
- F. Place crushed stone or gravel fill under concrete slabs on grade, tamped, and leveled. Thickness of fill shall be 150 mm (6 inches) unless otherwise shown.
- G. Finish subgrade in a condition acceptable to Resident Engineer at least one day in advance of paving operations. Maintain finished subgrade in a smooth and compacted condition until succeeding operation has been accomplished. Scarify, compact, and grade subgrade prior to further construction when approved compacted subgrade is disturbed by Contractor's subsequent operations or adverse weather.
- H. Grading for Paved Areas: Provide final grades for both subgrade and base course to +/- 6 mm (0.25 inches) of indicated grades.

3.5 DISPOSAL OF UNSUITABLE AND EXCESS EXCAVATED MATERIAL

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Cemetery property.
- B. Remove from site and dispose of any excess excavated materials after all fill and backfill operations have been completed.
- C. Segregate all excavated contaminated soil designated by the Resident Engineer from all other excavated soils, and stockpile on site on two 0.15 mm (6 mil) polyethylene sheets with a polyethylene cover. A designated area shall be selected for this purpose. Dispose of excavated contaminated material in accordance with State and Local requirements.

Black Hills National Cemetery
Renovate and Expand Administration and Maintenance Buildings
20901 Pleasant Valley Drive
Sturgis, SD 57785

NCA Project #884CM3015
10/31/22
Bid Documents

3.6 CLEAN UP

Upon completion of earthwork operations, clean areas within contract limits, remove tools, and equipment. Provide site clear, clean, free of debris, and suitable for subsequent construction operations. Remove all debris, rubbish, and excess material from Cemetery Property.

----- E N D -----

SECTION 32 05 23
CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Site work concrete.
2. Curb, gutter, and combination curb and gutter.
3. Pedestrian Pavement: Walks flower/water stations mow strips
wheelchair curb ramps and plaza areas.
4. Vehicular Pavement: Maintenance yards and driveways.
5. Equipment Pads: Transformers and irrigation field satellites.

1.2 RELATED REQUIREMENTS

- A. Laboratory and Field Testing Requirements: Section 01 45 29, TESTING
LABORATORY SERVICES.
- B. Subgrade Preparation: Section 31 20 00, EARTH MOVING.
- C. Concrete Materials, Quality, Mixing, Design and Other Requirements:
Section 03 30 53, SHORT FORM CAST-IN-PLACE CONCRETE.
- D. Metal Components of Steps (Nosing and Railing): Section 05 50 00, METAL
FABRICATIONS.

1.3 APPLICABLE PUBLICATIONS

- A. Comply with references to extent specified in this section.
- B. American Association of State Highway and Transportation Officials
(AASHTO):
 1. M31M/M31-15 - Deformed and Plain Carbon-Steel Bars for Concrete
Reinforcement.
 2. M55M/M55-09 - Steel Welded Wire Reinforcement, Plain, for Concrete,
Single User.
 3. M147-65 (2004) - Materials for Aggregate and Soil-Aggregate Subbase,
Base, and Surface Courses.
 4. M148-05 - Liquid Membrane-Forming Compounds for Curing Concrete.
 5. M171-05 - Sheet Materials for Curing Concrete.
 6. M182-05(2012) - Burlap Cloth Made from Jute or Kenaf and Cotton
Mats.
 7. M213-01(2010) - Preformed Expansion Joint Fillers for Concrete
Paving and Structural Construction (Nonextruding and Resilient
Bituminous Types).

8. M233-86 - Boiled Linseed Oil Mixture for Treatment of Portland Cement Concrete.
 9. T99-15 - Moisture-Density Relations of Soils Using a 2.5-kg. (5.5-lb) Rammer and a 305-mm (12-in.) Drop.
 10. T180-15 - Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
- C. American National Standards Institute (ANSI):
1. B101.3 - Wet DOCF of Common Hard Surface Floor Materials (Including Action and Limit Thresholds for the Suitable Assessment of the Measured Values).
- D. ASTM International (ASTM):
1. A775/A775M-16 - Epoxy-Coated Steel Reinforcing Bars.
 2. C94/C94M-16 - Ready-Mixed Concrete.
 3. C143/C143M-15a - Slump of Hydraulic Cement Concrete.
 4. C1116/C1116M-10a(2015) - Fiber-Reinforced Concrete.
 5. D5893/D5893M-10 - Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements.
 6. D6690-15 - Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.

1.4 PREINSTALLATION MEETINGS

- A. Conduct preinstallation meeting at project site minimum 30 days before beginning Work of this section.
1. Required Participants:
 - a. Project Manager (PM/COR).
 - b. Architect/Engineer.
 - c. Inspection and Testing Agency.
 - d. Contractor.
 - e. Installer.
 - f. Manufacturer's field representative.
 - g. Other installers responsible for adjacent and intersecting work, including excavation, plantings, traffic markings and masonry.
 2. Meeting Agenda: Distribute agenda to participants minimum 3 days before meeting.
 - a. Installation schedule.
 - b. Installation sequence.
 - c. Preparatory work.

- d. Protection before, during, and after installation.
 - e. Installation.
 - f. Terminations.
 - g. Transitions and connections to other work.
 - h. Inspecting and testing.
 - i. Other items affecting successful completion.
3. Document and distribute meeting minutes to participants to record decisions affecting installation.

1.5 SUBMITTALS

- A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Submittal Drawings:
1. Show size, configuration, and fabrication and installation details.
 2. Show reinforcing.
 3. Include jointing plan for concrete pavements, curbs and gutters.
- C. Manufacturer's Literature and Data:
1. Description of each product.
 - a. Expansion joint filler.
 - b. Hot poured sealing compound.
 - c. Reinforcement.
 - d. Curing materials.
 2. Installation instructions.
- D. Test Reports: Certify products comply with specifications.
1. Job-mix formula.
 2. Select subbase materials.
- E. Certificates: Certify products comply with specifications.
1. Expansion joint filler.
 2. Reinforcement.
 3. Curing materials.
 4. Concrete protective coating.
- F. Qualifications: Substantiate qualifications comply with specifications.
1. Installer with project experience list.
 2. Land surveyor.
- G. Concrete mix design.
- H. Select subbase job-mix design: Report the following:
1. Material sources.

2. Gradation.
3. Plasticity index.
4. Liquid limit.
5. Laboratory compaction curves indicating maximum density at optimum moisture content.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications:
 1. Regularly installs specified products.
 2. Installed specified products with satisfactory service on five similar installations.
 - a. Project Experience List: Provide contact names and addresses for completed projects.
- B. Land Surveyor: Professional land surveyor or engineer registered to provide land surveys in jurisdiction where project is located.
- C. Preconstruction Testing:
 1. Engage independent testing laboratory to perform tests and submit reports.
 - a. Deliver samples to laboratory in number and quantity required for testing.
 2. Concrete mix design.

1.7 DELIVERY

- A. Deliver products in manufacturer's original sealed packaging.
- B. Mark packaging, legibly. Indicate manufacturer's name or brand, type, and manufacture date.
- C. Deliver steel reinforcement to prevent damage.
- D. Before installation, return or dispose of products with damaged or opened packaging and distorted or damaged steel reinforcement.
- E. Bulk Products: Deliver bulk products away from buildings, utilities, pavement, and existing turf and planted areas. Maintain dry bulk product storage away from contaminants.

1.8 STORAGE AND HANDLING

- A. Store products indoors in dry, weathertight facility.
- B. Protect products from damage during handling and construction operations.

1.9 FIELD CONDITIONS

- A. Place concrete as specified under Article 3.4 E., for Cold Weather Placement and Article 3.4 D., for Hot Weather Placement of Section 03 30 53, SHORT FORM CAST-IN-PLACE CONCRETE.

1.10 WARRANTY

- A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."

PART 2 - PRODUCTS

2.1 CONCRETE

- A. Concrete: Type B, air-entrained as specified in Section 03 30 53, SHORT FORM CAST-IN-PLACE CONCRETE, except as follows:

| TYPE | MAXIMUM SLUMP* |
|--|--|
| Curb & Gutter | 75 mm (3 inches) |
| Pedestrian Pavement | 75 mm (3 inches) |
| Vehicular Pavement | 50 mm (2 inches) (Machine Finished) 100 mm (4 inches) (Hand Finished) |
| Equipment Pad | 75 to 100 mm (3 to 4 inches) |
| * For concrete to be vibrated: Slump as determined by ASTM C143/C143M. Tolerances as established by ASTM C94/C94M. | |

2.2 REINFORCEMENT

- A. Steel Reinforcement: Type, amount, and locations as shown on drawings and as specified.
- B. Welded Wire-Fabric: AASHTO M55M/M55.
- C. Dowels: Plain steel bars complying with AASHTO M31M/M31.
- D. Tie Bars: Deformed steel bars complying with AASHTO M31M/M31.

2.3 SELECT SUBBASE (WHERE REQUIRED)

- A. See Geotechnical report.

2.4 FORMS

- A. Forms: Metal or wood, straight and suitable in cross-section, depth, and strength to resist springing during depositing and consolidating of concrete.

- B. Tolerance: 3 mm (1/8 inch) maximum variation from straight line in any 3000 mm (10 foot) long section, in either a horizontal or vertical direction.
- C. Wood Forms: Minimum 50 mm (2 inches) thick (nominal), free from warp, twist, loose knots, splits, or other defects. Provide approved flexible or curved forms for forming radii.

2.5 CONCRETE CURING MATERIALS

- A. Concrete Curing Materials: Comply with one of the following:
 - 1. Burlap: AASHTO M182, weighing 233 g/sq. m (7 oz./sq. yd.) dry.
 - 2. Impervious Sheeting: AASHTO M171.
 - a. Polyethylene: Minimum 0.1 mm (4 mils) thick.
 - 3. Liquid Membrane Curing Compound: AASHTO M148 Type 1, without paraffin or petroleum.

2.6 EXPANSION JOINT FILLERS

- A. Expansion Joint Filler: AASHTO M213.

2.7 ACCESSORIES

- A. Equipment and Tools: Obtain PM's approval of equipment and tools for handling materials and performing work before work begins. Maintain equipment and tools in satisfactory working condition at all times.
- B. Sealants:
 - 1. Concrete Paving Expansion Joints: ASTM D5893/D5893M, Type SL, single component, self-leveling, silicone joint sealant.
 - 2. Concrete Paving Joints: ASTM D6690, Type IV, hot-applied, single component joint sealant.
- C. Concrete Protective Coating: AASHTO M233 linseed oil mixture.

2.8 CEMENT, SAND, AGGREGATES AND OTHER ADDITIVES

- A. Cement, Sand and Aggregate Color: As required to match paver colors.
- B. Provide silicon carbide or aluminum oxide grains as required to match paver colors.

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. Prepare, construct, and finish subgrade as specified in Section 31 20 00, EARTH MOVING.
- D. Maintain subgrade in smooth, compacted condition, complying with required section and established grade until succeeding operation has been accomplished.

3.2 SETTING FORMS

- A. Form Substrate:
 - 1. Compact form substrate to uniformly support forms along entire length at grade as shown on drawings.
 - 2. Correct substrate imperfections or variations by cutting or filling and compacting.
- B. Form Setting:
 - 1. Set forms sufficiently in advance of concrete placement to permit performance and approval of operations required with and adjacent to form lines.
 - 2. Set forms to indicated line and grade and use stakes, clamps, spreaders, and braces to prevent movement in any direction.
 - 3. Tolerances: Conform to line and grade with 3 mm (1/8 inch) tolerance when checked with straightedge, with maximum 6 mm (1/4 inch) deviation from true line at any point.
 - 4. Remove forms when removal will not damage concrete and when required for finishing.
 - 5. Clean and oil forms before each use.
- C. Land Surveyor: Establish and control alignment and form grade elevations or concrete slipforming machine operations.
 - 1. Make necessary corrections to forms immediately before placing concrete.
 - 2. When any form has been disturbed or any subgrade or subbase has become unstable, reset and recheck form before placing concrete.

3.3 PLACING REINFORCEMENT

- A. Keep reinforcement free of dirt, oil, rust, scale or other substances preventing concrete bond.
- B. Install reinforcement as shown on drawings.
- C. Support and securely tie reinforcing steel to prevent displacement during concrete placement.

- D. Obtain PM's approval of reinforcement placement before placing concrete.

3.4 PLACING CONCRETE - GENERAL

- A. Preparation:
 - 1. Obtain PM's approval.
 - 2. Remove debris and other foreign material from between forms.
 - 3. Uniformly moisten subgrade, base, or subbase without standing water.
- B. Convey concrete from mixer to final location without segregation or loss of ingredients. Deposit concrete to minimize handling.
- C. During placement, consolidate concrete by spading or vibrating to minimize voids, honeycomb, and rock pockets.
 - 1. Vibrate concrete against forms and along joints.
 - 2. Avoid excess vibration and handling causing segregation.
- D. Place concrete continuously between joints without bulkheads.
- E. Install construction joint whenever concrete placement is suspended for more than 30 minutes and at end of each day's work.
- F. Workmen or construction equipment coated with foreign material will not be permitted to walk or operate in concrete during placement and finishing operations.

3.5 PLACING CONCRETE FOR CURB AND GUTTER, PEDESTRIAN PAVEMENTS, AND EQUIPMENT PADS

- A. Place concrete in one layer conforming to cross section shown on drawings after consolidating and finishing.
- B. Deposit concrete near joints without disturbing joints. Do not place concrete directly onto joint assemblies.
- C. After concrete has been placed in forms, use a strike-off guided by side forms to bring surface to proper section to be compacted.
- D. Consolidate concrete thoroughly by tamping and spading, or with approved mechanical finishing equipment.
- E. Finish concrete surface to grade with wood or metal float.
- F. Construct concrete pads and pavements with sufficient slope to drain, preventing standing water.

3.6 PLACING CONCRETE FOR VEHICULAR PAVEMENT

- A. Deposit concrete into forms as close as possible to its final position.
- B. Place concrete rapidly and continuously between construction joints.

- C. Strike off concrete and thoroughly consolidate with finishing machine, vibrating screed, or by hand-finishing.
- D. Finish surface to elevation and crown as shown on drawings.
- E. Deposit concrete near joints without disturbing joints. Do not place directly onto joint assemblies. Do not place adjacent lanes/areas without PM's approval.
- F. Curb-Forming Machines: Curb-forming machines for constructing curbs and gutter will be approved based on trial use on project. If equipment produces unsatisfactory results, discontinue use and accomplish work by hand method construction as specified. Remove unsatisfactory work and reconstruct full length between regularly scheduled joints. Legally dispose of removed portions off project site.

3.7 CONCRETE FINISHING - GENERAL

- A. Follow operation sequence below, unless otherwise indicated on drawings:
 - 1. Consolidating, floating, straight-edging, troweling, texturing, and joint edging.
 - 2. Maintain finishing equipment and tools in clean and approved condition.

3.8 CONCRETE FINISHING - CURB AND GUTTER

- A. Gutter and Curb Top:
 - 1. Round edges of gutter and curb top with edging tool to 6mm (1/4 inch) radius or as otherwise shown on drawings.
 - 2. Float surfaces and finish with smooth wood or metal float until true to grade and section and uniform texture.
 - 3. Finish surfaces longitudinally, while still wet, with bristle type brush.
- B. Curb Face:
 - 1. Remove curb form and immediately rub curb face with wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed.
 - 2. Brush curb face, while still wet, to match gutter and curb top.
- C. Tolerances: Except at grade changes or curves, when tested with 3000 mm (10 foot) straightedge.
 - 1. Variation from Indicated Plane and Grade:
 - a. Gutter: Maximum 3 mm (1/8 inch).

- b. Curb Top and Face: Maximum 6 mm (1/4 inch).
- D. Replace curbs and gutters within joint boundary when curbs and gutters exceed specified tolerances.
- E. Correct depressions causing standing water.
- F. Visible surfaces and edges of finished curb and gutter to be free of blemishes, form marks, and tool marks, and uniform in color, shape, and appearance.

3.9 CONCRETE FINISHING PEDESTRIAN PAVEMENT

- A. Walks, Flower Water Stations, Mow Strips, Wheelchair Curb Ramps and Plaza Areas:
 - 1. Finish concrete surfaces to grade and cross section with metal float, troweled smooth and finished with a broom moistened with clear water.
 - 2. Broom surfaces transverse to traffic direction.
 - 3. Carefully finish slab edges, including at formed joints, with edger with radius as shown on drawings.
 - 4. Unless otherwise indicated, edge transverse joints before brooming. Use brooming to eliminate flat surface produced by edger. Produce uniform corrugations, maximum 2 mm (1/16 inch) deep.
 - 5. Provide surface uniform in color and free of surface blemishes, form marks, and tool marks.
 - 6. Paving Tolerances:
 - a. Variation from Indicated Plane: Maximum 5 mm in 3000 mm (3/16 inch in 10 feet).
 - b. Variation from Indicated Thickness: Maximum 6 mm (1/4 inch).
 - 7. Replace paving within joint boundary when paving exceeds specified tolerances.
- B. Longitudinally float pavement surface with float minimum 3000 mm (10 feet) long and 150 mm (6 inches) wide, properly stiffened to prevent flexing and warping. Operate float from foot bridges in sawing motion parallel to direction in which pavement is being laid from one side of pavement to the other, and advancing maximum half float length.
- C. After longitudinal floating, but while concrete is still plastic, eliminate minor irregularities in pavement surfaces by metal floats, 1500 mm (5 feet) long, and straightedges, 3000 mm (10 feet) long. Make the final finish and float entire pavement surface with straightedges.

- D. Test surface trueness with 3000 mm (10 foot) straightedge successively held parallel and at right angles to direction in which pavement is being laid and entire area, as required, to detect variations. Advance straightedge along pavement in successive stages of maximum one half straightedge length. Correct irregularities and refinish surface.
- E. Pavement Tolerances:
 - 1. Variation from Indicated Plane: Maximum 6 mm in 3000 mm (1/4 inch in 10 feet) tested parallel and perpendicular to traffic direction at maximum 1500 mm (5 feet) intervals.
 - 2. Variation from Indicted Thickness: Maximum 6 mm (1/4 inch).
- F. Finish pavement edges and joints with edging tool.
- G. Broom finish concrete surface after bleed water dissipates and before concrete hardens with approved fiber broom, minimum 450 mm (18 inches) wide.
 - 1. Gently broom surface transverse to traffic direction from edge to edge.
 - a. Use brooming to eliminate flat surface produced by edger.
 - b. Produce uniform corrugations, maximum 3 mm (1/8 inch) deep.
- H. Align finish surfaces where new and existing pavements abut.

3.10 CONCRETE FINISHING - EQUIPMENT PADS

- A. Strike pad surface to elevation shown on drawings.
- B. Provide smooth, dense float finish, free from depressions or irregularities.
- C. Carefully finish pad edges with edger having radius as shown on drawings.
- D. After removing forms, rub pad edge faces with wood or concrete rubbing block, removing blemishes, form marks, and tool marks and providing uniform color.
- E. Pad Tolerances:
 - 1. Variation from Indicated Plane: Maximum 3 mm in 3000 mm (1/8 inch in 10 feet).
- F. Correct irregularities when pads exceed specified tolerances.

3.11 JOINTS - GENERAL

- A. Place joints, where shown on drawings.
 - 1. Conform to details shown.
 - 2. Install joints perpendicular to finished concrete surface.

- B. Make joints straight and continuous from edge to edge of pavement.

3.12 CONTRACTION JOINTS

- A. Cut joints to depth as shown with grooving tool or jointer of radius as shown on drawings or by sawing with blade to produce required width and depth.
- B. Construct joints in curbs and gutters by inserting 3 mm (1/8 inch) steel plates conforming to curb and gutter cross sections.
 - 1. Keep plates in place until concrete can hold its shape.
- C. Finish joint edges with edging tool having radius as shown on drawings.
- D. Score pedestrian pavement with standard grooving tool or jointer.

3.13 EXPANSION JOINTS

- A. Form expansion joints with preformed expansion joint filler material of thickness shown on drawings.
 - 1. Without dowels, locate joints around perimeter of structures and features abutting site work concrete.
 - 2. Create complete, uniform separation between structure and site work concrete.
- B. Extend expansion joint material full depth of concrete with top edge of joint filler below finished concrete surface where sealant is indicated on drawings.
- C. Cut and shape material matching cross section.
- D. Anchor with approved devices to prevent displacing during placing and finishing operations.
- E. Round the edges of joints with an edging tool.

3.14 CONSTRUCTION JOINTS

- A. Locate longitudinal and transverse construction joints between slabs of vehicular pavement as shown on drawings.
- B. Place transverse construction joints of type shown, where indicated, and whenever concrete placement is suspended for more than 30 minutes.
- C. Provide butt-type joint with dowels in curb and gutter if joint occurs at planned joint location.
- D. Provide keyed joints with tiebars if joint occurs in middle third of typical curb and gutter joint interval.

3.15 FORM REMOVAL

- A. Keep forms in place minimum 12 hours after concrete placement. Remove forms without damaging concrete.
- B. Do not use bars or heavy tools against concrete to remove forms. Promptly repair damaged concrete found after form removal.

3.16 CONCRETE

- A. Concrete Protection:
 1. Protect unhardened concrete from rain and flowing water.
 2. Ensure sufficient curing and protection materials are available and ready for use before concrete placement begins.
 3. Protect concrete to prevent pavement cracking from ambient temperature changes during curing period.
 - a. Replace pavement damaged by curing method allowing concrete cracking.
 - b. Employ another curing method as directed by PM.
- B. Cure concrete for minimum 7 days by one of the following methods appropriate to weather conditions preventing moisture loss and rapid temperature change:
 1. Burlap Mat: Provide minimum two layers kept saturated with water during curing period. Overlap mats minimum 150 mm (6 inches).
 2. Impervious Sheeting: Provide waterproof paper, polyethylene-coated burlap, or polyethylene sheeting.
 - a. Wet exposed concrete surface with fine water spray and cover with sheet materials.
 - b. Overlap sheets minimum 300 mm (12 inches).
 - c. Securely anchor sheet materials preventing displacement.
- C. Liquid Membrane Curing Compound:
 1. Protect joints indicated to receive sealants preventing contamination from curing compound.
 2. Insert moistened paper or fiber rope into joint or cover joint with waterproof paper.
 3. Apply curing compound before concrete dries.
 4. Apply curing compound in two coats at right angles to each other.
 5. Application Rate: Maximum 5 sq. m/L (200 sq. ft./gal.), both coats.
 6. Immediately reapply curing compound to surfaces damaged during curing period.

3.17 FIELD QUALITY CONTROL

- A. Field Tests: Performed by testing laboratory specified in Section 01 45 29, TESTING LABORATORY SERVICES.
 - 1. Concrete: Testing specified in Section 03 30 53 SHORT FORM CAST-IN-PLACE CONCRETE.
 - a. Delivery samples.
 - b. Field samples.
 - 2. Slip Resistance: Steps and pedestrian paving.
- B. Concrete temperature shall not exceed 90 degrees.

3.18 CLEANING

- A. After completing curing:
 - 1. Remove curing material, except liquid membrane.
 - 2. Sweep the concrete clean.
 - 3. Seal all joints after removing foreign matter from joint.
 - 4. Clean concrete of debris and construction equipment as soon as curing and joint sealing have been completed.
- B. Remove and legally dispose of debris, rubbish, and excess material from project site.

3.19 PROTECTION

- A. Protect exterior improvements from traffic and construction operations.
 - 1. Prohibit traffic on paving for minimum seven days after placement, or longer as directed by PM.
- B. Remove protective materials immediately before acceptance.
- C. Repair damage.
 - 1. When directed by PM, replace concrete containing cracking, fractures, spalling, and other defects within joint boundary, at no additional cost to Government.

- - - E N D - - -

SECTION 32 90 00
PLANTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plants, soils, edging, turf, and landscape materials.

1.2 DEFINITIONS

- A. Pesticide: Any substance or mixture of substances, including biological control agents, that may prevent, destroy, repel, or mitigate pests and is specifically labeled for use by U.S. Environmental Protection Agency (EPA). Also, any substance used as plant regulator, defoliant, disinfectant, or biocide.

- B. Stand of Turf: 100 percent of established species.

1.3 APPLICABLE PUBLICATIONS

- A. Comply with references to extent specified in this section.

B. American National Standards Institute (ANSI):

1. Z60.1-2014 - Nursery Stock.

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

1. B221-14 - Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
2. B221M-13 - Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
3. C33/C33M-16-Concrete Aggregates.
4. C136/C136M-14 - Sieve Analysis of Fine and Coarse Aggregates.
5. C602-13a - Agricultural Liming Materials.
6. D977-13e1 - Emulsified Asphalt.
7. D5268-13 - Topsoil Used for Landscaping Purposes.

- D. Hortus Third: Concise Dictionary of Plants Cultivated in United States and Canada.

E. Tree Care Industry Association (TCIA):

1. A300P1-2008 - Tree Care Operations - Trees, Shrubs and Other Woody Plant Maintenance Standard Practices (Pruning).
2. Z133.1-2012 - Arboricultural Operations - Safety Requirements.

F. Turfgrass Producers International (TPI):

1. 2006 Guideline Specifications to Turfgrass Sodding.

- G. United States Department of Agriculture (USDA):

1. DOA SSIR 42-2014 - Soil Survey Laboratory Methods Manual.
2. Handbook No. 60 - Diagnosis and Improvement of Saline and Alkali Soils.

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. Photographs: Color photographs of each plant species showing actual size and condition of plants to be provided with measuring device included for scale. Where more than 20 plants are required of any species, submit minimum three photographs of average, best, and worst quality plant to be provided. Include on each photograph, plant full scientific name, size, and source nursery.
 3. Installation instructions.
 4. Warranty.
- C. Samples:
 1. Trees and Shrubs: Full sized of each variety and size. Deliver samples to project site and maintain samples for duration of construction period.
 2. Organic and Compost Mulch: 1 L. (1 quart) sealed plastic bag of each required mulch, including label with percentage weight of each material and source representing material to be provided. Samples to match color, texture, and composition of installed material.
 3. Mineral Mulch: 2.5 kg (5 lb.) sealed plastic bag of mulch, including label with source. Samples to match color, texture, and composition of installed material.
 4. Filter Fabric: 300 by 300 mm (12 by 12 inches).
 5. Edging Materials and Accessories: Manufacturer's standard sizes.
 6. Tree Wrap: Width of panel by 300 mm (12 inches).
- D. Test reports: Certify products comply with specifications.
- E. Certificates: Certify products comply with specifications.
 1. Plant Materials: Department of Agriculture certification by State Nursery Inspector declaring material to be free from insects and disease.
 2. Seed and Turf Materials: Notarized certificate of product analysis.

- F. Qualifications: Substantiate qualifications comply with specifications.
 - 1. Installer, including supervisor with project experience list.
- G. Operation and Maintenance Data:
 - 1. Care instructions for each plant material.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 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.
 - 3. Member in good standing of either Professional Landcare Network or American Nursery and Landscape Association.
 - 4. Personnel assigned to Work certified in one of following categories from Professional Landcare Network and submit one copy of certificate to Contracting Officer's Representative:
 - a. Certified Landscape Technician (CLT) - Exterior, with installation, maintenance, irrigation, specialty areas, designated CLT-Exterior.
 - b. Certified Ornamental Landscape Professional, designated COLP.
- B. Licensed Arborist required to submit one copy of license to Contracting Officer's Representative.
- C. Independent or university laboratory, recognized by State Department of Agriculture, with experience and capability to conduct testing indicated and that specializes in types of tests to be performed.
- D. Measure plants according to ANSI Z60.1. Pruning to obtain required sizes will not be permitted.
- E. Contracting Officer's Representative may review plant materials either at place of growth or project site before planting for compliance with requirements. Contracting Officer's Representative retains right to inspect trees and shrubs to determine if any unacceptable conditions exist and to reject any trees or shrubs at any time during Project. All rejected trees and shrubs must be immediately removed from Project site.
 - 1. Submit plant material source information to Contracting Officer's Representative seven days in advance of delivery to Project site.

- F. Material Test Reports: For standardized ASTM D5268 topsoil existing native surface topsoil existing in-place surface soil and imported or manufactured topsoil.
1. For each unamended soil type, provide soil analysis and written report by qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; sodium absorption ratio; deleterious material; pH; and mineral and plant-nutrient content of soil.
 2. Comply with USDA's Handbook No. 60 testing methods and written recommendations.
 3. Soil-testing laboratory to oversee soil sampling; with depth, location, and number of samples to be taken per instructions from Contracting Officer's Representative. Take minimum 3 representative samples from varied locations for each soil to be used or amended for planting purposes.
 4. Report suitability of tested soil for plant growth.
 5. Based on test results, state recommendations for soil treatments and soil amendments to be incorporated. State recommendations in weight per 92.9 sq. m (1000 sq. ft.) or volume per 0.76 cu. m (1 cu. yd.) for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.
 6. Report presence of problem salts, minerals, or heavy metals, including aluminum, arsenic, barium, cadmium, chromium, cobalt, lead, lithium, and vanadium. If such problem materials are present, provide additional recommendations for corrective action.

1.6 DELIVERY

- A. Deliver packaged products in manufacturer's original sealed packaging.
- B. Bulk Products:
 1. Deliver bulk products away from buildings, utilities, pavement, and existing turf and planted areas. Maintain dry bulk product storage away from contaminants.
 2. Install erosion control materials to prevent erosion or displacement of bulk products.
- C. Apply antidesiccant to trees and shrubs according to manufacturer's instructions to protect during digging, handling, and transportation.

1. For deciduous trees or shrubs in full leaf, spray with antidesiccant at nursery before transporting and again two weeks after planting.
- D. Wrap trees and shrubs with tree wrap according to manufacturer's instructions to protect from wind and other damage during digging, handling, and transportation.
- E. Deliver bare-root stock plants freshly dug with root system packed in wet straw, hay, or similar material.
- F. Deliver branched plants with branches tied and exposed branches covered with material that allows air circulation. Prevent damage to branches, trunks, root systems, and root balls and desiccation of leaves.
- G. Use of equipment such as "tree spades" is permitted provided plant balls are sized according to ANSI Z60.1 and tops are protected from damage.

1.7 STORAGE AND HANDLING

- A. Store bulbs, corms, and tubers in dry location at 16 to 18 degrees C (60 to 65 degrees F) until planting.
- B. Store seeds and other packaged materials in dry locations away from contaminants.
- C. Plant Storage and Protection: Store and protect plants not planted on day of arrival at Project site as follows:
 1. Shade and protect plants in outdoor storage areas from wind and direct sunlight until planted.
 2. Heel-in bare root plants.
 3. Protect balled and burlapped plants from freezing or drying out by covering balls or roots with moist burlap, sawdust, wood chips, shredded bark, peat moss, or other approved material. Provide covering that allows air circulation.
 4. Keep plants in moist condition until planted by watering with fine mist spray.
 5. Do not store plant materials directly on concrete or bituminous surfaces.
- D. Topsoil: Before stockpiling topsoil, eradicate on site undesirable growing vegetation. Clear and grub existing vegetation three to four weeks before stockpiling existing topsoil.

- E. Root Control Barrier and Weed Control Fabric: Store materials in site in enclosures or under protective covering in dry location out of direct sunlight. Do not store materials directly on ground.
- F. Handling: Do not drop or dump plants from vehicles. Avoid damaging plants being moved from nursery or storage area to planting site. Handle balled and burlapped plants carefully to avoid damaging or breaking earth ball or root structure. Do not handle plants by trunk or stem. Remove damaged plants from Project site.

1.8 FIELD CONDITIONS

- A. Environment:
 - 1. Coordinate installation of planting materials during optimal planting seasons for each type of plant material required.
 - 2. Restrictions: Do not plant when ground is frozen, snow covered, muddy, or when air temperature exceed 32 degrees C (90 degrees F).
- B. Weather Limitations: Install plantings only during current and forecasted weather conditions that are comply with plant requirements. Apply associated products in compliance with manufacturers' instructions.

1.9 WARRANTY

- A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."
- B. Manufacturer's Warranty: Warrant plantings and against material defects.
 - 1. Warranty Period: Two years.
 - 2. Plant and Turf Warranty Periods will begin from date of Government acceptance of project or phase for beneficial use and occupancy.
 - 3. Contracting Officer's Representative will reinspect plants and turf at end of Warranty Period. Replace any dead, missing, or defective plant material and turf immediately. Warranty Period will end on date of this inspection provided Contractor has complied with warranty work required by this specification. Comply with following requirements:
 - a. Replace any plants more than 25 percent dead, missing or defective plant material before final inspection.

- b. Only one replacement of each plant will be required except when losses or replacements are due to failure to comply with these requirements.
- c. Complete remedial measures directed by Contracting Officer's Representative to ensure plant and turf survival.
- d. Repair damage caused while making plant or turf replacements.

PART 2 - PRODUCTS

2.1 PRODUCTS - GENERAL

- A. Provide each product from one source or manufacturer.

2.2 PLANT MATERIALS

- A. Plant Materials: ANSI Z60.1, conforming to varieties specified and be true to scientific name as listed in Hortus Third. Well-branched, well-formed, sound, vigorous, healthy planting stock free from disease, sunscald, windburn, abrasion, and harmful insects or insect eggs and having healthy, normal, and undamaged root system.
 1. Trees-Deciduous and Evergreen: Single trunked with single leader, unless otherwise indicated; symmetrically developed deciduous trees and shrubs of uniform habit of growth; straight boles or stems; free from objectionable disfigurements; evergreen trees and shrubs with well-developed symmetrical tops, with typical spread of branches for each particular species or variety. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk; crossing trunks; cut-off limbs more than 19 mm (3/4 inch) in diameter; or with stem girdling roots will be rejected.
 2. Ground Cover and Vine Plants: Provide number and length of runners for size specified on drawings, together with proper age for grade of plants specified. Provide vines and ground cover plants well established in removable containers, integral containers, or formed homogeneous soil sections. Provide plants grown under climatic conditions similar to those in locality of project. Spray all plants budding into leaf or having soft growth with an anti-desiccant at nursery before digging.
 3. Provide plants of sizes indicated, measured before pruning with branches in normal position. Plants larger in size than specified is

- acceptable with approval of Contracting Officer's Representative, with no change in contract price. When larger plants are used, increase ball of earth or spread of roots according to ANSI Z60.1.
4. Provide nursery grown plant material conforming to requirements and recommendations of ANSI Z60.1. Dig and prepare plants for shipment in manner that will not cause damage to branches, shape, and future development after planting.
 5. Balled and burlapped (B&B) plant ball sizes and ratios will conform to ANSI Z60.1, consisting of firm, natural balls of soil wrapped firmly with burlap or strong cloth and tied.
 6. Bare root (BR) plants to have root system substantially intact, but with earth carefully removed. Cover roots with thick coating of mud by "puddling" after plants are dug.
 7. Container grown plants to have sufficient root growth to hold earth intact when removed from containers, but not be root bound.
 8. Make substitutions only when plant (or alternates as specified) is not obtainable and Contracting Officer's Representative authorizes change order providing for use of nearest equivalent obtainable size or variety of plant with same essential characteristics and an equitable adjustment of contract price.
 9. Existing plants to be relocated: Ball sizes to conform to requirements for collected plants in ANSI Z60.1, and plants dug, handled, and replanted according to applicable articles of this Section.
 10. Only plants grown in nursery are permitted.
- B. Label plants with durable, waterproof labels in weather-resistant ink. Provide labels stating correct botanical and common plant name and variety and size as specified in list of required plants. Groups of plants may be labeled by tagging one plant. Labels to be legible for minimum 60 days after delivery to planting site.

2.3 SOD

- A. Sod: Nursery grown, certified and classified in TPI's "Guideline Specifications to Turfgrass Sodding" as GSS. Machine cut sod at uniform thickness of 19 mm (3/4 inch) within tolerance of 6 mm (1/4 inch), excluding top growth and thatch. Each individual sod piece to be strong enough to support its own weight when lifted by ends. Broken pads,

irregularly shaped pieces, and torn or uneven ends will not be permitted.

- B. Sod Species: Genetically pure, free of weeds, pests, and disease.
 - a. Match existing on site.

2.4 SEED

- A. Grass Seed: State-certified seed of latest season's crop delivered in original sealed packages, bearing producer's guaranteed analysis for percentages of mixtures, purity, germination, weed seed content, and inert material. Label in conformance with AMS Seed Act and applicable state seed laws. Wet, moldy, or otherwise damaged seed will not be acceptable. Field mixes will be acceptable when field mix is performed on site in presence of Contracting Officer's Representative.
- B. Seed Mixtures: Proportion seed mixtures by weight.
 - a. Match existing on site.

2.5 PLANTING SOILS

- A. Planting Soil: Evaluate soil for use as topsoil according to ASTM D5268. From 5 to 10 percent organic matter as determined by topsoil composition tests of Organic Carbon, 6A, Chemical Analysis Method described in USDA DOA SSIR 42. Maximum particle size, 19 mm (3/4 inch), with maximum 3 percent retained on 6 mm (1/4 inch) screen. Mix topsoil with following soil amendments and fertilizers as recommended by soils analysis.
- B. Existing Planting Soil: Existing, native surface topsoil formed under natural conditions retained during excavation process and stockpiled on-site. Verify suitability of native surface topsoil to produce viable planting soil. Clean soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.
 - 1. Supplement with planting soil when quantities are insufficient.
 - 2. Mix existing, native surface topsoil with soil amendments and fertilizers as recommended by soils analysis.
- C. Imported Planting Soil: Imported topsoil or manufactured topsoil from off-site sources are acceptable if sufficient topsoil is not available on site to meet specified depth. At least 10 days before topsoil delivery, notify Contracting Officer's Representative of topsoil sources. Obtain imported topsoil displaced from naturally well-drained construction or mining sites where topsoil is at least 100 mm

(4 inches) deep. Topsoil from agricultural land, bogs, or marshes will be rejected.

2.6 INORGANIC SOIL AMENDMENTS

- A. Lime: Commercial grade limestone containing calcium carbonate equivalent (CCE) specified in ASTM C602 of minimum 80 percent.
- B. Sulfur: 100 percent elemental.
- C. Iron Sulfate: 100 percent elemental.
- D. Aluminum Sulfate: Commercial grade.
- E. Perlite: Horticultural grade.
- F. Agricultural Gypsum: Coarsely ground from recycled scrap gypsum board comprised of calcium sulfate dehydrate 91 percent, calcium 22 percent, sulfur 17 percent, minimum 96 percent passing through 850 micrometers 20 mesh screen, 100 percent passing through 970 micrometers 16 mesh screen.
- G. Coarse Sand: ASTM C33/C33M, clean and free of materials harmful to plants.
- H. Vermiculite: Horticultural grade for planters.
- I. Diatomaceous Earth: Calcined, 90 percent silica, with approximately 140 percent water absorption capacity by weight.
- J. Zeolites: Mineral clinoptilolite with at least 60 percent water absorption by weight.

2.7 ORGANIC SOIL AMENDMENTS

- A. Organic Matter: Commercially prepared compost. Free of substances toxic to plantings and as follows:
 - 1. Organic Matter Content: Wood cellulose fiber, wood chips, ground or shredded bark, shredded hardwood, bark peelings, pine straw mulch, pine needles from project site when available. Biobased content 100 percent. Wood cellulose fiber processed to contain no growth or germination-inhibiting factors, dyed with non-toxic, biodegradable dye to appropriate color to facilitate visual metering of materials application.
- B. Peat: Natural product of sphagnum moss peat derived from fresh-water site, conforming to ASTM D4427 and containing no invasive species, including seeds. Shred and granulate peat to pass 12.5 mm (1/2 inch) mesh screen and condition in storage pile for minimum 6 months after excavation. Biobased content minimum 100 percent.

C. Composted Derivatives: Ground bark, nitolized sawdust, humus, or other green wood waste material free of stones, sticks, invasive species, including seeds, and soil stabilized with nitrogen and having following properties:

1. Particle Size: Minimum percent by weight passing:
 - a. 4.75 mm (No. 4) mesh screen: 95.
 - b. 2.36 mm (No. 8) mesh screen: 80.
2. Nitrogen Content: Minimum percent based on dry weight:
 - a. Fir sawdust: 0.7.
 - b. Fir or pine bark: 1.0.
3. Biobased Content: 100 percent.

2.8 PLANT FERTILIZERS

- A. Soil Test: Evaluate existing soil conditions and requirements before fertilizer selection and application to minimize use of all fertilizers and chemical products. Obtain approval of Contracting Officer's Representative for allowable products, product alternatives, scheduling, and application procedures. Evaluate existing weather and site conditions before application. Apply products during favorable weather and site conditions according to manufacturer's instructions and warranty requirements. Fertilizers to be registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer applicable to specific areas as required for Project conditions and application. Provide commercial grade plant and turf fertilizers, free flowing, uniform in composition and conforms to applicable state and federal regulations.
- B. Fertilizer for groundcover, wildflowers, and grasses is not acceptable. Provide fertilizer for trees, plants, and shrubs as recommended by plant supplier, except synthetic chemical fertilizers are not acceptable. Fertilizers containing petrochemical additives or that have been treated with pesticides or herbicides are not acceptable.
- C. Granular Fertilizer: Organic, granular controlled release fertilizer containing minimum percentages, by weight, of plant food nutrients.
1. Composition: Nitrogen, phosphorous, potassium, sulfur, and iron in amounts recommended in soil reports from qualified soil-testing laboratory.

D. Fertilizer Tablets: Organic plant tablets composed of tightly compressed fertilizer chips, insoluble in water, to provide continuous release of nutrients for minimum 24 months and containing following minimum percentages, by weight, of plant food nutrients:

1. Nutrient Composition: 20 percent available nitrogen, 20 percent available phosphorous, and 5 percent available potassium.

2.9 WEED CONTROL FABRIC

A. Roll Type Polypropylene or Polyester Mats: Woven, needle punched, or non-woven fabric treated for protection against deterioration due to ultraviolet radiation. Minimum 99 percent opaque to prevent photosynthesis and seed germination, fabric allows air, water, and nutrients to pass through to plant roots.

1. Minimum weight: 0.11 kg per square meter (5 ounces per square yard).
2. Minimum thickness: 0.50 mm (20 mils).

2.10 MULCH

A. Organic Mulch:

1. Wood cellulose fiber, shredded hardwood for project site when available. Biobased content minimum 100 percent. Wood cellulose fiber processed to contain no growth or germination-inhibiting factors, dyed with non-toxic, biodegradable dye to an appropriate color to facilitate visual metering of application.

- a. Straw for Lawn Seed Bed Mulch: Stalks from oats, wheat, rye, barley, or rice free of noxious weeds, mold or other objectionable material. Air dried and suitable for placing with blower equipment.
- b. Wood cellulose fiber for hydraulic application of grass seed and fertilizer: Specially prepared wood cellulose fiber, processed to contain no growth or germination inhibiting factors, and dyed an appropriate color to facilitate visual metering of application of materials. Maximum 12 percent moisture dry weight, plus or minus 3 percent at time of manufacture. pH range from 3.5 to 5.0. Manufacturer wood cellulose fiber for application as follows:

- 1) After addition and agitation in slurry tanks with fertilizers, grass seeds, water, and other approved

additives, fibers will become uniformly suspended to form a homogeneous slurry.

- 2) When hydraulically sprayed, material will form blotter-like cover impregnated uniformly with grass seed.
- 3) Cover will allow absorption of moisture and allow rainfall or applied water to percolate to underlying soil.

2. Color: Natural.

- B. Compost Mulch: Decomposed organic matter with low carbon to nitrogen ratio.

2.11 ANTIDESICCANT

- A. Antidesiccant: An emulsion specifically manufactured for agricultural use that will provide protective film over plant surfaces permeable enough to permit transpiration.

2.12 EROSION CONTROL

- A. Erosion Control Blankets: 70 percent agricultural straw and 30 percent coconut fiber matrix stitched with degradable nettings, designed to degrade within 12 months.
- B. Erosion Control Fabric: Knitted construction of polypropylene yarn with uniform mesh openings 19 to 25 mm (3/4 to 1 inch) square with strips of biodegradable paper. Minimum filler paper strip life of six months.
- C. Erosion Control Net: Heavy, twisted jute mesh weighing approximately 605 grams per meter (1.22 pounds per linear yard) and 1200 mm (4 feet) wide with mesh openings approximately 25 mm (1 inch) square.
- D. Erosion Control Material Anchors: As recommended by erosion control material manufacturer.

2.13 ROOT CONTROL BARRIER

- A. Root Control Barrier: Flexible and permeable geotextile fabric with permanently attached time-release nodules. Pre-formed tapered cylinder barrier with integral vertical root deflecting ribs constructed of ultraviolet resistant polypropylene material.

2.14 BIOSTIMULANTS

- A. Biostimulants: Formulation containing soil conditioners, VAM fungi, and endomycorrhizal and ectomycorrhizal fungi spores and soil bacteria appropriate for existing soil conditions.

2.15 STAKING AND GUYING MATERIALS

A. Staking Material:

1. Tree Support Stakes: Rough sawn hardwood free of knots, rot, cross grain, bark, long slivers, or other defects that impair strength. Minimum 50 mm (2 inches) square or 64 mm (2-1/2 inches) diameter by 2.4 m (8 feet) long, pointed at one end.
2. Ground Stakes: 50 mm (2 inches) square by 0.91 m (3 feet) long wood or plastic, pointed at one end.

B. Guying Material:

1. Guying Wire: ASTM A580/A580M, galvanized steel wire.
2. Guying Cable: Minimum five-strand, 5 mm (3/16 inch) galvanized steel cable.

C. Hose Chafing Guards: New or used 2 ply 19 mm (3/4 inch) reinforced rubber or plastic hose, black or dark green, all of same color.

D. Flags: White surveyor's plastic tape 150 mm (6 inches) long, fastened to guying wires or cables.

E. Turnbuckles: Galvanized or cadmium-plated steel with minimum 75 mm (3 inch) long openings fitted with screw eyes and galvanized or cadmium-plated steel eye bolts with 25 mm (1 inch) diameter eyes and 38 mm (1-1/2 inches) minimum screw length.

2.16 TREE WRAP

A. Crinkled Paper Tree Wrap: Two thicknesses of crinkled paper cemented together with layer of bituminous material. Minimum 100 mm (4 inches) wide with stretch factor of 33 1/3 percent. Tie with lightly tarred medium or coarse sisal yarn twine.

B. Tree Shelters: Extruded, translucent, twin walled polypropylene protection board sheets, 3 mm (1/8 inch) thick, 1800 mm (6 feet) long, utilized for short trunk trees 75 mm (3 inch) caliper or less.

C. Synthetic Fabric Tree Wrap: White, breathable polypropylene fabric in 75 mm (3 inch) wide rolls.

D. Tape: Bio-degradable tape suitable for nursery use to secure tree wrap which degrades in sunlight maximum 2 years after installation.

2.17 TACKIFIERS AND ADHESIVES

A. Nonasphalt Tackifier: Colloidal liquid fixative recommended by fiber mulch manufacturer for hydroseeding.

B. Asphalt emulsion: ASTM D977, Grade SS-1.

2.18 WATER

- A. Water: Source approved by Contracting Officer's Representative and suitable quality for irrigation, containing no elements toxic to plant life, including acids, alkalis, salts, chemical pollutants, and organic matter. Use collected storm water or graywater when available.

2.19 PESTICIDES

- A. Consider IPM (Integrated Pest Management) practices to minimize use of all pesticides and chemical products. Obtain Contracting Officer's Representative's approval for allowable products, product alternatives, scheduling, and application procedures. Evaluate existing weather and site conditions before application. Apply products during favorable weather and site conditions according to manufacturer's instructions and warranty requirements.

2.20 FINISHES

- A. Steel Paint Finish:
1. Powder-Coat Finish: Manufacturer's standard two-coat finish system consisting of following:
 - a. One coat primer.
 - b. One coat thermosetting topcoat.
 - c. Dry-film Thickness: 0.05 mm (2 mils) minimum.
 - d. Color: Refer to Section 09 06 00, SCHEDULE FOR FINISHES.
- B. Aluminum Anodized Finish: NAAMM AMP 500.
1. Color Anodized Finish: AA-C22A32 or AA-C22A34; Class II Architectural, 0.01 mm (0.4 mil) thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive plants for compliance with requirements and conditions affecting installation and performance.
1. Verify that no materials that would inhibit plant growth are present in planting area. If such materials are present, remove soil and contaminants as directed by Contracting Officer's Representative and provide new planting soil.
 2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.

3. Suspend soil spreading, grading, and tilling operations if soil moisture becomes excessive. Resume soil preparations when moisture content returns to acceptable level.
 4. If soil is excessively dry, not workable, and too dusty, moisten uniformly.
 5. Special conditions may exist that warrant variance in specified planting dates or conditions. Submit written request to Contracting Officer's Representative stating special conditions and proposed variance.
- B. Proceed with planting operations only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Protect existing and proposed landscape features, elements, and site construction and completed work from damage. Protect trees, vegetation, and other designated features by erecting high-visibility, reusable construction fencing. Locate fence no closer to trees than drip line. Plan equipment and vehicle access to minimize and confine soil disturbance and compaction to areas indicated on drawings.
- B. Install erosion control materials at all areas inside or outside limits of construction that are disturbed by planting operations. Provide erosion control and seeding with native plant species to protect slopes.
- C. Stake out approved plant material locations and planter bed outlines on project site before digging plant pits or beds. Contracting Officer's Representative reserves right to adjust plant material locations to meet field conditions. Do not plant closer than 300 mm (12 inches) to building wall, fence or wall edge and other similar structures. Provide on-site locations for excavated rock, soil, and vegetation.

3.3 PLANT BED PREPARATION

- A. Verify location of underground utilities before excavation. Protect existing adjacent turf before excavations are made. Do not disturb topsoil and vegetation in areas outside those indicated on Drawings. Where planting beds occur in existing turf areas, remove turf to depth that will ensure removal of entire roof system. Measure depth of plant pits from finished grade. Provide depth of plant pit excavation and relation of top of root ball and finish grade as indicated on drawings.

Install plant materials as specified in Article 3.8. Do not plant trees within 3 m (10 feet) of any utility lines or building walls.

- B. For newly graded subgrades, loosen subgrade to minimum 150 mm (6 inches) deep. Remove stones larger than 25 mm (1 inch) in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Government's property.
 - 1. Apply fertilizer, lime, and soil amendments directly to subgrade before loosening, at rates recommended by soils analysis.
 - 2. Spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil.
 - 3. Spread planting soil 100 mm (4 inches) /deep but minimum required to meet finish grades after light rolling and natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.
 - a. Spread approximately 1/2 thickness of planting soil over loosened subgrade. Mix thoroughly into top 100 mm (4 inches) of subgrade. Spread remainder of planting soil.
 - b. Reduce elevation of planting soil to allow for soil thickness of sod.
- C. Finish grade planting areas to smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 13 mm (1/2 inch) of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit finish grading to areas that can be planted in immediate future.

3.4 GROUND COVER AND PLANT INSTALLATION

- A. Place ground cover and plants, not including trees, shrubs, and vines, as indicated on drawings in even rows and with triangular spacing.
- B. Use prepared soil mixture for backfill.
- C. Place so roots are in natural position.
- D. Do not remove plants from flats or containers until immediately before planting. Plat at depth to sufficiently cover all roots. Start watering areas planted as required by temperature and wind conditions. Water plants at sufficient rate to ensure thorough wetting of soil to 150 mm (6 inches) deep without runoff or puddling. Smooth planting areas after planting to provide even, smooth finish.

- E. Plant ground cover in areas to receive erosion control materials through material after erosion control materials are in place.

3.5 TREE, SHRUB, AND VINE PLANTING

- A. Move plant materials only by supporting root ball / container. Set plants on hand compacted layer of prepared backfill soil mixture 150 mm (6 inches) thick and hold plumb in center of pit until soil has been tamped firmly around root ball.
- B. Set plant materials in relation to surrounding finish grade 25 to 50 mm (1 to 2 inches) above depth at which they were grown in nursery, collecting field, or container. Replace plant material whose root balls are cracked or damaged either before or during planting process.
- C. Place backfill soil mixture on previously scarified subsoil to completely surround root balls and bring to smooth and even surface, blending into existing areas.
- D. Balled and Burlapped Stock: Backfill with // prepared soil mixture // topsoil // to approximately half ball depth then tamp and water. Carefully remove or fold back excess burlap and tying materials from top to minimum 1/3 depth from top of root ball. Tamp and complete backfill, place mulch topdressing, and water. Remove wires and non-biodegradable materials from plant pit before backfilling.

3.6 MECHANIZED TREE SPADE PLANTING

- A. At designated locations and with approved equipment, trees may be planted by mechanized tree spade. Tree spade is not acceptable for moving trees that are larger than maximum size of similar field-grown, balled-and-burlapped root-ball diameter recommended by ANSI Z60.1, or that are larger than manufacturer's recommended maximum size for tree spade to be used, whichever is smaller.
- B. For tree extraction, center trunk in tree spade and move tree and solid root ball.
- C. Cut any exposed roots with sharp instruments.
- D. Excavate planting hole with same tree spade used to extract and move tree.
- E. If possible, place trees with same orientation as at location from which they were extracted.

3.7 TREE WRAP

- A. Wrap deciduous tree trunks immediately after planting. Wrap tree trunks 40 mm (1-1/2 inches) or greater in caliper with specified material beginning at base and extending to lowest branches. Remove tree wrap after one year. Securely tie crinkled paper wrap with twine at top and bottom and at maximum 450 mm (18 inch) intervals.

3.8 TREE AND SHRUB PRUNING

- A. Pruning: Performed by trained and experience personnel according to TCIA A300P1.
- B. Remove dead and broken branches. Prune only to correct structural defects.
- C. Retain typical growth shape of individual plants with as much height and spread as practical. Do not central leader on trees. Make cuts with sharp instruments. Do not flush cut with trunk or adjacent branches. Collars to remain in place.
- D. Do not apply tree wound dressing to cuts.

3.9 STAKING AND GUYING

- A. Staking: Stake plants with number of stakes indicated on drawings with double strand of guy wire. Attach guy wire at half tree trunk height but maximum 1.5 m (5 feet) high. Drive stakes to depth of 0.80 to 0.91 m (2-1/2 to 3 feet) into the ground outside plant pit. Do not injure root ball. Install hose chafer guards where wire is in contact with tree trunk.
- B. Guying: Guy plants as indicated on drawings. Attach three strands of guy wire / guying cable around tree trunk at 0.785 rad (45 degrees) at half tree trunk height. Install hose chafer guards where wire cable is in contact with tree trunk. Anchor guys to ground stakes. Fasten flags to each guying wire / cable at 2/3 of the distance above ground level. Provide turnbuckles as indicated on drawings.

3.10 ROOT CONTROL BARRIER INSTALLATION

- A. At trees planted within 1500 mm (60 inches) of paving, walls, curbs, and walkways, install root control barrier, unless otherwise shown on Drawings.
- B. Install geotextile fabric in soil for vertical, horizontal and surrounding application with appropriate holding device to ensure

fabric position. For vertical and horizontal application, provide minimum 50 mm (2 inch) soil cover over top surface and edge. Extend fabric minimum 450 mm (18 inches) beyond structure area to be protected to prevent root growth around fabric edges.

- C. Install polypropylene barrier minimum 25 mm (1 inch) above finished grade to prevent root growth over barrier. Backfill outside barrier with 19 to 25 mm (3/4 to 1 inch) of gravel for minimum 50 mm (2 inches). For linear application, use device recommended by barrier manufacturer to connect two pieces.

3.11 MULCH INSTALLATION

- A. Provide specified mulch over entire planting bed surfaces and individual plant surfaces, including earth mount watering basin around plants, to 75 mm (3 inches) depth after plant installation and before watering. Do not place mulch in crowns of shrubs. Place mulch minimum 50 to 75 mm (2 to 3 inches) away from tree or shrub trunks. Place mulch on all weed control fabric.

SPEC WRITER NOTE: Select one of two edging types below.

3.12 SODDING

- A. Place sod maximum 36 hours after initial harvesting according to TPI GSS, except as modified herein.
- B. For slopes 2 to 1 and greater, lay sod with long edge perpendicular to contour. For V-ditches and flat-bottomed ditches, lay sod with long edge perpendicular to water flow. Anchor each piece of sod with wood pegs or wire staples maximum 600 mm (24 inches) on center. On sloped areas, start sodding at bottom of slope.
- C. Finishing: After sodding, blend edges of sodded area smoothly into surrounding area. Eliminate air pockets and provide true and even surface. Trim frayed areas and patch holes and missing areas with sod.
- D. Rolling: Immediately after sodding, firm entire area, except slopes more than 3:1, with roller maximum 134 kg (90 lbs.) for each foot of roller width.
- E. Watering: Start watering sodded areas as required by daily temperature and wind conditions. Water at rate sufficient to ensure thorough wetting of soil to minimum 150 mm (6 inches) deep. Prevent run-off, puddling, and wilting. Do not drive watering trucks over turf areas,

unless otherwise directed. Prevent watering of other adjacent areas or plant materials.

3.13 SEEDING

- A. Broadcast and Drop Seeding: Uniformly broadcast seed at rate per manufacture recommendations.

3.14 HYDROSEEDING

- A. Mix water with wood cellulose fiber, paper fiber, or recycled paper at rate of 11.2 kg per 100 square meters (1,000 lb. per acre) dry weight. Add seed and fertilizer to fiber and water and mix to produce homogeneous slurry.
 - 1. Broadcast seed mixture at rate per manufacturer recommendations.
 - 2. Hydraulically spray slurry to form uniformly impregnated grass seed cover. Spread with one application with no second application of mulch.

3.15 TURF RENOVATION

- A. General: Restore to original condition existing turf areas damaged during turf installation and construction operations. Always keep at least one paved pedestrian access route and one paved vehicular access route to each building clean. Clean other paving when work in adjacent areas is complete.
- B. Aeration: Eradicate weeds and, with Contracting Officer's Representative's approval to proceed, aerate turf areas with approved device. Core, by pulling soil plugs. Leave all soil plugs that are produced, in turf area. After aeration operations are complete, topdress entire area 6.35 mm (1/4 inch) deep. Blend all parts of topdressing mixture to uniform consistency. Clean all soil plugs off of other paving when work is complete.
- C. Vertical Mowing: At completion of aerating and, with Contracting Officer's Representative's approval to proceed, vertical mow turf areas indicated on drawings with approved device to 13 mm (1/2 inch) deep above existing soil level to reduce thatch build-up, grain, and surface compaction. Remove all debris generated during this operation off site.
- D. Dethatching: At completion of aerating and, with Contracting Officer's Representative's approval to proceed, dethatch turf areas indicated on drawings with approved device to 13 mm (1/2 inch) deep below existing

soil level to reduce thatch build-up, grain, and surface compaction.
Remove all debris generated during this operation off site.

- E. Overseeding: Apply seed according to applicable portions of "Seed Application Method" at rates specified in "Seed Composition."

3.16 PLANT MAINTENANCE

- A. Frequency: Begin maintenance immediately after plants have been installed. Inspect plants at least once week and perform required maintenance promptly.
- B. Promotion of Plant Growth and Vigor: Water, prune, fertilize, mulch, eradicate weeds, and perform other operations necessary to promote plant growth and vigor.
- C. Planter Beds: Weed, fertilize, and irrigate planter beds and keep pest free, pruned, and mulch levels maintained. Do not permit planter beds encroach into turf areas. Maintain edging breaks between turf areas and planter beds. Fertilize plant materials to promote healthy growth without encouraging excessive top foliar growth. Remove noxious weeds common to area from planter beds by mechanical means.
- D. Shrubs: In addition to planter bed maintenance requirements, selectively prune and shape shrubs for health and safety when following conditions exist:
 - 1. Remove growth in front of windows, over entrance ways or walks, and any growth which will obstruct vision at street intersections or of security personnel.
 - 2. Remove dead, damaged, or diseased branches or limbs where shrub growth obstructs pedestrian walkways, where shrub growth is growing against or over structures, and where shrub growth permits concealment of unauthorized persons.
 - 3. Properly dispose of all pruning debris.
- E. Trees: Adjust stakes, ties, guy supports and turnbuckles and water, fertilize, control pests, mulch, and prune for health and safety.
 - 1. Fertilize trees to promote healthy plant growth without encouraging excessive top foliar growth. Inspect and adjust stakes, ties, guy supports and turnbuckles to avoid girdling and promote natural development.
 - 2. Selectively prune all trees within project boundaries, regardless of caliper, for safety and health reasons, including, but not limited

to, removal of dead and broken branches and correction of structural defects. Prune trees according to their natural growth characteristics leaving trees well shaped and balanced.

3. All pruning, including palm tree pruning, must be by or in presence of certified member of International Society of Arboriculture and according to TCIA Z133.1.
4. Properly dispose of all pruning debris.

3.17 SLOPE EROSION CONTROL MAINTENANCE

- A. Provide slope erosion control maintenance to prevent undermining of all slope areas. Maintenance tasks include immediate repairs to weak spots in sloped areas and maintaining clean, clear culverts and graded berms to intercept and direct water flow to prevent development of large gullies and slope erosion and securing irrigation systems during periods of extended rainfall.
 1. Fill eroded areas with amended topsoil and replant with same plant species.
 2. Reinstall erosion control materials damaged due to slope erosion.

3.18 REMOVAL OF DYING OR DEAD PLANTS

- A. Remove dead and dying plants and provide new plants immediately upon commencement of specified planting season and replace stakes, guys, mulch, and eroded earth mound water basins. No additional correction period will be required for replacement plants beyond original warranty period. Plants will be considered dead or dying as follows:
 1. Tree: Main leader died-back or minimum 20 percent of crown died.
 2. Shrub and Ground Cover: Minimum 20 percent of plant died.
 3. Determination: Scrape on maximum 2 mm (1/16 inch) square branch area to determine dying plant material cause and provide recommendations for replacement.

3.19 TURF MAINTENANCE

- A. Mow turf to uniform finished height measured from soil. Perform mowing in manner that prevents scalping, rutting, bruising, uneven and rough cutting. Before mowing, remove and dispose of all rubbish, debris, trash, leaves, rocks, paper, and limbs or branches on turf areas. Sweep or vacuum clean adjacent paved areas.
- B. Apply fertilizer in manner that promotes health, growth, vigor, color and appearance of cultivated turf areas. Determine method of

application, fertilizer type and frequencies by results of laboratory soil analysis. Provide organic fertilizer. If organic fertilizer does not produce desired effect, contact Contracting Officer's Representative for approval before applying synthetic fertilizer. Apply fertilizer by approved methods and according to manufacturer's instructions.

- C. Watering: Perform irrigation in manner that promotes health, growth, color, and appearance of cultivated vegetation, complying with Federal, State, and local water agency and authority directives. Prevent overwatering, water run-off, erosion, and ponding due to excessive quantities or rate of application.

3.20 CLEANING

- A. Remove and legally dispose of all excess soil and planting debris.

3.21 PROTECTION

- A. Protect plants from traffic and construction operations.
- B. Provide temporary fences or enclosures and signage, at planted areas. Maintain fences and enclosures during maintenance period.
- C. Remove protective materials immediately before acceptance.
- D. Repair damage.

- - - E N D - - -

SECTION 33 10 00
WATER UTILITIES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Underground water distribution system complete, ready for operation, including all appurtenant structures, and connections to both new building service lines and to existing potable water supply.
- B. Definitions:
 - 1. Water Distribution: Pipelines and appurtenances which are part of the distribution system. The distribution system comprises the network of piping located throughout the site, as applicable, and in the building areas that provides water from the potable water supply source for the project, including valves, and other appurtenances used to supply water for domestic, and fire-fighting/fire protection purposes only when required due to Life Safety issues.
 - 2. Water Service Line: Pipe line connecting building piping to water distribution lines.

1.2 RELATED WORK

- A. Section 01 00 01, GENERAL REQUIREMENTS
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Section 01 42 19, REFERENCE STANDARDS.
- D. Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS. Erosion and Sediment Control.
- E. Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT.
- F. Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS.
- G. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.
- H. Section 03 30 53, (SHORT-FORM) CAST-IN-PLACE CONCRETE.
- I. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING: Building Plumbing starting 1500 mm (5 feet) outside of the building.
- J. Section 31 20 00, EARTH MOVING: Excavation, trench widths, pipe bedding, backfill, shoring, sheeting, bracing.

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):

- A112.6.3-2016.....Floor and Trench Drains
- B16.1-2010.....Gray Iron Pipe Flanges and Flanged Fittings,
Classes 25, 125 and 250
- B16.18-2012.....Cast Copper Alloy Solder Joint Pressure
Fittings
- B16.26-2013.....Cast Copper Alloy Fittings for Flared Copper
Tubes
- B18.2.2-2015.....Nuts for General Applications: Machine Screw
Nuts, Hex, Square, Hex Flange, and Coupling
Nuts (Inch Series)
- B18.5.2.1M-2006 (R2011).Metric Round Head Short Square Neck Bolts
ASME Boiler and Pressure Vessel Code -
BPVC Section IX-2015....Welding, Brazing, and Fusing Qualifications

C. American Society of Safety Engineers (ASSE):

- 1003-2009 Water Pressure Reducing Valves

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

- A36/A36M-2014.....Standard Specification for Carbon Structural
Steel
- A47/A47M-1999 (R2014)...Standard Specification for Ferritic Malleable
Iron Castings
- A48/A48M-2003 (R2012)...Standard Specification for Gray Iron Castings
- A148/A148M-2015a.....Standard Specification for Steel Castings, High
Strength, for Structural Purposes
- A307-2014.....Standard Specification for Carbon Steel Bolts,
Studs, and Threaded Rod 60,000 PSI Tensile
Strength
- A536-1984 (R2014).....Standard Specification for Ductile Iron
Castings
- A563-2015.....Standard Specification for Carbon and Alloy
Steel Nuts
- B61-2015.....Standard Specification for Steam or Valve
Bronze Castings
- B62-2015.....Standard Specification for Composition Bronze
or Ounce Metal Castings
- B88-2014.....Standard Specification for Seamless Copper
Water Tube

- B117-2011.....Standard Practice for Operating Salt Spray
(Fog) Apparatus
- B633-2013.....Standard Specification for Electrodeposited
Coatings of Zinc on Iron and Steel
- C443-2012.....Standard Specification for Joints for Concrete
Pipe and Manholes, Using Rubber Gaskets
- C857-2014.....Standard Practice for Minimum Structural Design
Loading for Underground Precast Concrete
Utility Structures
- C858-2010e1.....Standard Specification for Underground Precast
Concrete Utility Structures
- D1785-2015.....Standard Specification for Poly(Vinyl Chloride)
(PVC) Plastic Pipe, Schedules 40, 80, and 120
- D2000-2012.....Standard Classification System for Rubber
Products in Automotive Applications
- D2464-2015.....Standard Specification for Threaded Poly(Vinyl
Chloride (PVC) Plastic Pipe Fittings, Schedule
80
- D2467-2015.....Standard Specification for Poly(Vinyl Chloride)
(PVC) Plastic Pipe Fittings, Schedule 80
- D2672-2014.....Standard Specification for Joints for IPS PVC
Pipe Using Solvent Cement
- D4101-2014.....Standard Specification for Polypropylene
Injection and Extrusion Materials
- F437-2015.....Standard Specification for Threaded Chlorinated
Poly(Vinyl Chloride) (CPVC) Plastic Pipe
Fittings, Schedule 80
- F439-2013.....Standard Specification for Chlorinated
Poly(Vinyl Chloride) (CPVC) Plastic Pipe
Fittings, Schedule 80
- F441/F441M-2015.....Standard Specification for Chlorinated
Poly(Vinyl Chloride) (CPVC) Plastic Pipe,
Schedules 40 and 80
- F477-2014.....Standard Specification for Elastomeric Seals
(Gaskets) for Joining Plastic Pipe
- F593-2013a.....Standard Specification for Stainless Steel
Bolts, Hex Cap Screws, and Studs

E. American Water Works Association (AWWA):

- B300-2010.....Hypochlorites
- B301-2010.....Liquid Chlorine
- C104-2013.....Cement-Mortar Lining for Ductile-Iron Pipe and Fittings
- C105-2010.....Polyethylene Encasement for Ductile-Iron Pipe Systems
- C110-2012.....Ductile-Iron and Gray-Iron Fittings
- C111-2012.....Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
- C115-2011.....Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
- C150-2014.....Thickness Design of Ductile-Iron Pipe
- C151-2009.....Ductile-Iron Pipe, Centrifugally Cast
- C153-2011.....Ductile-Iron Compact Fittings
- C502-2014.....Dry-Barrel Fire Hydrants
- C504-10.....Rubber-Seated Butterfly Valves
- C508-2009.....Swing-Check Valves for Waterworks Service, 50 mm thru 600 mm (2 inches through 24 inches) NPS
- C509-2009.....Resilient-Seated Gate Valves for Water Supply Service
- C510-2007.....Double Check Valve Backflow Prevention Assembly
- C511-2007.....Reduced-Pressure Principle Backflow Prevention Assembly
- C512-07.....Air Release, Air/Vacuum and Combination Air Valves
- C550-2013.....Protective Interior Coatings for Valves and Hydrants
- C600-2010.....Installation of Ductile Iron Water Mains and Their Appurtenances
- C605-2013.....Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings
- C651-2014.....Disinfecting Water Mains
- C700-2015.....Cold-Water Meters - Displacement Type, Metal Alloy Main Case

- C701-2015.....Cold-Water Meters - Turbine Type, for Customer Service
- C702-2015.....Cold-Water Meters - Compound Type
- C706-2010 (Withdrawn)....Direct-Reading, Remote-Registration Systems for Cold-Water Meters
- C707-2010.....Encoder-Type Remote-Registration Systems for Cold-Water Meters
- C800-2014.....Underground Service Line Valves and Fittings
- C900-2007.....Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 100 mm Through 300 mm (4 inches Through 12 inches), for Water Transmission and Distribution
- C906-15.....Polyethylene (PE) Pressure Pipe and Fittings, 4 In. (100 mm) Through 64 In. (1,600 mm), for Water Distribution and Transmission
- F. American Welding Society (AWS):
 - A5.8/A5.8M-2011.....Specification for Filler Metals for Brazing and Braze Welding
- G. Copper Development Association, Inc. (CDA):
 - A4015.....Copper Tube Handbook
- H. National Fire Protection Association (NFPA):
 - 24-2016.....Standard for the Installation of Private Fire Service Mains and Their Appurtenances
- I. NSF International:
 - 61-2014a.....Drinking Water System Components-Health Effects
- J. University of Southern California Foundation for Cross Connection Control and Hydraulic Research (USC FCCCHR):
 - 9th 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 33 10 00, WATER UTILITIES", with applicable paragraph identification.

- C. Make all necessary field measurements and investigations to assure that the equipment and assemblies will meet contract requirements and will fit the space available.
- D. If equipment is submitted which differs in arrangement from that shown, provide drawings that show the rearrangement of all associated systems. Approval by VA 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, certify in writing that manufacturers of all major items of equipment have each reviewed drawings and specifications, and have jointly coordinated and properly integrated their equipment and controls to provide a complete and efficient installation.
- F. Provide lists of previous installations by the installing contractor. Contact persons who will serve as references, with telephone numbers and e-mail addresses shall be submitted with the references.
- G. 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. Submit all items as one package. Ductile iron pipe and Polyvinyl Chloride (PVC) shall be in accordance with AWWA C600 and AWWA C605 respectively. Submit all items as one package or submittal will be rejected.
 - 1. Piping.
 - 2. Fittings.
 - 3. Gaskets.
 - 4. Valves.
 - 5. Valve boxes.
 - 6. Corporation and curb stops.
 - 7. Curb stop boxes.
 - 8. Joint restraint.
 - 9. Disinfection products.
 - 10. Warning Tape
- H. Submittals and shop drawings for interdependent items, containing applicable descriptive information, shall be furnished together and complete in a group. Coordinate and properly integrate materials and

equipment in each group to provide a compatible and efficient installation. Final review and approvals will be made only by groups.

- I. 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.
- J. Testing Certifications:
 - 1. Hydrostatic Testing.
 - 2. Certification of Disinfection, including free chlorine residuals, and bacteriological examinations.
- K. 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 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

1.5 QUALITY ASSURANCE

- A. Products Criteria:
 - 1. Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture, supply, and servicing of the specified products for at least 5 years. However, digital electronics devices, software, and systems such as controls, instruments, and computer work station, shall be the current generation of technology and basic design that has a proven satisfactory service record of at least 5 years.
 - 2. Equipment Service: There shall be permanent service organizations, authorized and trained by manufacturers of the equipment supplied, located within 160 km (100 miles) of the project. These organizations shall come to the site and provide acceptable service to restore operations within four hours of receipt of notification by phone, e-mail, or fax in event of an emergency, such as the shut-down of equipment; or within 24 hours in a non-emergency. Names, mail, e-mail addresses, and phone numbers of service organizations providing service under these conditions for (as applicable to the project): pumps, compressors, water heaters, critical

- instrumentation, computer workstation, and programming shall be submitted for project record and inserted into the operations and maintenance manual.
3. All items furnished shall be free from defects that would adversely affect the performance, maintainability, and appearance of individual components and overall assembly.
 4. The products and execution of work specified in Division 33 shall conform to the referenced codes and standards as required by the specifications. Local codes and amendments enforced by the local code official shall be enforced, if required by local authorities such as the natural gas supplier. If the local codes are more stringent, then the local code shall apply. Any conflicts shall be brought to the attention of the (PM).
 5. Multiple Units: When two or more units of the same type or class of materials or equipment are required, these units shall be the product of one manufacturer.
 6. Assembled Units: Ensure that manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.
 7. Nameplate: Nameplate bearing manufacturer's name or identifiable trademark 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 containing products, equipment, or materials is prohibited.
- B. Comply with all rules and regulations of Federal, State, and Local Health Department having jurisdiction over the design, construction, and operation of potable water systems.
- C. Manufacturer's Recommendations: Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, electronic copies of these recommendations shall be furnished to the PM prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.
- D. Welding: Before any welding is performed, 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.
2. Comply with provisions of ASME B31 series "Code for Pressure Piping".
3. Certify that each welder and welding operator has passed American Welding Society (AWS) qualification tests for the welding processes involved, and that certification is current.
4. All welds shall be stamped according to the provisions of the American Welding Society.

E. Execution (Installation, Construction) Quality:

1. All items shall be applied and installed in accordance with manufacturer's written instructions. Conflicts between the manufacturer's instructions and the contract documents shall be referred to the PM for resolution. Printed copies or electronic files of manufacturer's installation instructions shall be provided to the PM at least 10 working days prior to commencing installation of any item.
2. All items that require access, such as for operating, cleaning, servicing, maintenance, and calibration, shall be easily and safely accessible by persons standing at floor level, or standing on permanent platforms, without the use of portable ladders. Examples of these items include, but are not limited to: all types of valves, filters and strainers, transmitters, and control devices. Prior to commencing installation work, refer conflicts between this requirement and contract documents to PM for resolution.
3. Complete layout drawings shall be required by Paragraph, SUBMITTALS. Construction work shall not start on any system until the layout drawings have been approved by VA.
4. Installer Qualifications: Installer shall be licensed and shall provide evidence of the successful completion of at least five projects of equal or greater size and complexity. Provide tradesmen skilled in the appropriate trade.
5. If an installation is unsatisfactory to the PM, the Contractor shall correct the installation at no additional cost or additional time to the Government.

F. Cleanliness of Piping and Equipment Systems:

1. Care shall be exercised in the storage and handling of equipment and piping material to be incorporated in the work. Debris arising from cutting, threading, and welding of piping shall be removed.
2. Piping systems shall be flushed, blown, or pigged as necessary to deliver clean systems.
3. The interior of all tanks shall be cleaned prior to delivery and beneficial use by the Government. All piping shall be tested in accordance with the specifications and the International Plumbing Code (IPC). All filters, strainers, and fixture faucets shall be flushed of debris prior to final acceptance.
4. Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems.

G. All material surfaces in contact with potablewater shall comply with NSF 61.

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 final acceptance, whether or not the Government has reimbursed the Contractor for the equipment and material. The Contractor is solely responsible for the protection of such equipment and material against any damage.
2. Damaged equipment shall be replaced with an identical unit as determined and directed by the PM. Such replacement shall be at no additional cost or additional time to the Government.
3. Interiors of new equipment and piping systems shall be protected against entry of foreign matter. Both inside and outside shall be cleaned before painting or placing equipment in operation.
4. Existing equipment and piping being worked on by the Contractor shall be under the custody and responsibility of the Contractor and shall be protected as required for new work.

1.7 AS-BUILT DOCUMENTATION

- A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.
- B. Submit operation and maintenance data updated to include submittal review comments, substitutions and construction revisions shall be inserted into a three ring binder. All aspects of system operation and

maintenance procedures, including 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. As-built drawings are to be provided, and a copy of them on Auto-Cad version 2015 or newer provided on CD 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 PM 10 working days prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and a certification that all results of tests were within limits specified.

PART 2 - PRODUCTS

2.1 DUCTILE IRON PIPE AND FITTINGS

- A. Ductile iron pipe, direct buried:
 - 1. Provide ductile iron pipe conforming to the requirements of AWWA C151, Pressure Class 350 for Pipe 100 mm through 300 mm (4 inches through 12 inches) in diameter with double thickness cement mortar lining interior, interior asphaltic seal coat, and exterior asphaltic coating, in accordance with AWWA and ANSI Standards.
 - 2. Below Grade: Supply pipe in lengths not in excess of a nominal 6.1 m (20 feet) with rubber ring type push-on joints, mechanical joint, or approved restrained joint. Provide mechanical and restrained joint

pipe with sufficient quantities of accessories as required for each joint.

3. When a polyethylene encasement over pipe, fittings, and valves is a requirement as indicated on the drawings, the material, installation, and workmanship shall conform to applicable sections of AWWA C105. Make provisions to keep the polyethylene from direct exposure to sunlight prior to installation. Backfill following installation without delay to avoid exposure to sunlight.
- B. All Pipe Fittings: Ductile iron with a minimum pressure rating of 2413 kPa (350 psi). Fittings shall meet the requirements of ANSI and AWWA specifications as applicable. Rubber gasket joints shall conform to AWWA C111 for mechanical and push-on type joints. Ball joints shall conform to AWWA C151 with a separately cast ductile iron bell conforming to ASTM A148/A148M. Flanged fittings shall conform to AWWA C115 and be furnished flat faced and drilled to 861 kPa (125 psi) or 1724 kPa (250 psi) template in accordance with ANSI B16.1 with full faced gaskets.
- C. Provide cement mortar lining and bituminous seal coat on the inside of the pipe and fittings in accordance with AWWA C104. Provide standard asphaltic coating on the exterior.
- D. Provide a factory hydrostatic test of not less than 3.5 MPa (500 psi) for all pipe in accordance with AWWA C151.

2.2

- A. High Density Polyethylene: Pipe and accessories shall bear the NSF mark indicating pipe size, manufacturer's name, AWWA and/or ASTM Specification number, working pressure, and production code.
- B. Pipe: AWWA C901-17 Polyethylene (PE) Pressure Pipe, 3/4 In. (19 mm) Through 3 In. (76 mm), for Water Services.
- C. Color or striped blue.
- D. Working pressure 200psi (min).

2.3 VALVES

A. Gate:

1. Unless otherwise specified, valves shall conform to AWWA C509 with mechanical-joint ends. Valves 75 mm (3 inches) and greater shall be resilient seated, ductile iron body, bronze mounted inclined seats, non-rising stem type, turning counter-clockwise to open, with a minimum 1380 kPa (200 psi) WOG. The resilient seat shall be fastened to the gate with stainless steel fasteners or vulcanizing methods. The interior and exterior shall be coated with thermo-setting or fusion epoxy coating in accordance with AWWA C550. Stuffing boxes shall have O-ring stem seals. Stuffing boxes shall be bolted and constructed so as to permit easy removal of parts for repair. Asbestos packing is prohibited.
2. Operator:
 - a. Underground: Except for use with post indicators, furnish valves with 50 mm (2 inch) nut for socket wrench operation.
 - b. Above Ground and in Pits: Hand wheels.
3. Joints: Ends of valves shall accommodate, or be adapted to, pipe installed.

B. Corporation Stops and Saddles: Ground key type; bronze, ASTM B61 or ASTM B62; and suitable for the working pressure of the system. Ends shall be suitable for solder-joint or flared tube compression type joint. Threaded ends for inlet and outlet of corporation stops, AWWA C800; coupling nut for connection to flared copper tubing, ASME B16.26.

C. Curb or Service Stops: Ground key, round way, inverted key type; made of bronze, ASTM B61 or ASTM B62; and suitable for the working pressure of the system. Ends shall be as appropriate for connection to the service piping. Arrow shall be cast into body of the curb or service stop indicating direction of flow. Smaller than 75 mm (3 inches). Waterworks standard for Type "K" copper, single piece cast bronze body with tee top operated plug sealed with O-ring gaskets, 1380 kPa (200 psi) WOG per AWWA C800.

2.4 TRACER WIRE FOR NONMETALLIC PIPING

- A. Provide plastic coated solid copper wire not less than 2.5 mm (0.10 inch) in diameter in sufficient length to be continuous over each

separate run of nonmetallic pipe. Plastic coating to be BLUE for water lines and GREEN for sanitary lines.

2.5 WARNING TAPE

- A. Standard, 0.10 mm (4-mil) polyethylene 75 mm (3 inch) wide tape, detectable type, blue with black letters, and imprinted with "CAUTION BURIED WATER LINE BELOW".

2.6 LOCATOR EQUIPMENT

- A. Provide location equipment (device and appurtenances) suitable for locating tracer wire and/or detectable warning tape placed above water utility lines at the actual depths for this project. The locator device shall be capable of locating the detectable warning tape from above the tape without making physical contact with the detectable warning tape. Before acceptance, the equipment shall be demonstrated at various locations and conditions for the project to confirm the functionality for its intended purpose.

2.7 CURB STOP BOX

- A. Cast iron extension box with screw or slide type adjustment and flared base. Box shall be adapted, without full extension, to depth of cover required over pipe at stop location. Cast the word "WATER" in cover and set cover flush with finished grade. Curb stop shut-off rod shall extend 600 mm (2 feet) above top of deepest stop box.

2.8 VALVE BOX

- A. Cast iron extension box with screw or slide-type adjustment and flared base. Minimum thickness of metal shall be 5 mm (3/16 inch). Box shall be adapted, without full extension, to depth of cover required over pipe at valve location. Cast the word "WATER" in cover. Provide 2 "T" handle socket wrenches of 18 mm (5/8 inch) round stock long enough to extend 600 mm (2 feet) above top of deepest valve box. The least diameter of the shaft of the box shall be 135 mm (5-1/4 inches). Cast iron box shall have a heavy coat of bituminous paint. Valve box and cover shall be installed where indicated on the drawings to be utilized as access points for the tracer wire or detectable warning tape.

B.

2.9 PIPE SLEEVES

- A. Cast gray ductile iron or zinc coated steel.

2.10 POTABLE WATER

- A. Water used for filling, flushing, and disinfection of water mains and appurtenances shall conform to Safe Drinking Water Act.

2.11 DISINFECTION CHLORINE

- A. Liquid chlorine shall conform to AWWA B301 and AWWA C651.
- B. Sodium hypochlorite shall conform to AWWA B300 with 5 percent to 15 percent available chlorine.
- C. Calcium hypochlorite shall conform to AWWA B300 supplied in granular form or 5 gram tablets, and shall contain 65 percent chlorine by weight.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. If an installation is unsatisfactory to the RE, the Contractor shall correct the installation at no additional cost or time to the Government.

3.2 BUILDING SERVICE LINES

- A. Install water service lines to point of connection within approximately 1500 mm (5 feet) outside of buildings to which such service is to be connected and make connections thereto. If building services have not been installed, provide temporary caps.

3.3 REGRADING

- A. Raise or lower existing valve and curb stop boxes, or any other applicable water system facilities, to finish grade in areas being graded.

3.4 PIPE LAYING, GENERAL

- A. Care shall be taken in loading, transporting, and unloading to prevent injury to the pipe or coatings. Pipe or fittings shall not be dropped. All pipe or fittings shall be examined before laying, and no piece shall be installed which is found to be defective. Any damage to the pipe coatings shall be repaired as recommended by the manufacturer in order to maintain the product performance as if it were undamaged.
- B. All pipe and fittings shall be inspected just prior to being laid or installed. If any defective piping is discovered after it has been laid, it shall be removed and replaced with a sound pipe in a satisfactory manner at no additional cost or time to the Government. All pipe and fittings shall be thoroughly cleaned before laying, shall

be kept clean until they are used in the work, and when installed or laid, shall conform to the lines and grades required.

- C. All buried piping shall be installed to the lines and grades as shown on the drawings. All underground piping shall slope uniformly between joints where elevations are shown. If elevations are not indicated, pipe shall have a minimum depth of cover of 1.5 m (4.5 feet).
- D. Exercise extreme care when installing piping to shore up and protect from damage all existing utilities and structures.
- E. Do not lay pipe on unstable material, in wet trench, or when trench or weather conditions are unsuitable.
- F. Do not lay pipe in same trench with other pipes or utilities unless shown otherwise on drawings.
- G. Hold pipe securely in place while joint is being made.
- H. Do not walk on pipes in trenches until covered by layers of earth compacted in place to a depth of at least 300 mm (12 inches) over pipe.
- I. Full length of each section of pipe shall rest solidly upon pipe bed with recesses excavated to accommodate bells or joints. Do not lay pipes on wood blocking.
- J. Tees, plugs, caps, bends, and hydrants installed on underground pipe shall be anchored. See paragraph PIPE SUPPORTS.
- K. Close pipe openings with caps or plugs during installation. Tightly cover and protect equipment against dirt, water, and chemical, or mechanical injury. At completion of all work, thoroughly clean exposed materials and equipment.
- L. Good alignment shall be preserved in laying. The deflection at joints shall not exceed that recommended by the manufacturer.
- M. Warning tape shall be continuously placed 300 mm (12 inches) below finish grade above buried water pipes, or at bottom of subbase where roadways exist, whichever is deeper with overall depth not exceeding 600 mm (24 inches). Detectable warning tape shall be locatable by the NCA staff from the finish grade above the pipe, utilizing existing locating equipment, or the approved locator equipment provided by the Contractor to the Owner (NCA Staff) as specified in paragraph LOCATOR EQUIPMENT.
- N. Trench excavation and compaction of backfill shall comply with the requirements of Section 31 20 00, EARTH MOVING.

3.5 DUCTILE IRON PIPE

- A. Installing Pipe: Lay pipe in accordance with AWWA C600. Provide a firm even bearing throughout the length of the pipe by tamping selected material at the sides of the pipe up to the spring line.
- B. All pipe shall be sound and clean before laying. When laying is not in progress, the open ends of the pipe shall be closed by watertight plug or other approved means.
- C. When cutting pipe is required, the cutting shall be done by machine leaving a smooth cut at right angles to the axis of the pipe. Bevel cut ends of pipe to be used with push-on bell in order to conform to the manufactured spigot end. Cement lining shall be undamaged or perform cutting following manufacturer's recommendations for field cutting of pipe..
- D. Jointing Ductile-Iron Pipe:
 1. Push-on joints shall be made in strict accordance with the manufacturer's instruction. Pipe shall be laid with bell ends looking ahead. A rubber gasket shall be inserted in the groove of the bell end of the pipe, and the joint surfaces cleaned and lubricated. The plain end of the pipe is to be aligned with the bell of the pipe to which it is joined, and pushed home following industry standard procedures or manufacturer's approved means.
 2. Mechanical Joints at Valves, Fittings: Install in strict accordance with AWWA C111. To assemble the joints in the field, thoroughly clean the joint surfaces and rubber gaskets with soapy water before tightening the bolts. Bolts shall be tightened to the specified torque. For new construction, all mechanical joints at valves and fittings shall be secured with an approved mechanical joint retainer glands suitable for the pipe.
 3. Ball Joints: Install in strict accordance with the manufacturer's instructions. Where ball joint assemblies occur at the face of structures, the socket end shall be at the structure and ball end assembled to the socket.
 4. Flanged joints shall be in accordance with AWWA C115. Flanged joints shall be fitted so that the contact faces bear uniformly on the gasket and then are made up with relatively uniform bolt stress.

3.6 PVC PIPE

- A. PVC piping shall be installed in strict accordance with the manufacturer's instructions and AWWA M55. Place selected material and thoroughly compacted to one foot above the top of the pipe and thereafter back filled as specified in Section 31 20 00, EARTH MOVING.
- B. Copper Tracer Wire: Copper tracer wire consisting of No. 14 AWG solid, single conductor, insulated copper wire shall be installed in the trench with all piping to permit location of the pipe with electronic detectors. The wire shall not be spiraled around the pipe nor taped to the pipe. Wire connections are to be made by stripping the insulation from the wire and soldering with rosin core solder. Solder joints shall be wrapped with rubber tape and electrical tape. At least every 300 m (984 feet), provide a 2.3 kg (5 pound) magnesium anode attached to the main tracer wire by solder. The solder joint shall be wrapped with rubber tape and with electrical tape. An anode shall be attached at the end of each line.

3.7 TRACER SYSTEM INSTALLATION

- A. Install with all buried water main piping.
- B. Begin and terminate system at all connections to existing mains.
- C. Install wire continuously along the lower quadrant of the pipe. Do not install wire along the bottom of the pipe. Attach wire to the pipe at the midpoint of each pipe length; use 50 mm (2 inch) wide, 0.25 mm (10 mil) thickness polyethylene pressure sensitive tape.
- D. Install splices only as authorized by the PM. Allow the PM to inspect all below-grade splices of tracer wire prior to backfill.
- E. Bring wire(s) to the surface at each valve box and cover and terminate with an accessible tracer wire termination.
- F. Final inspection of the tracer system will be conducted at the completion of the project and prior to acceptance by the owner. Verify the electrical continuity of the system. Repair any discontinuities.

3.8 PIPE SEPARATION

- A. Horizontal Separation-Water Mains and Sewers:
 - 1. Water mains shall be located at least 3 m (10 feet) horizontally from any proposed drain, storm sewer, sanitary, or sewer service connection.

2. Water mains may be located closer than 3 m (10 feet) to a sewer line when:
 - a. Local conditions prevent a lateral separation of 3 m (10 feet); and
 - b. The water main invert is at least 457 mm (18 inches) above the crown of the sewer; and
 - c. The water main is either in a separate trench or in the same trench on an undisturbed earth shelf located one side of the sewer.
3. When it is impossible to meet (1) or (2) above, both the water main and drain or sewer shall be constructed of mechanical joint ductile iron pipe. Ductile iron pipe shall comply with the requirements listed in this specification section. The drain or sewer shall be pressure tested to the maximum expected surcharge head before back filling.

B. Vertical Separation-Water Mains and Sewers:

1. A water main shall be separated from a sewer so that its invert is a minimum of 457 mm (18 inches) above the crown of the drain or sewer whenever water mains cross storm sewers, sanitary sewers, or sewer service connections. The vertical separation shall be maintained for that portion of the water main located within 3 m (10 feet) horizontally of any sewer or drain crossed. A length of water main pipe shall be centered over the sewer to be crossed with joints equidistant from the sewer or drain.
2. Both the water main and sewer shall be constructed of slip-on or mechanical joint ductile iron pipe or PVC pipe equivalent to water main standards of construction when:
 - a. It is impossible to obtain the proper vertical separations described in (1) above; or
 - b. The water main passes under a sewer or drain.
3. A vertical separation of 457 mm (18 inches) between the invert of the sewer or drain and the crown of the water main shall be maintained where a water main crosses under a sewer. Support the sewer or drain lines to prevent settling and breaking the water main.

4. Construction shall extend on each side of the crossing until the perpendicular distance from the water main to the sewer or drain line is at least 3 m (10 feet).

3.9 SETTING OF VALVES AND BOXES

- A. Provide a surface concrete pad 457 by 457 by 150 mm (18 by 18 by 6 inches) to protect valve box when valve is not located below pavement.
- B. Clean valve and curb stops interior before installation.
- C. Set valve and curb stop box cover flush with finished grade.
- D. Set curb stop box and cover for access to identification wire and/or detectable warning tape with a 300 by 300 by 75 mm (12 by 12 by 3 inches) at approximately the depth of the warning tape and bring the tape and/or identification wire into the box and coil extra length sufficient to allow the tape or wire to be uncoiled and extended 1500 mm (5 feet) above finish grade at the location.
- E. Valves shall be installed plumb and level and in accordance with manufacturer's recommendations.

3.10 PIPE SLEEVES

- A. Install where water lines pass through retaining walls, building foundations, and floors. Seal with modular mechanical type link seal. Install piping so that no joint occurs within a sleeve. Split sleeves may be installed where existing lines pass through new construction.

3.11 HYDROSTATIC TESTING

- A. Hydrostatic testing of the system shall occur prior to disinfecting the system.
- B. After new system is installed, except for connections to existing system and building, backfill at least 300 mm (12 inches) above pipe barrel, leaving joints exposed. The depth of the backfill shall be adequate to prevent the horizontal and vertical movement of the pipe during testing.
- C. Prior to pressurizing the line, all joint restraints shall be completely installed and inspected.
- D. If the system is tested in sections, and at the temporary caps at connections to the existing system and buildings, provide and install all required temporary thrust restraints required to safely conduct the test.

E. Install corporation stops in the line as required to purge the air out of the system. At the completion of the test, all corporation stops shall be capped.

F. Perform pressure and leakage tests for the new system for 2 hours to 1380 kPa (200 psi). Leakage shall not exceed the following requirements.

1. HDPE: AWWA C900 - Provide to REs office.

3.12 FLUSHING AND DISINFECTING

A. Flush and disinfect new water lines in accordance with AWWA C651.

B. Initial flushing shall obtain a minimum velocity in the main of 0.75 m/s (2.5 f/s) at 276 kPa (40 psi) residual pressure in water main. The duration of the flushing shall be adequate to remove all particles from the line.

| Pipe Diameter | | Flow Required to Produce 76 cm/sec (2.5 ft/sec) (approx.) Velocity in Main | | Number of Hydrant Outlets | | | |
|---------------|------|--|--------|---------------------------|-----------|-------|-----------|
| | | | | Size of Tap. mm (in.) | | | |
| | | | | 25(1) | 38(1 1/2) | 51(2) | 64(2 1/2) |
| mm | (In) | L/sec | (gpm) | Number of taps on pipe | | | |
| 100 | (4) | 6.3 | (100) | 1 | -- | -- | 1 |
| 150 | (6) | 12.6 | (200) | -- | 1 | -- | 1 |
| 200 | (8) | 25.2 | (400) | -- | 2 | 1 | 1 |
| 250 | (10) | 37.9 | (600) | -- | 3 | 2 | 1 |
| 300 | (12) | 56.8 | (900) | -- | -- | 3 | 2 |
| 400 | (16) | 100.9 | (1600) | -- | -- | 4 | 2 |

Note: The backflow preventers shall not be in place during the flushing.

C. Provide the water source for filling, flushing, and disinfecting the lines; only potable water shall be used. Provide all required temporary pumps, storage facilities required to complete the specified flushing, and disinfection operations.

D. Dispose of all water used to flush and disinfect the system in accordance with all governing rules and regulations. The discharge water shall not be allowed to create a nuisance for activities occurring on or adjacent to the site.

- E. The bacteriological test specified in AWWA C651 shall be performed by a laboratory approved by the Health Department of the State. The cost of sampling, transportation, and testing shall be the responsibility of the Contractor.
- F. Re-disinfection and bacteriological testing of failed sections of the system shall be the sole responsibility of the Contractor.
- G. Before backflow preventers are installed, all upstream piping shall be thoroughly flushed.

3.13 STARTUP AND TESTING

- A. Make tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.
- B. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.
- C. The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the PM and Commissioning Agent. Provide a minimum notice of 10 working days prior to startup and testing.

3.14 COMMISSIONING

- A. Provide commissioning documentation in accordance with the requirements of Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.
- B. Components provided under this section of the specification will be tested as part of a larger system.

- - - E N D - - -

**SECTION 33 30 00
SANITARY SEWERAGE UTILITIES**

PART 1 - GENERAL

1.1 DESCRIPTION

A. Outside, underground sanitary sewer system, complete, ready for operation, including all gravity flow lines, manholes, cleanouts, frames, covers, structures, appurtenances, and connections to new building and structure, service lines, existing sanitary sewer lines, and existing sanitary structures, and all other incidentals.

1.2 RELATED WORK

- A. Section 01 00 01, GENERAL REQUIREMENTS (Major NCA Projects).
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Section 01 42 19, REFERENCE STANDARDS.
- D. Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS.
- E. Section 03 30 53, (SHORT FORM) CAST-IN-PLACE CONCRETE.
- F. Section 31 20 00, EARTH MOVING: Section 32 90 00, PLANTING: Seeding, Topsoil.
- G. Section 33 10 00, WATER UTILITIES.

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 for Testing and Materials (ASTM):
 - A48/A48M-2003 (R2012)...Standard Specification for Gray Iron Castings
 - A536-1984 (R2014).....Standard Specification for Ductile Iron Castings
 - A615/A615M-2015a.....Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
 - A746-2009 (R2014).....Standard Specification for Ductile Iron Gravity Sewer Pipe
 - C76-2015a.....Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
 - C139-2014.....Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes
 - C150/C150M-2015.....Standard Specification for Portland Cement

- C478-2015.....Standard Specification for Circular Precast Reinforced Concrete Manhole Sections
- C857-2014.....Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
- C990-2009 (R2014).....Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
- D698-2012e2.....Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³))
- D2321-2014e1.....Standard Practice for Underground Installation of Thermoplastic Pipes for Sewers and Other Gravity-Flow Applications
- D2412-2011.....Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
- D3034-2014a.....Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
- D3212-2007 (R2013).....Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
- D3261-2012e1.....Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
- D3350-2014.....Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
- D4101-2014.....Standard Specification for Polypropylene Injection and Extrusion Materials
- F477-2014.....Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
- F679-2015.....Standard Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
- F714-2013.....Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter

- F794-2003 (R2014).....Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
- F894-2013.....Standard Specification for Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe
- F949-2015.....Standard Specification for Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings

C. American Water Works Association (AWWA):

- C110-2012.....Ductile-Iron and Gray-Iron Fittings
- C153-2011.....Ductile-Iron Compact Fittings
- C508-2009.....Swing Check Valves for Waterworks Service, 2 inches Through 24 inches (50 mm Through 600 mm) NPS
- C509-2009.....Resilient-Seated Gate Valves for Water Supply Service
- C512-2015.....Air Release, Air/Vacuum, and Combination Air Valves for Water and Wastewater Service
- C515-2009.....Reduced-Wall, Resilient-Seated Gate Valves For Water Supply Service
- C550-2013.....Protective Interior Coatings for Valves and Hydrants
- C605-2013.....Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings
- C900-2007.....Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 100 mm Through 300 mm (4 inches Through 12 inches) for Water Transmission and Distribution
- C905-2010.....Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 350 mm through 1,200 mm (14 Inches through 48 Inches), for Water Transmission and Distribution
- C906-2015.....Polyethylene (PE) Pressure Pipe and Fittings, 100 mm through 1650 mm (4 Inches through 65 Inches), for Waterworks

D. Uni-Bell PVC Pipe Association:

Uni-B-6-1998.....Recommended Practice for Low-Pressure Air
Testing of Installed Sewer Pipe

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 33 30 00, SANITARY SEWERAGE UTILITIES", 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. Submit the following as one package or submittal will be rejected:
 - 1. Pipe, Fittings, and, Appurtenances.
 - 2. Jointing Material.
 - 3. Frames and Covers.

1.5 QUALITY ASSURANCE

- A. Products Criteria:
 - 1. Multiple Units: When two or more units of the same type or class of materials or equipment are required, these units shall be products of one manufacturer.
 - 2. Nameplates: Nameplate bearing manufacturer's name, or identifiable trademark, including model number, securely affixed in a conspicuous place on equipment, or name or trademark, including model number cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.
- B. Comply with the rules and regulations of the Public Utility having jurisdiction over the connection, extension, and modification to Public Sanitary Sewer lines and Public Utility Systems as applicable.

1.6 AS-BUILT DOCUMENTATION

- A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.

- B. 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 2015 or newer provided on CD 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.
- C. Certification documentation shall be provided to PM 10 working days prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and certification that all results of tests were within limits specified.

PART 2 - PRODUCTS

2.1 PIPING

- A. Gravity Flow Lines (Pipe and Fittings):
 - 1. Polyvinyl Chloride (PVC):
 - a. Pipe and Fittings, 100 mm to 381 mm (4 inches to 15 inches) in diameter, shall conform to ASTM D3034, Type PSM, SDR 35. Pipe and fittings shall have elastomeric gasket joints providing a watertight seal when tested in accordance with ASTM D3212. Gaskets shall conform to ASTM F477. Solvent welded joints are prohibited.
 - b. Pipe and fittings, 450 mm to 900 mm (18 inches to 36 inches) in diameter, shall be solid wall or have a corrugated or ribbed exterior profile and a smooth interior. Pipe shall conform to the following:
 - 1) Pipe and fittings shall conform to ASTM F949 corrugated sewer pipe with a smooth interior. The corrugated outer wall shall be fused to the smooth innerwall at the corrugation valley. Pipe and fitting shall have a smooth bell, elastomeric joints conforming to ASTM D3212, and shall have a minimum pipe stiffness of 345 kPa (50 psi) at 5 percent deflection when tested in accordance with ASTM D2412. Corrugation shall be perpendicular to the axis of the pipe to allow gaskets to be

installed on field cut sections of pipe without the requirement for special fittings.

- 2) Ribbed wall PVC pipe and fittings shall conform to ASTM F794 ribbed sewer pipe with smooth interior pipe. Fittings shall have a smooth bell, elastomeric joints conforming to ASTM D3212, and shall have a minimum pipe stiffness of 320 kPa (46 psi) when tested in accordance with ASTM D 2412 at 5 percent vertical deflection. Joints shall not leak at 7.6 m (25 feet) of head under 5 percent deflection.
- 3) Solid wall pipe and fittings shall conform to ASTM F679, SDR 35 pipe. Fittings shall have gaskets conforming to ASTM F477 and shall be able to withstand a hydrostatic pressure of 345 kPa (50 psi).

2.2 JOINTING MATERIAL

A. Gravity Flow Lines:

1. Polyvinyl Chloride (PVC) Pipe (Gravity Use): Joints, ASTM D3212. Elastomeric gasket, ASTM F477.
2. High Density Polyethylene (HDPE) pipe and fitting joints, ASTM D3212, elastomeric gaskets, ASTM F477.

2.3 CONCRETE

- ### **A. Concrete shall have a minimum compressive strength of 4000 psi at 28 days. The cement shall be Type III conforming to ASTM C150/C150M. Concrete shall conform with the provisions of Division 03, CONCRETE.**

2.4 REINFORCING STEEL

- ### **A. Reinforcing steel shall be deformed bars, ASTM A615/A615M, Grade 60 unless otherwise noted.**

2.5 CLEANOUT FRAMES AND COVERS

- ### **A. Frames and covers shall be gray iron casting conforming to ASTM A48/A48M. The frame and cover shall be rated for AASHTO HS20-44 wheel loading, have a studded pattern on its cover, vent holes, and lifting slots. The cover shall fit firmly on the frame without movement when subject to vehicular traffic. The word "SEWER" shall be cast on the cover.**

2.6 WARNING TAPE

- A. Standard, 0.10 mm (4 mils) polyethylene 75 mm (3 inch) wide tape detectable type, green with black letters and imprinted with "CAUTION BURIED SEWER LINE BELOW".

PART 3 - EXECUTION

3.1 INSTALLATION

- A. If an installation is unsatisfactory to the PM , the Contractor shall correct the installation at no additional cost or time to the Government.

3.2 BUILDING SERVICE LINES

- A. Install sanitary sewer service lines to point of connection within approximately 1500 mm (5 feet) outside of buildings where service is required and make connections. Coordinate the invert and location of the service line with the contractor installing the building lines.
- B. Connections of service line to building piping shall be made after the new sanitary sewer system has been constructed, tested, and accepted for operation by the PM . Install all temporary caps or plugs required for testing.
- C. When building services have not been installed at the time when the sanitary sewer system is complete, provide temporary plugs or caps at the ends of all service lines. Mark the location and depth of the service lines with continuous warning tape placed 300 mm (12 inches) above service lines.

3.3 ABANDONED MANHOLES STRUCTURES AND PIPING

- A. Manholes and Structures Outside of Building Areas: Remove frame and cover, cut, and remove the top to an elevation of 600 mm (2 feet) below finished grade. Fill the remaining portion with compacted gravel or crushed rock or concrete.
- B. Manholes and Structures within Building Areas: Remove frame and cover and cut and remove the top to an elevation of 600 mm (3 feet) below the finish floor elevation, and completely fill the structure with 21 MPa (3,000 psi) concrete.
- C. Piping under and within 1500 mm (5 feet) of building areas shall be completely removed.

- D. Piping outside of building areas shall have all ends of the piping at the limit of the abandonment and within structures and manholes, plugged with concrete, and abandoned in-place.
- E. Comply with all OSHA confined space requirements while working within existing manholes and structures.
- F. When the limit of the abandonment terminates in an existing manhole to remain, the flow line in the bench of the manhole to the abandoned line shall be filled with concrete and shaped to maintain the flowline of the lines to remain.

3.4 REGRADING

- A. Raise or lower existing manholes and structures frames and covers, cleanout frames and covers and valve boxes in regraded areas to finish grade. Carefully remove, clean, and salvage cast iron frames and covers. Adjust the elevation of the top of the manhole or structure as detailed on the drawings. Adjust the elevation of the cleanout pipe riser, and reinstall the cap or plug. Reset cast iron frame and cover, grouting below and around the frame. Install concrete collar around reset frame and cover as specified for new construction.
- B. During periods when work is progressing on adjusting manholes or structures cover elevations, install a temporary cover above the bench of the structure or manhole. The temporary cover shall be installed above the high flow elevation within the structure, and shall prevent debris from entering the wastewater stream.
- C. Comply with all OSHA confined space requirements when working within existing structures.

3.5 CONNECTIONS TO EXISTING VA OWNED MANHOLES

- A. During construction of new connections to existing manholes, maintain continued sanitary sewer service to all buildings and users upstream. Provide, install, and maintain all pumping, conveyance system, dams, weirs, etc. required to maintain the continuous flow of sewage. All temporary measures required to meet this requirement shall be subject to the review of the PM .
- B. Core existing structure, install pipe at the design invert. Install an elastomeric gasket around the pipe, and grout the interstitial space between the pipe and the core.

- C. The bench of the manhole shall be cleaned and reshaped to provide a smooth flowline for all pipes connected to the manhole.
- D. Connections and alterations to existing manholes shall be constructed so that finished work conforms as nearly as practicable to the applicable requirements specified for new manholes, including concrete and masonry work, cutting and shaping.

3.6 PIPE SEPARATION

A. Horizontal Separation - Water Mains and Sewers:

- 1. Existing and proposed water mains shall be at least 3 meters (10 feet) horizontally from any proposed gravity flow and pressure (force main) sanitary sewer or sewer service connection.
- 2. Gravity flow mains and pressure (force) mains may be located closer than 3 meters (10 feet) but not closer than 1.8 m (6 feet) to a water main when:
 - a. Local conditions prevent a lateral separation of ten feet; and
 - b. The water main invert is at least 450 mm (18 inches) above the crown of the gravity sewer or 600 mm (24 inches) above the crown of the pressure (force) main; and
 - c. The water main is in a separate trench separated by undisturbed earth.
- 3. When it is impossible to meet (1) or (2) above, both the water main and sanitary sewer main shall be constructed of push-on or mechanical joint ductile iron pipe. The pipe for the sanitary sewer main shall comply with the specifications for pressure (force) mains, and the water main material shall comply with Section 33 10 00, WATER UTILITIES. The sewer shall be pressure tested as specified for pressure (force) mains before backfilling.

B. Vertical Separation - Water Mains and Sewers at Crossings:

- 1. Water mains shall be separated from sewer mains so that the invert of the water main is a minimum of 600 mm (24 inches) above the crown of gravity flow sewer or 1219 mm (48 inches) above the crown of pressure (force) mains. The vertical separation shall be maintained within 3 meters (10 feet) horizontally of the sewer and water crossing. When these vertical separations are met, no additional protection is required.
- 2. In no case shall pressure (force) sanitary main cross above, or within 600 mm (24 inches) of water lines.

3. When it is impossible to meet (1) above, the gravity flow sewer may be installed 450 mm (18 inches) above or 300 mm (12 inches) below the water main, provided that both the water main and sewer shall be constructed of push-on or mechanical ductile pipe. Pressure (Force) sewers may be installed 600 mm (24 inches) below the water line provided both the water line and sewer line are constructed of ductile iron pipe. The pipe for the sewer shall conform to the requirements for pressure sewers specified herein. Piping for the water main shall conform to Section 33 10 00, WATER UTILITIES.
4. The required vertical separation between the sewer and the water main shall extend on each side of the crossing until the perpendicular distance from the water main to the sewer line is at least 3 meters (10 feet).

3.7 GENERAL PIPING INSTALLATION

- A. Lay pipes true to line and grade. Gravity flow sewer shall be laid with bells facing upgrade. Pressure (force) mains shall have the bells facing the direction of flow.
- B. Do not lay pipe on unstable material, in wet trench, or when trench and weather conditions are unsuitable for the work.
- C. Support pipe on compacted bedding material. Excavate bell holes only large enough to properly make the joint.
- D. Inspect pipes and fittings, for defects before installation. Defective materials shall be plainly marked and removed from the site. Cut pipe shall have smooth regular ends at right angles to axis of pipe.
- E. Clean interior of all pipe thoroughly before installation. When work is not in progress, open ends of pipe shall be closed securely to prevent entrance of storm water, dirt, or other substances.
- F. Lower pipe into trench carefully and bring to proper line, grade, and joint. After jointing, interior of each pipe shall be thoroughly wiped or swabbed to remove any dirt, trash, and excess jointing materials.
- G. Do not lay sewer pipe in same trench with another pipe or other utility. Sanitary sewers shall cross at least 600 mm (2 feet) below water lines.
- H. Do not walk on pipe in trenches until covered by layers of bedding or backfill material to a depth of 300 mm (12 inches) over the crown of the pipe.

- I. Warning tape shall be continuously placed 300 mm (12 inches) above sewer pipe.
- J. Install gravity sewer line in accordance with the provisions of these specifications and the following standards:
 - 1. Polyvinyl Chloride (PVC) Piping: ASTM D2321.

3.8 CLEANOUTS

- A. 150 mm (6 inches) in diameter and consisting of a ductile iron 45 degree fitting on end of run, or combination Y fitting and 1/8 bend in the run with ductile iron pipe extension, water tight plug, or cap and cast frame and cover flush with finished grade. Center-set cleanouts, located in unpaved areas, in a 300 mm by 300 mm by 150 mm (12 inches by 12 inches by 6 inches) thick concrete slab set flush with adjacent finished grade. Where cleanout is in force main, provide a blind flange top connection. The center of the flange shall be equipped with a 50 mm (2 inches) base valve to allow the pressure in the line to be relieved prior to removal of the blind flange. Frames and covers for pressure (force) mains shall be 600 mm (24 inches) in diameter.
- B. The top of the cleanout assembly shall be 50 mm (2 inches) below the bottom of the cover to prevent loads being transferred from the frame and cover to the piping.

3.9 INSPECTION OF SEWERS

- A. Inspect and obtain the PM 's approval. Thoroughly flush out before inspection. Contractor shall camera new lines, and also verify no damage was made to existing lines. Camera inspection of existing line should be done prior to construction to verify existing condition. See plan sheet for camera extents.

3.10 TESTING OF SANITARY SEWERS

- A. Gravity Sewers and Manholes (Select one of the following):
 - 1. Air Test: PVC Pipe, Uni-Bell Uni-B-6. Clean and isolate the section of sewer line to be tested. Plug or cap the ends of all branches, laterals, tees, wyes, and stubs to be included in the test to prevent air leakage. The line shall be pressurized to 28 kPa (4 psi) and allowed to stabilize. After pressure stabilization, the pressure shall be dropped to 24 kPa (3.5 psi) greater than the average back-

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pressure of any groundwater above the sewer. The minimum test time shall be as specified in Uni-Bell Uni-B-6.

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SECTION 33 30 12

UTILITY HORIZONTAL DIRECTIONAL DRILLING

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies materials and procedures for construction of by Horizontal Directional Drilling (HDD) of High-Density Polyethylene (HDPE) pipe and/or conduit networks, and planting irrigation networks that are complete and ready for operation. This includes piping, structures and all other incidentals.

1.2 RELATED WORK

- A. Excavation, Trench Widths, Pipe Bedding, Backfill, Shoring, Sheeting, Bracing: Section 31 20 00, EARTH MOVING.
- B. Concrete Work, Reinforcing, Placement and Finishing: Section 03 30 53, CAST-IN-PLACE CONCRETE.
- C. General plumbing, protection of Materials and Equipment, and quality assurance: Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- D. Section 33 10 00, WATER UTILITIES.
- E. Materials and Testing Report Submittals: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- F. Erosion and Sediment Control: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.
- G. Section 32 90 00 PLANTING IRRIGATION

1.3 QUALITY ASSURANCE

- A. Experience: Actively engaged in horizontal directional drilling for minimum of 3 years.
- B. Field supervisory personnel: Experienced in the performance of the work and tasks as stated herein for minimum of 3 years.

1.4 COORDINATION

- A. Coordinate connections to direct bury utilities.
- B. Coordinate crossings of in-place utilities with Cemetery staff and PM/RE.

1.5 SUBMITTALS

- A. Submit for review and approval:
 - 1. Presentation of similar experience in the last 3 years.

2. Include, but not limited to, owner name, address, telephone number, contact person, date and duration of work, location, pipe information, and contents handled by pipeline.
3. Supervisory field personnel and historical information of HDD experience.
 - a. At least one field supervisors listed must be at site when HDD operations are in progress.

B. Submit the following:

1. Working Drawings and written procedure describing in detail proposed method and entire operation for information only including, but not limited to:
 - a. Size, capacity and arrangement of equipment.
 - b. Location and size of drilling and receiving pits.
 - c. Dewatering and methods of removing spoils material.
 - d. Method of installing detection wire and pipe.
 - e. Type, location and method of installing locator station.
 - f. Method of fusion pipe segment and type of equipment.
 - g. Type of cutting head.
 - h. Method of monitoring and controlling line and grade.
 - i. Detection of surface movement.
 - j. Bentonite drilling mud for information only:
 - 1) Products information, material specifications, and handling procedures.
 - 2) Material safety data sheet and special precautions required.
 - 3) Method of mixing and application.
2. Materials submittal including applicable cut sheets of pipe, drilling fluids, fittings and locating stations

1.6 PROJECT CONDITIONS

- A. Complete HDD so as not to interfere with, interrupt, or endanger surface and activity thereon.
- B. Do not use HDD in rock stratum or subsoil consisting of boulders and underground obstructions that impede the process.
- C. Comply with applicable ordinances, codes, statutes, rules, and regulations of State of Texas, applicable County building codes, and applicable regulations of Federal Government, OSHA 29CFR 1926, and

applicable criteria of ANSI A10.16-1995 (R2001), "Safety Requirements for Tunnels, Shafts, and Caissons."

PART 2 - PRODUCTS

2.1 PIPE

A. HDPE: See 26 Electrical and/or 27 communications or as applicable.

2.2 HDPE JOINTS:

A. Use butt fusion joining technique for joining pipe segments installed by HDD.

B. When joining HDPE pipe at ends of directional drilling runs fusion bond to adjacent pipe section.

1. Use butt fusion, socket fusion, or electrofusion coupling joining technique

2. Mechanical Couplings are not permitted for joining of directional drilled pipe sections.

2.3 DRILLING FLUID.

A. Bentonite drilling mud compatible with the environment.

B. Waste oil or environmentally non-compatible polymers cannot be part of composition.

2.4 LOCATOR STATION.

A. Underground, Flush Mounted

1. Light blue cast iron or high-impact plastic locking lid that will withstand AASHTO H-20 traffic loads and ultra-violet rays.

2. Mark locking lid to identify pipeline with a permanent identification

3. Terminal block made of high dielectric material, which is made of phenolic resin, plastic, micarta, Lexan or Bakelite for each locator station. Terminal block furnished with two 3/16-inch threaded studs, nuts, and washers made of nickel-plated brass.

PART 3 - EXECUTION

3.1 PREPARATION

A. Excavate pits following approved working drawings and Section 31 20 00 EARTH MOVING. Verify excavation pit location(s) with RE.

B. Provide equipment to guard against electrocution and an alarm system on drilling equipment capable of detecting electrical current as it approaches electric lines.

C. Test pit underground utilities crossing before HDD operation.

3.2 OPERATION

A. General.

1. Determine drilling length and equipment pull strength for type of soil encountered.
2. Provide method to control line and grade.
 - a. Provide and maintain instrumentation that accurately locates pilot hole.
 - b. Drill pilot hole along path following Drawings to these tolerances:
 - 1) Vertical alignment plus or minus 0.5 foot. Vertical path of the pilot hole must not establish new high points not shown on Drawings.
 - 2) Horizontal alignment plus or minus 1.0 foot.
 - c. Include electronic monitoring of horizontal and vertical drilling head location.
 - d. Obtain accuracy range within 1 inch of actual position of pipeline. Record position readings at maximum of 10 foot intervals.
 - e. At completion of pilot hole drilling, furnish PM /RE tabulations of horizontal and vertical alignment.
3. When water is encountered.
 - a. Provide and maintain dewatering system of sufficient capacity to remove water.
 - b. Keep excavation free of water until backfill operation is in progress.
 - c. Perform dewatering in such a manner that removal of soils particles are held to a minimum.
 - d. Dewater into sediment trap following Section 31 23 19.
4. Maintain close observation to detect settlement or displacement of surface and adjacent facilities.
 - a. Notify RE/ PM and applicable agency immediately if settlement or displacement is detected
 - b. Maintain safe conditions and prevent damage.

B. Drilling Operation.

1. Drilling Fluids.

- a. Maintain drilling fluid in bore hole to increase stability of surrounding soil and reduce drag on pulled pipe.
 - b. Dispose of drilling fluid and other spoils at location following laws, ordinances, rules, and regulations of local jurisdiction.
 - c. Transport excess fluids and other spoils to approved disposal site off Cemetery Property
 - d. Minimize drilling fluid at locations other than entry and exit points. Immediately clean up any drilling fluids that inadvertently surface.
 - e. Provide clean water for drilling.
2. Pilot Hole Drilling.
- a. Angle entry hole so that curvature of pilot hole does not exceed allowable bending radius of HDPE pipe.
 - b. Be able to make a turn of up to 90 degrees and maintain a curvature not to exceed allowable bending radius of HDPE pipe.
 - c. Alignment Adjustment and Restarts.
 - 1) Follow pipeline alignment on Drawings within tolerances specified herein. Before adjustments, notify Contract Manager for approval.
 - 2) Notify Contract Manager when forward motion of operation is stopped by an obstruction.
 - a) Abandon in place with drilling fluid, unless Contract Manager directs otherwise.
 - b) Attempt a second installation at approved location or excavate at the point of difficulty and install the HDPE pipe by trench method following Section 31 20 00.
 - 3) Exercise caution including, but not limited to, locating utilities drilling downholes (test pits) to observe drill stems or reamer assembly to clear other existing utilities at all crossings.
 - 4) Keep the number of boring pits to a minimum, no closer than following distances.
 - a) Equipment must be capable of boring following lengths in a single bore:
 - b) 2 Inch Diameter - 400 LF

3.3 INSTALLATION

A. Installing HDPE Pipe.

1. Provide a swivel to reaming assembly and pull section of pipe to minimize torsional stress on pull section after drilling pilot hole.
2. Hold reaming diameter to 1.5 times outside diameter of HDPE pipe being installed.
3. Protect pull section as it proceeds during pull back so it moves freely and is not damaged.
4. Pull detection wire along with HDPE pipe. Extend wire into locator station at each end of HDPE pipe.
5. When connecting to adjacent pulled or non-pulled section of HDPE pipe, allow pull section of pipe to extend past termination point. Make tie-ins the next day after pullback of HDPE pipe.
6. Test pit pipe installation to verify horizontal and vertical alignment.
 - a. One test pit for every 500 feet along length of pipeline.
 - b. Contract Manager may order additional test pit for each test pit that reveals pipeline installation is not in compliance with Contract Documents.
7. Replace portions of pipeline not in compliance with Contract Documents.

B. Installing Locator Station.

1. At each end of the HDPE pipe. Install flush mount underground locator. When HDPE pipe is connected to another type of pipe material, continue detector wire over connecting pipe, so locator station is installed out of paved area.

C. Detection Wire.

1. Install detection wire without splices
2. Terminate detection wire inside locator box using proper sized crimp type connectors on wire ends.
3. Connect each wire to terminal maintaining at least 18 inches slack in each wire for underground flush mounted locator stations.
4. Neatly coil slack wire in test station below terminal board.
5. Locate wires on top and along HDPE pipe.
6. Allow adequate slack and support to protect wires from damage during backfilling operations.

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7. Test each detection wire for continuity after backfill is completed. If test for continuity is negative, repair or replace. After continuity is verified, connect each detection wire to terminal block in locator station.

3.4 FIELD QUALITY ASSURANCE

- A. Perform field testing of HDPE pipe following Section 33 10 00 Water Utilities and/or Section 32 90 00 Planting Irrigation.

**SECTION 33 40 00
STORM SEWER UTILITIES**

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies materials and procedures for construction of outside, underground storm sewer systems that are complete and ready for operation. This includes piping, structures, and all other incidentals.

1.2 RELATED WORK

- A. Section 01 00 01, GENERAL REQUIREMENTS (Major NCA Projects).
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES: Materials and Testing Report Submittals.
- C. Section 01 42 19, REFERENCE STANDARDS.
- D. Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS: Erosion and Sediment Control.
- E. Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS.
- F. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.
- G. Section 03 30 00, CAST-IN-PLACE CONCRETE: Concrete Work, Reinforcing, Placement and Finishing.
- H. Section 05 50 00, METAL FABRICATIONS: Fabrication of Steel Ladders.
- I. Section 31 20 00, EARTH MOVING: Excavation, Trench Widths, Pipe Bedding, Backfill, Shoring, Sheeting, Bracing.

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 Association of State Highway and Transportation Officials (AASHTO):
 - HB-17-2002.....Standard Specifications for Highway Bridges, 17th Edition
 - M190-2004.....Standard Specification for Bituminous-Coated Corrugated Metal Culvert Pipe and Pipe Arches
 - M252-2009.....Standard Specification for Corrugated Polyethylene Drainage Pipe
 - M294-2015.....Standard Specification for Corrugated Polyethylene Pipe, 300 to 1500 mm (12 to 60 In.) Diameter

C. American Concrete Institute (ACI):

318-2014.....Building Code Requirements for Structural
Concrete and Commentary

350-2006.....Code Requirements for Environmental Engineering
Concrete Structures and Commentary

D. American Society of Mechanical Engineers (ASME):

A112.6.3-2016.....Floor and Trench Drains

A112.14.1-2003.....Backwater Valves

A112.36.2M-1991.....Cleanouts

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

A48/A48M-2003 (R2012)...Standard Specification for Gray Iron Castings

A242/A242M-2013.....Standard Specification for High-Strength Low-
Alloy Structural Steel

A536-1984 (R2014).....Standard Specification for Ductile Iron
Castings

A615/A615M-2016.....Standard Specification for Deformed and Plain
Carbon-Steel Bars for Concrete Reinforcement

A760/A760M-2015.....Standard Specification for Corrugated Steel
Pipe, Metallic-Coated for Sewers and Drains

A762/A762M-2015.....Standard Specification for Corrugated Steel
Pipe, Polymer Precoated for Sewers and Drains

A798/A798M-2013.....Standard Specification for Installing Factory-
Made Corrugated Steel Pipe for Sewers and Other
Applications

A849-2015.....Standard Specification for Post-Applied
Coatings, Pavings, and Linings for Corrugated
Steel Sewer and Drainage Pipe

A929/A929M-2001(2013)...Standard Specification for Steel Sheet,
Metallic-Coated by the Hot-Dip Process for
Corrugated Steel Pipe

A1064/A1064M-2016.....Standard Specification for Carbon-Steel Wire
and Welded Wire Reinforcement, Plain and
Deformed, for Concrete

B745/B745M-2015.....Standard Specification for Corrugated Aluminum
Pipe for Sewers and Drains

- B788/B788M-2009 (R2014).Standard Specification for Installing Factory-Made Corrugated Aluminum Culverts and Storm Sewer Pipe
- C14-2015a.....Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe
- C33/C33M-2016.....Standard Specification for Concrete Aggregates
- C76-2015a.....Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
- C150/C150M-2016.....Standard Specification for Portland Cement
- C443-2012.....Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
- C478-2015.....Standard Specification for Circular Precast Reinforced Concrete Manhole Sections
- C506-2016a.....Standard Specification for Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe
- C507-2015.....Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe
- C828-2011.....Standard Test Method for Low-Pressure Air Test of Vitrified Clay Pipe Lines
- C890-2013.....Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures
- C891-2011.....Standard Practice for Installation of Underground Precast Concrete Utility Structures
- C913-2008.....Standard Specification for Precast Concrete Water and Wastewater Structures
- C923-2008 (R2013)e1.....Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals
- C990-2009 (R2014).....Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
- C1103-2014.....Standard Specification for Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
- C1173-2010 (R2014).....Standard Specification for Flexible Transition Couplings for Underground Piping Systems

- C1433-2016a.....Standard Specification for Precast Reinforced
Concrete Monolithic Box Sections for Culverts,
Storm Drains, and Sewers
- C1479-2013.....Standard Practice for Installation of Precast
Concrete Sewer, Storm Drain, and Culvert Pipe
Using Standard Installations
- D448-2012.....Standard Classification for Sizes of Aggregate
for Road and Bridge Construction
- D698-2012e2.....Standard Test Methods for Laboratory Compaction
Characteristics of Soil Using Standard Effort
(12,400 ft-lbf/ft³ (600 kN-m/m³))
- D1056-2014.....Standard Specification for Flexible Cellular
Materials—Sponge or Expanded Rubber
- D2321-2014e1.....Standard Practice for Underground Installation
of Thermoplastic Pipe for Sewers and Other
Gravity-Flow Applications
- D2661-2014.....Standard Specification for Acrylonitrile-
Butadiene-Styrene (ABS) Schedule 40 Plastic
Drain, Waste, and Vent Pipe and Fittings
- D3034-2015.....Standard Specification for Type PSM Poly(Vinyl
Chloride) (PVC) Sewer Pipe and Fittings
- D3350-2014.....Standard Specification for Polyethylene
Plastics Pipe and Fittings Materials
- D3753-2012e1.....Standard Specification for Glass-Fiber-
Reinforced Polyester Manholes and Wetwells
- D4101-2014.....Standard Specification for Polypropylene
Injection and Extrusion Materials
- D5926-2015.....Standard Specification 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
- F679-2015.....Standard Specification for Poly(Vinyl Chloride)
(PVC) Large-Diameter Plastic Gravity Sewer Pipe
and Fittings

- F714-2013.....Standard Specification for Polyethylene (PE)
Plastic Pipe (DR-PR) Based on Outside Diameter
- F794-2003 (R2014).....Standard Specification for Poly(Vinyl Chloride)
(PVC) Profile Gravity Sewer Pipe and Fittings
Based on Controlled Inside Diameter
- F891-2010.....Standard Specification for Coextruded
Poly(Vinyl Chloride) (PVC) Plastic Pipe With a
Cellular Core
- F894-2013.....Standard Specification for Polyethylene (PE)
Large Diameter Profile Wall Sewer and Drain
Pipe
- F949-2015.....Standard Specification for Poly(Vinyl Chloride)
(PVC) Corrugated Sewer Pipe With a Smooth
Interior and Fittings
- F1417-2011a (R2015).....Standard Practice for Installation Acceptance
of Plastic Non-Pressure Sewer Lines Using Low-
Pressure Air
- F1668-2008.....Standard Guide for Construction Procedures for
Buried Plastic Pipe
- F. American Water Works Association (AWWA):
 - C105-2010.....Polyethylene Encasement for Ductile-Iron Pipe
Systems
 - C110-2012.....Ductile-Iron and Gray-Iron Fittings
 - C219-2011.....Bolted, Sleeve-Type Couplings for Plain-End
Pipe
 - C600-2010.....Installation of Ductile iron Mains and Their
Appurtenances
 - C900-2007.....Polyvinyl Chloride (PVC) Pressure Pipe and
Fabricated Fittings, 4 In. Through 12 In. (100
mm Through 300 mm), for Water Transmission and
Distribution
 - M23-2002.....PVC Pipe: Design And Installation, Second
Edition
- G. National Stone, Sand and Gravel Association (NSSGA):
 -Quarried Stone for Erosion and Sediment 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 33 40 00, STORM SEWER UTILITIES", 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. Submit all items as one package or submittal will be rejected.
 - 1. Piping
 - 2. Fittings
 - 3. Manholes
 - 4. Catch basins
 - 5. Flared end sections
 - 6. Rip Rap
 - 7. Grates and Frames
- D. 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 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

1.5 QUALITY ASSURANCE

- A. Products Criteria:
 - 1. When two or more units of the same type or class of materials or equipment are required, these units shall be products of one manufacturer.
 - 2. A nameplate bearing manufacturer's name or trademark, including model number, shall be securely affixed in a conspicuous place on equipment. In addition, the model number shall be either cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic manholes, pipe, and fittings in direct sunlight.
- B. Handle manholes, catch basins, FES, and stormwater inlets according to manufacturer's written rigging instructions.

1.7 COORDINATION

- A. Coordinate connection to storm sewer main with the Public Agency providing storm sewer off-site drainage.
- B. Coordinate exterior utility lines and connections to building services up to the actual extent of building wall.

1.8 WARRANTY

- A. Guaranty: Warranty of Construction, FAR clause 52.246-21.
- B. The Contractor shall remedy any defect due to faulty material or workmanship and pay for any damage to other work resulting therefrom within a period of one year from final acceptance. Further, the Contractor will furnish all manufacturers' and suppliers' written guarantees and warranties covering materials and equipment furnished under this Contract.

1.9 AS-BUILT DOCUMENTATION

- A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.
- B. Submit operation and maintenance data updated to include submittal review comments, substitutions and construction revisions shall be inserted into a three ring binder. All aspects of system operation and maintenance procedures, including 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. As-built drawings are to be provided, and a copy of them in Auto-CAD version 2017 or newer provided on CD 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 PM 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 FACTORY-ASSEMBLED PRODUCTS

- A. Standardization of components shall be maximized to reduce spare part requirements. 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.

2.2 CONCRETE PIPE AND FITTINGS

- A. Reinforced concrete sewer pipe and fittings shall be ASTM C76.
1. Bell-and-spigot or tongue and groove ends and gasketed joints with ASTM C443, rubber gaskets.
 2. All RCP pipe shall be Class V
 3. RCP Concrete pipes not at manholes shall terminate with precast concrete flared end section ASTM C-507.
 4. Where noted on plans, pipe sections and flared end shall be ties with 1 inch diameter A36 steel tie bolts. Tie bolt system shall include threaded adjustment to ensure a tight joint. Tie bolts may penetrate pipe wall in preformed holes. Holes to be grouted after installation and prior to backfill.

2.3 NONPRESSURE TRANSITION COUPLINGS

- A. Comply with ASTM C1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground non-pressure piping. Include ends of same sizes as piping to be joined, and corrosion resistant metal tension band and tightening mechanism on each end.
- B. Sleeve Materials:
1. For concrete pipes: ASTM C443, rubber.
 2. For plastic pipes: ASTM F477, elastomeric seal or ASTM D5926, PVC.
 3. For dissimilar pipes: ASTM D5926, PVC or other material compatible with pipe materials being joined.

- C. Unshielded, Flexible Couplings: Couplings shall be an elastomeric sleeve with corrosion resistant metal tension band and tightening mechanism on each end.
- D. Shielded, flexible couplings shall be elastomeric or rubber sleeve with full length, corrosion resistant outer shield and corrosion resistant metal tension band and tightening mechanism on each end.

2.4 E. RING-TYPE, FLEXIBLE COUPLINGS SHALL BE ELASTOMERIC COMPRESSION SEAL WITH DIMENSIONS TO FIT INSIDE BELL OF LARGER PIPE AND FOR SPIGOT OF SMALLER PIPE TO FIT INSIDE RING. MANHOLES AND CATCH BASINS

A. Standard Precast Concrete Manholes:

1. Description: ASTM C478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
2. Diameter: 1200 mm (48 inches) minimum unless otherwise indicated.
3. Ballast: Increase thickness of precast concrete sections or add concrete to base section as required to prevent flotation.
4. Base Section: 150 mm (6 inch) minimum thickness for floor slab and 100 mm (4 inch) minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
5. Riser Sections: 100 mm (4 inch) minimum thickness, and lengths to provide depth indicated.
6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated, and top of cone of size that matches grade rings.
7. Joint Sealant: ASTM C990, bitumen or butyl rubber.
8. Resilient Pipe Connectors: ASTM C923, cast or fitted into manhole walls, for each pipe connection.
9. Steps: If total depth from floor of manhole to finished grade is greater than 1500 mm (60 inches). ASTM A615, deformed, 15 mm (1/2 inch) steel reinforcing rods encased in ASTM D4101, PP width of 400 mm (16 inches) minimum, spaced at 300 to 400 mm (12 to 16 inch) intervals.
10. Adjusting Rings: Reinforced concrete rings, 150 to 225 mm (6 to 9 inch) total thickness, to match diameter of manhole frame and cover, and height as required to adjust manhole frame and cover to indicated elevation and slope.

B. Designed Precast Concrete Structures:

1. Description: ASTM C913; designed for A-16 (AASHTO HS20-44), heavy-traffic, structural loading; of depth, shape, and dimensions indicated, with provision for sealant joints.
2. Ballast: Increase thickness of one or more precast concrete sections or add concrete to manhole as required to prevent flotation.
3. Joint Sealant: ASTM C990, bitumen or butyl rubber.
4. Resilient Pipe Connectors: ASTM C923, cast or fitted into manhole walls, for each pipe connection.
5. Steps: If total depth from floor of structure to finished grade is greater than 1500 mm (60 inches). ASTM A615, deformed, 15 mm (1/2 inch) steel reinforcing rods encased in ASTM D4101, PPASTM A615 deformed, 15 mm (1/2 inch) steel reinforcing rods encased in ASTM D 4101, PP, width of 400 mm (16 inches) minimum, spaced at 300 to 400 mm (12 to 16 inch) intervals.
6. Adjusting Rings: Reinforced concrete rings, 150 to 225 mm (6 to 9 inches) total thickness, to match diameter of manhole frame and cover, and height as required to adjust manhole frame and cover to indicated elevation and slope.

C. Manhole Frames and Covers:

1. Description: Ferrous; 600 mm (24 inch) ID by 175 to 225 mm (7 to 9 inch) riser with 100 mm (4 inch) minimum width flange and 660 mm (26 inch) diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."
2. Material: ASTM A536, Grade 60-40-18 ductile iron unless otherwise indicated.

2.5 CONCRETE FOR MANHOLES AND CATCH BASINS

A. General: Cast-in-place concrete according to ACI 318, ACI 350, and the following:

1. Cement: ASTM C150, Type II.
2. Fine Aggregate: ASTM C33, sand.
3. Coarse Aggregate: ASTM C33, crushed gravel.
4. Water: Potable.

B. Concrete Design Mix: 27.6 MPa (4000 psi) minimum, compressive strength in 28 days.

1. Reinforcing Fabric: ASTM A1064/A1064M, steel, welded wire fabric, plain.

2. Reinforcing Bars: ASTM A615/A615M, Grade 60 420 MPa (60,000 psi) deformed steel.

C. Manhole Channels and Benches: Channels shall be the main line pipe material. Include benches in all manholes and catch basins.

1. Channels: Main line pipe material or concrete invert. Height of vertical sides to 3/4 of pipe diameter. Form curved channels with smooth, uniform radius and slope. Invert Slope: Same slope as the main line pipe. Bench to be concrete, sloped to drain into channel. Minimum of 6 inch slope from main line pipe to wall sides.

2.6 PIPE OUTLETS

A. RCP pipes shall terminate with precast flared end sections.

B. HDPE pipes shall terminate with HDPE flared end sections.

C. Riprap basins: Broken, irregularly sized and shaped, graded stone according to NSSGA's "Quarried Stone for Erosion and Sediment Control."

1. Average Size 3 to 12 inch, Per SDDOT 830.1; CLASS A.

D. Filter Stone: NSSGA's "Quarried Stone for Erosion and Sediment Control," No. FS-2, No. 4 screen opening, average-size graded stone.

E. Energy Dissipaters: To be as per NSSGA's "Quarried Stone for Erosion and Sediment Control," No. A-1, 3-ton (2721-kg) average weight armor stone, unless otherwise indicated.

2.7 FLARED END SECTIONS

A. Flared End Sections: Sections shall be of standard design of reinforced concrete in accordance with DOT standards.

2.8 RESILIENT CONNECTORS AND DOWNSPOUT BOOTS FOR BUILDING ROOF DRAINS

A. Resilient connectors and downspout boots: Flexible, watertight connectors used for connecting pipe to manholes and inlets, and shall conform to ASTM C923.

2.9 WARNING TAPE

A. Standard, 4-Mil polyethylene 75 mm (3 inch) wide tape detectable type, purple with black letters, and imprinted with "CAUTION BURIED STORM SEWER BELOW".

PART 3 - EXECUTION

3.1 GENERAL

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

3.2 PIPE BEDDING

- A. The bedding surface of the pipe shall provide a firm foundation of uniform density throughout the entire length of pipe. Concrete pipe requirements are such that when no bedding class is specified, concrete pipe shall be bedded in a soil foundation accurately shaped and rounded to conform to the lowest 1/4 of the outside portion of circular pipe. When necessary, the bedding shall be tamped. Bell holes and depressions for joints shall not be more than the length, depth, and width required for properly making the particular type of joint. Plastic pipe bedding requirements shall meet the requirements of ASTM D2321. Bedding, haunching and initial backfill shall be either Class IB or Class II material. Corrugated metal pipe bedding requirements shall conform to ASTM A798/A798M.

3.3 PIPING INSTALLATION

- A. Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install piping with 900 mm (36 inch) minimum cover as shown on the Drawings.
- C. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
1. Do not lay pipe on unstable material, in wet trench or when trench and weather conditions are unsuitable for the work.
 2. Support pipe on compacted bedding material. Excavate bell holes only large enough to properly make the joint.
 3. Inspect pipes and fittings, for defects before installation. Defective materials shall be plainly marked and removed from the site. Cut pipe shall have smooth regular ends at right angles to axis of pipe.
 4. Clean interior of all pipe thoroughly before installation. When work is not in progress, open ends of pipe shall be closed securely to prevent entrance of storm water, dirt or other substances.

5. Lower pipe into trench carefully and bring to proper line, grade, and joint. After jointing, interior of each pipe shall be thoroughly wiped or swabbed to remove any dirt, trash or excess jointing materials.
 6. Do not walk on pipe in trenches until covered by a depth of 300 mm (12 inches) over the crown of the pipe.
 7. Warning tape shall be continuously placed 300 mm (12 inches) above storm sewer piping.
- D. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.
- E. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- F. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.
- G. Install gravity-flow, nonpressure drainage piping according to the following:
1. Install piping pitched down in direction of flow.
 2. Install corrugated steel piping according to ASTM A798/A798M.
 3. Install corrugated aluminum piping according to ASTM B788/B788M.
 4. Install ABS sewer piping according to ASTM D2321 and ASTM F1668.
 5. Install PE corrugated sewer piping according to ASTM D2321
 6. Install PVC cellular-core piping, PVC sewer piping, and PVC profile gravity sewer piping, according to ASTM D2321 and ASTM F1668.
 7. Install reinforced concrete sewer piping according to ASTM C1479.

3.4 REGRADING

- A. Raise or lower existing manholes and structures frames and covers in regraded areas to finish grade. Carefully remove, clean and salvage cast iron frames and covers. Adjust the elevation of the top of the manhole or structure as detailed on the drawings. Reset cast iron frame and cover, grouting below and around the frame. Install concrete collar around reset frame and cover as specified for new construction.
- B. During periods when work is progressing on adjusting manholes or structures cover elevations, install a temporary cover above the bench of the structure or manhole. The temporary cover shall be installed

above the high flow elevation within the structure, and shall prevent debris from entering the wastewater stream.

3.5 CONNECTIONS TO EXISTING VA-OWNED MANHOLES

- A. Make pipe connections and alterations to existing manholes so that finished work will conform as nearly as practicable to the applicable requirements specified for new manholes, including concrete and masonry work, cutting, and shaping.

3.6 CLEANOUT INSTALLATION:

1. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast iron soil pipe fittings in sewer pipes at branches for cleanouts and cast iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.
 - a. Use Heavy-Duty, top-loading classification cleanouts in all areas.
 - b. Use Extra-Heavy-Duty, top-loading classification cleanouts in roads.
 2. Set cleanout frames and covers in earth in cast-in-place concrete block, 18 by 18 by 12 inches deep. Set with flush with surrounding earth grade.
- B. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.7 DRAIN INSTALLATION

- A. Install type of drains in locations indicated.
1. Use Heavy-Duty, top-loading classification cleanouts vehicle-traffic service areas.
 2. Use Extra-Heavy-Duty, top-loading classification cleanouts in roads.
- B. Set drain frames and covers with tops flush with pavement surface.

3.8 MANHOLE INSTALLATION

- A. Install manholes, complete with appurtenances and accessories indicated. Install precast concrete manhole sections with sealants according to ASTM C891.
- B. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 75 mm (3 inches) above finished surface elsewhere unless otherwise indicated.

C. Circular Structures:

1. Precast concrete segmental blocks shall lay true and plumb. All horizontal and vertical joints shall be completely filled with mortar. Parge interior and exterior of structure with 15 mm (1/2 inch) of cement mortar applied with a trowel and finished to an even glazed surface.
2. Precast reinforced concrete rings shall be installed true and plumb. The joints between rings and between rings and the base and top shall be sealed with a preform flexible gasket material specifically manufactured for this type of application. Adjust the length of the rings so that the eccentric conical top section will be at the required elevation. Cutting the conical top section is not acceptable.
3. Precast reinforced concrete manhole risers and tops. Install as specified for precast reinforced concrete rings.

D. Rectangular Structures:

1. Precast concrete structures shall be placed on a 200 mm (8 inch) reinforced concrete pad, or be provided with a precast concrete base section. Structures provided with a base section shall be set on a 200 mm (8 inch) thick aggregate base course compacted to a minimum of 95 percent of the maximum density as determined by ASTM D698. Set precast section true and plumb. Seal all joints with preform flexible gasket material.
2. Do not build structures when air temperature is 0 degrees C (32 degrees F), or below.
3. Invert channels shall be smooth and semicircular in shape conforming to inside of adjacent sewer section. Make changes in direction of flow with a smooth curve of as large a radius as size of structure will permit. Make changes in size and grade of channels gradually and evenly. Construct invert channels by one of the listed methods:
 - a. Forming directly in concrete base of structure.
 - b. Building up with brick and mortar.
4. Floor of structure outside the channels shall be smooth and slope toward channels not less than 1 to 12 or more than 1 to 6. Bottom slab and benches shall be concrete.
5. The wall that supports access rungs or ladder shall be 90 deg vertical from the floor of structure to manhole cover.

6. Install steps and ladders per the manufacturer's recommendations. Steps and ladders shall not move or flex when used. All loose steps and ladders shall be replaced by the Contractor.
7. Install manhole frames and covers on a mortar bed, and flush with the finish pavement. Frames and covers shall not move when subject to vehicular traffic. Install a concrete collar around the frame to protect the frame from moving until the adjacent pavement is placed. In unpaved areas, the rim elevation shall be 50 mm (2 inches) above the adjacent finish grade. Install a 200 mm (8 inch) thick, by 300 mm (12 inch) concrete collar around the perimeter of the frame. Slope the top of the collar away from the frame.
8. Structure and rebar design per manufacture recommendations based on structure depth, anticipated traffic loading, and intended use.

3.9 CATCH BASIN INSTALLATION

- A. Construct catch basins to sizes and shapes indicated.
- B. Set frames and grates to elevations indicated.

3.10 STORMWATER INLET AND OUTLET INSTALLATION

- A. Construct inlet head walls, aprons, and sides of reinforced concrete.
- B. Construct riprap of broken stone.
- C. Install outlets that spill onto grade, anchored with concrete.
- D. Install outlets that spill onto grade, with flared end sections that match pipe.
- E. Construct energy dissipaters at outlets.

3.11 CONNECTIONS

- A. Connect non-pressure, gravity-flow drainage piping in building's storm drains to near by catch basins per plans.
- B. Encase entire connection fitting, plus 150 mm (6 inch) overlap, with not less than 150 mm (6 inches) of concrete with 28-day compressive strength of 20 MPa (3000 psi).
- C. Make connections to existing piping and underground manholes.
 1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping.
 2. Make branch connections from side into existing piping, DN 100 to DN 500 (NPS 4 to NPS 20). Remove section of existing pipe, install wye fitting into existing piping.

3. Make branch connections from side into existing piping, DN 525 (NPS 21) or larger, or to underground manholes and structures by cutting into existing unit and creating an opening large enough to allow 75 mm (3 inches) of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe, manhole, or structure wall, use epoxy-bonding compound as interface between new and existing concrete and piping materials.
 4. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.
- D. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.
 - a. Shielded flexible couplings for same or minor difference OD pipes.
 - b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
 - c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.
 2. Use pressure-type pipe couplings for force main joints.

3.12 IDENTIFICATION

- A. Install green warning tape directly over piping and at outside edge of underground structures.

3.13 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Prior to final acceptance, provide a video record of all piping from the building to the municipal connection to show the lines are free from obstructions, properly sloped and joined.
 1. Submit separate reports for each system inspection.
 2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structures.

- b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.
- 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
 - 4. Reinspect and repeat procedure until results are satisfactory.

3.14 STARTUP AND TESTING

- A. Submit separate report for each test.
- B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
 - 1. Do not enclose, cover, or put into service before inspection and approval.
 - 2. Test completed piping systems according to requirements of authorities having jurisdiction.
 - 3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours advance notice.
 - 4. Submit separate report for each test.
- C.

3.15 CLEANING

- A. Clean interior of piping of dirt and superfluous materials. Flush with water.

--- E N D ---

APPENDIX



**Report of Geotechnical Exploration
PROPOSED MAINTENANCE
BUILDING ADDITION**
Black Hills National Cemetery
Sturgis, South Dakota

AET Project No. P-0007904

Date:
February 8, 2022

Prepared for:
Anderson Engineering of Minnesota, LLC
13605 1st Ave N, Suite 100
Plymouth, Minnesota 55441

Geotechnical • Materials
Forensic • Environmental
Building Technology
Petrography/Chemistry

American Engineering Testing
1745 Samco Road
Rapid City, South Dakota 57702
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February 8, 2022

Anderson Engineering of Minnesota, LLC
13605 1st Ave N, Suite 100
Plymouth, Minnesota 55441



Attn: Mr. Eric Sautbine, PE
esautbine@ae-mn.com

RE: Report of Geotechnical Exploration & Review
Proposed Maintenance Building Addition
Black Hills National Cemetery
20901 Pleasant Valley Drive
Sturgis, South Dakota
AET Project No. P-0007904

Dear Eric:

American Engineering Testing, Inc. (AET) is pleased to present the results of our subsurface exploration program and geotechnical engineering review for the above referenced project to be constructed at the Black Hills National Cemetery in Sturgis, South Dakota. These services were performed in general accordance with our proposal to you dated November 15, 2021 and your written authorization to proceed on January 5, 2022. We are submitting one (1) electronic copy of the report to you.

Please contact me if you have any questions about the report. I can also be contacted to arrange observation and testing services during construction of the project.

Sincerely,
American Engineering Testing, Inc.

A handwritten signature in blue ink, appearing to read 'James Reed', is written over a light blue horizontal line.

James Reed, PG
Geologist II
jreed@amengtest.com
Phone: (605) 388-0029



SIGNATURE PAGE

Prepared for:

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James Reed, PG
Geologist II

Reviewed by:

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Robert Temme, PE
VP West Region Business Development

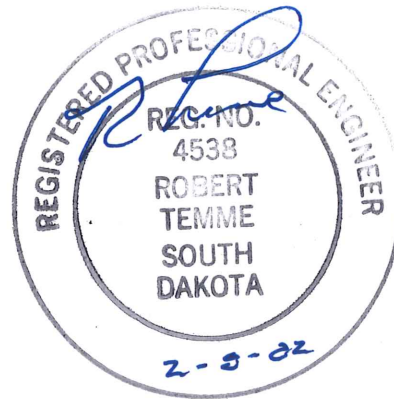




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1.0 INTRODUCTION

We understand the construction of a new addition, on the south side of the existing maintenance building, has been proposed at the Black Hills National Cemetery facility, located south of Sturgis, South Dakota. Please refer to Figure 1: Site Location Map within Appendix A for the approximate location of the site. To assist with the planning and design, American Engineering Testing, Inc. (AET) has been authorized to conduct a subsurface exploration program at the site, conduct soil laboratory testing, and perform a geotechnical engineering review for the project. This report presents the results of the above services and provides our engineering recommendations based on this data.

2.0 SCOPE OF SERVICES

AET's services were performed in general accordance with our proposal dated November 15, 2021. The authorized scope consists of the following:

- 2 Standard Penetration Test (SPT) borings within the proposed building addition footprint to depths of about 15 feet below existing grade.
- Soil laboratory testing.
- Geotechnical engineering analysis based on the gained data and preparation of this report.

These services are intended for geotechnical purposes only. The scope is not intended to explore for the presence or extent of environmental contamination in the soil or groundwater.

3.0 PROJECT INFORMATION

Based on the information provided, we understand the project consists of the construction of a new approximately 400 square-foot single-story addition to the existing Maintenance Building, located north of the existing Administration Building at the Black Hills National Cemetery south of Sturgis, South Dakota. We understand the building addition will be constructed utilizing conventional concrete spread footings with slab-on-grade floors to match the existing building.

The purpose of the geotechnical study was to determine the subsurface conditions at the site and to evaluate the suitability of the site soils for their use in constructing the proposed structure. Our foundation design assumptions include a minimum factor of safety of 3 with respect to the ultimate bearing capacity.

The previously stated information represents our understanding of the proposed construction. This information is an integral part of our engineering review. It is important that you contact us if there are changes from that described so that we can evaluate whether modifications to our recommendations are appropriate.

4.0 SUBSURFACE EXPLORATION AND TESTING

4.1 Field Exploration Program

The subsurface exploration program conducted for the project consisted of 2 standard penetration test (SPT) borings drilled on January 11, 2022. The borings were drilled at locations selected by AET personnel based on site plans provided by Anderson Engineering of Minnesota, LLC. The logs of the borings and details of the methods used appear in Appendix A. The logs contain information concerning soil layering, soil classification, geologic origins, and moisture condition. A density description or consistency is also noted for the natural soils, which is based on the standard penetration resistance (N-value).

The boring locations and temporary benchmark (TBM) are shown on Figure 2: Boring Location Map, included in Appendix A. Surface elevations were measured in the field by AET personnel using an engineer's level. The TBM referenced was the finished top floor at the northwest corner of the existing Administration building located southwest of the proposed addition. For purposes of this report, an assumed elevation of 100.0 feet was used for the TBM.

4.2 Laboratory Testing

The laboratory test program included natural moisture content, dry density, Atterberg Limits, gradation, sieve analysis and swell-consolidation tests. The test results appear in Appendix A on the individual boring logs adjacent to the samples upon which they were performed or on the data sheet following the logs.

5.0 SITE CONDITIONS

5.1 Surface Observations

At the time of our field work, the site consisted of a previously graded greenspace located adjacent to the south side of the existing building, with site infrastructure including underground utilities, concrete and asphalt paved parking areas, driving lanes and surrounding buildings. At the time of our site work, the relatively flat area of the proposed addition was covered in planted grasses, with a general drainage direction to the east.

5.2 Subsurface Soils/Geology

Below topsoil, the subsurface soils encountered within the borings consisted of natural Terrace Deposit soils to the total depths sampled of approximately 15 feet below grade. The Terrace Deposit soils consisted of varying combinations of stiff to very stiff silty clay, firm to very stiff lean clay and/or loose to dense clayey gravel. Subsurface Boring Logs included in Appendix A give a more detailed description of the soils encountered within the borings.

5.3 Groundwater

At the time of our field work, groundwater was not measured in either of the soil borings. The lack of groundwater noted at the boring locations should not be taken as an accurate representation of the actual groundwater levels. Groundwater levels can fluctuate due to varying seasonal and annual rainfall and snow melt amounts, as well as other factors. A long period of time may be required for groundwater to stabilize in the soils present at the site; this period of time is generally not available during a typical subsurface exploration program.

6.0 RECOMMENDATIONS

6.1 Discussion

Our recommendations in the following sections are intended to minimize, to varying degrees, movement related problems for the proposed foundations and floor slabs. Even if our recommendations are followed, we cannot guarantee that some movement will not occur. The present state of the art is such that the risk of movement cannot be accurately assessed. It depends on a number of uncontrolled variables such as climatic conditions during and after construction, long term fluctuations of the groundwater level, utility line leakage, landscaping, and other similar aspects. The risk of detrimental movement must be assumed by the project owner.

To reduce the risk of movement of the bearing strata, good drainage must be maintained during and after construction. We recommend the final site grading be designed with positive drainage away from the building for at least a distance of 10 feet. We also recommend the excavations be left open a minimal amount of time to reduce the possible amount of surface water to accumulate in the base of the excavation.

6.2 Site Preparation

We recommend that all topsoil, organic material and construction/man-made debris, if

encountered, be removed from within the proposed building footprint addition. Once complete and where required, excavations should continue to the desired construction elevations. The excavated soils, cleaned of all unsuitable materials and aggregate greater than 3-inches in nominal size, may be stockpiled on-site and reused as utility trench backfill, overlot fill and wall backfill.

Prior to the placement of engineered fill and structural elements, we recommend that the subgrade soils be scarified to a depth of at least 8 inches, the moisture content adjusted to near optimum, and the soils re-compacted to at least 95% of the maximum dry density, as determined by ASTM: D698 (Standard Proctor). All exposed surfaces should be free of mounds and depressions which could prevent uniform compaction.

As noted, it is our opinion the processed clay site soils are suitable for use as fill material below structures and pavements (where required). The moisture content of the fill soils should be adjusted to within -1 to +3% of optimum and the soils compacted to at least 95% of maximum Standard Proctor dry density (ASTM: D698). Engineered fill should be placed in 8-inch thick maximum loose lifts.

Groundwater was not measured in the borings at the time of our field work, and we do not anticipate groundwater will be encountered in the footing or utility excavations; however, be aware that temporary dewatering of these excavations may be necessary if groundwater is encountered.

6.3 Foundation Design

It is our opinion the new building addition may be founded on a conventional spread footing foundation system bearing directly on the natural site soils. Exterior footings, interior footings in unheated portions of the building, or footings placed during freezing conditions should be placed at least 4 feet below final grades for frost protection. Interior footings in heated areas may be placed directly below the floor slab.

For additional information please refer to the attached Standard Sheet “Freezing Weather Effects on Building Construction”. We highly recommend the base of the footing and floor slab excavations be observed and properly compacted to verify a firm and unyielding subgrade has been obtained on which to place engineered fill and structural elements.

Based on the conditions encountered, it is our opinion the building foundations can be designed based on a net maximum allowable soil bearing pressure of 1,500 psf. It is our judgment this design pressure will have a factor of safety of at least 3 against the ultimate

bearing capacity. We judge that total movement under this loading, if properly constructed, should not exceed 1 inch and differential movement of conditions depicted by the borings should not exceed ½ inch.

6.4 Floor Slab Design

We recommend the interior floor slab be supported on a minimum of 1 foot of imported non-expansive granular engineered fill. Imported granular engineered fill should be a non-expansive granular material with a maximum aggregate size of 2-inches, 40% to 85% passing the No. 4 sieve, and no more than 15% passing the No. 200 sieve with a Liquid Limit less than 25. The moisture content of the granular engineered fill should be adjusted to within $\pm 3\%$ of optimum and compacted to at least 95% of the maximum Standard Proctor (ASTM: D698) dry density.

A leveling course, typically 4 to 6 inches of a granular material provided below the concrete slab, should be placed to prevent capillary moisture rise to the slab. This granular fill should contain less than 12% by weight passing the No. 200 sieve, and less than 40% passing the No. 40 sieve. This sand/gravel cushion layer may be considered as part of the 1 foot of granular engineered fill recommended below the floor slab.

For recommendations pertaining to moisture and vapor protection of interior floor slabs, we refer you to the attached standard sheet entitled “Floor Slab Moisture/Vapor Protection.”

6.5 Construction of Building Addition

Due to the possibility of differential movement between the existing building and the new addition, an expansion joint should be incorporated at the interface between the structures. The expansion joint should be capable of tolerating up to 1 inch of potential differential movement. During site excavation work for the new addition, care should be taken that the footings of the existing structure are not undermined.

6.6 Exterior Backfill Considerations

It is our opinion utility trench backfill, overlot fill and exterior backfill around the addition may consist of the excavated site clay soils. Based on the existing moisture content of the site soils, processing and drying of the material may likely be required prior to re-use as backfill material. Therefore, we recommend site work be performed during warmer months to allow for drying of the backfill material.

All recommendations are based on the Standard Proctor method (ASTM: D698).

1. All backfill should be free of deleterious/frozen material, and construction debris, and have a maximum aggregate size of 2-inches.
2. Site clays soils should be moisture conditioned to within -1 to +3% of the optimum moisture content. All granular backfill should be moisture conditioned to within $\pm 3\%$ of optimum moisture content prior to being placed.
3. All backfill should be placed in loose lift thicknesses of 8-inches or less. If hand-operated compaction equipment is used, the loose lift thickness should be reduced to 4-inches or less.
4. Each lift should be compacted to at least 95% of maximum proctor density. We recommend the final lift of backfill be compacted to at least 98% of the maximum dry density.
5. Compaction density tests should be performed on alternating lifts to ensure the minimum density is maintained.
6. Utility lines entering or exiting the structures should be leak tested prior to the placement of the slab.

6.7 Trench Excavation

If excavation faces are not retained, the excavations should maintain maximum allowable slopes in accordance with *OSHA Regulations (Standards 29 CFR), Part 1926, Subpart P, "Excavations"* (can be found on www.osha.gov). Even with the required OSHA sloping, water seepage or surface runoff can potentially induce side slope erosion or running which could require slope maintenance. For trench excavations, it is our opinion the site clay soils can be classified as Type B soils with recommended slope laybacks of 1H:1V.

These classifications should be considered preliminary and should be verified in the field on a daily basis by the contractor and/or geotechnical engineer. Excavations deeper than 20 feet and/or in saturated soils or below the ground water table should be considered on an individual basis. Water levels, due to climatic conditions should be evaluated at the time of construction. If the above trench layback recommendations are not feasible, due to space limitations or other factors, the OSHA rules should be consulted for alternative trench stabilization methods. Trench boxes or shoring in compliance with OSHA rules may be acceptable alternatives.

7.0 CONSTRUCTION CONSIDERATIONS

7.1 Potential Difficulties

7.1.1 Soft Subgrade Soils

Depending on the time of year in which construction takes place, unstable subgrade soils could be encountered during the site and building grading operations. If encountered, additional conditioning of the soils may be required to obtain moisture contents which allow for firm and unyielding subgrade and/or compaction.

Localized areas of soft wet subgrades can be remedied with additional excavation to expose firmer soils, placement of coarse rock to provide a solid base on which to place additional fill and/or the use of geotextiles between the soft soils and the overlying fill and/or pavement sections. The appropriate means of subgrade stabilization should be evaluated by the geotechnical engineer at the time of construction.

7.1.2 Runoff Water in Excavation

Water can be expected to collect in the excavation bottom during times of inclement weather or snow melt. To allow observation of the excavation bottom, to reduce the potential for soil disturbance, and to facilitate filling operations, we recommend water be removed from within the excavation during construction. Based on the soils encountered, we anticipate the groundwater can be handled with conventional sump pumping.

7.1.3 Disturbance of Soils

The on-site soils can be disturbed under construction traffic, especially if the soils are wet. If soils become disturbed, they should be subcut to the underlying undisturbed soils. The subcut soils can then be dried and recompacted back into place, or they should be removed and replaced with drier imported fill.

7.2 Excavation Backsloping

If excavation faces are not retained, the excavations should maintain maximum allowable slopes in accordance with *OSHA Regulations (Standards 29 CFR), Part 1926, Subpart P, "Excavations"* (can be found on www.osha.gov). Even with the required OSHA sloping, water seepage or surface runoff can potentially induce sideslope erosion or sloughing which could require slope maintenance.

7.3 Observation and Testing

The recommendations in this report are based on the subsurface conditions found at our

test boring locations. Since the soil conditions can be expected to vary away from the soil boring locations, we recommend on-site observation by a geotechnical engineer/technician during construction to evaluate these potential changes. Soil density testing should also be performed on new fill placed in order to document that project specifications for compaction have been satisfied.

8.0 LIMITATIONS

Within the limitations of scope, budget, and schedule, we have endeavored to provide our services according to generally accepted geotechnical engineering practices at this time and location. Other than this, no warranty, expressed or implied, is intended. Important information regarding risk management and proper use of this report is given in Appendix B entitled “Geotechnical Report Limitations and Guidelines for Use.”

Standard Sheets

Appendix A

Geotechnical Field Exploration and Testing
Boring Log Notes
Unified Soil Classification System
Figure 1: Site Location Map
Figure 2: Boring Location Map
Subsurface Boring Logs
Swell-Consolidation Results

Appendix A

Geotechnical Field Exploration and Testing

AET Project No. P-0007904

A.1 FIELD EXPLORATION

The subsurface conditions at the site were explored by drilling and sampling two (2) standard penetration test (SPT) borings. The locations of the borings appear on Figure 2, preceding the Subsurface Boring Logs in this appendix.

A.2 SAMPLING METHODS

A.2.1 Split-Spoon Samples (SS) - Calibrated to N_{60} Values

Standard penetration (split-spoon) samples were collected in general accordance with ASTM: D1586 with one primary modification. The ASTM test method consists of driving a 2-inch O.D. split-barrel sampler into the in-situ soil with a 140-pound hammer dropped from a height of 30 inches. The sampler is driven a total of 18 inches into the soil. After an initial set of 6 inches, the number of hammer blows to drive the sampler the final 12 inches is known as the standard penetration resistance or N-value. Our method uses a modified hammer weight, which is determined by measuring the system energy using a Pile Driving Analyzer (PDA) and an instrumented rod.

In the past, standard penetration N-value tests were performed using a rope and cathead for the lift and drop system. The energy transferred to the split-spoon sampler was typically limited to about 60% of its potential energy due to the friction inherent in this system. This converted energy then provides what is known as an N_{60} blow count.

The most recent drill rigs incorporate an automatic hammer lift and drop system, which has higher energy efficiency and subsequently results in lower N-values than the traditional N_{60} values. By using the PDA energy measurement equipment, we are able to determine actual energy generated by the drop hammer. With the various hammer systems available, we have found highly variable energies ranging from 55% to over 100%. Therefore, the intent of AET's hammer calibrations is to vary the hammer weight such that hammer energies lie within about 60% to 65% of the theoretical energy of a 140-pound weight falling 30 inches. The current ASTM procedure acknowledges the wide variation in N-values, stating that N-values of 100% or more have been observed. Although we have not yet determined the statistical measurement uncertainty of our calibrated method to date, we can state that the accuracy deviation of the N-values using this method is significantly better than the standard ASTM Method.

A.2.2 Disturbed Samples (DS)/Spin-up Samples (SU)

Sample types described as "DS" or "SU" on the boring logs are disturbed samples, which are taken from the flights of the auger. Because the auger disturbs the samples, possible soil layering and contact depths should be considered approximate.

A.2.3 Sampling Limitations

Unless actually observed in a sample, contacts between soil layers are estimated based on the spacing of samples and the action of drilling tools. Cobbles, boulders, and other large objects generally cannot be recovered from test borings, and they may be present in the ground even if they are not noted on the boring logs.

Determining the thickness of "topsoil" layers is usually limited, due to variations in topsoil definition, sample recovery, and other factors. Visual-manual description often relies on color for determination, and transitioning changes can account for significant variation in thickness judgment. Accordingly, the topsoil thickness presented on the logs should not be the sole basis for calculating topsoil stripping depths and volumes. If more accurate information is needed relating to thickness and topsoil quality definition, alternate methods of sample retrieval and testing should be employed.

A.3 CLASSIFICATION METHODS

Soil descriptions shown on the boring logs are based on the Unified Soil Classification (USC) system. The USC system is described in ASTM: D2487 and D2488. Where laboratory classification tests (sieve analysis or Atterberg Limits) have been performed, accurate classifications per ASTM: D2487 are possible. Otherwise, soil descriptions shown on the boring logs are visual-manual judgments. Charts are attached which provide information on the USC system, the descriptive terminology, and the symbols used on the boring logs.

The boring logs include descriptions of apparent geology. The geologic depositional origin of each soil layer is interpreted primarily by observation of the soil samples, which can be limited. Observations of the surrounding topography, vegetation, and development can sometimes aid this judgment.

Appendix A

Geotechnical Field Exploration and Testing

AET Project No. P-0007904

A.4 WATER LEVEL MEASUREMENTS

The ground water level measurements are shown at the bottom of the boring logs. The following information appears under “Water Level Measurements” on the logs:

- ◆ Date and Time of measurement
- ◆ Sampled Depth: lowest depth of soil sampling at the time of measurement
- ◆ Casing Depth: depth to bottom of casing or hollow-stem auger at time of measurement
- ◆ Cave-in Depth: depth at which measuring tape stops in the borehole
- ◆ Water Level: depth in the borehole where free water is encountered
- ◆ Drilling Fluid Level: same as Water Level, except that the liquid in the borehole is drilling fluid

The true location of the water table at the boring locations may be different than the water levels measured in the boreholes. This is possible because there are several factors that can affect the water level measurements in the borehole. Some of these factors include: permeability of each soil layer in profile, presence of perched water, amount of time between water level readings, presence of drilling fluid, weather conditions, and use of borehole casing.

A.5 LABORATORY TEST METHODS

A.5.1 Water Content Tests

Conducted per AET Procedure 01-LAB-010, which is performed in general accordance with ASTM: D2216 and AASHTO: T265.

A.5.2 Atterberg Limits Tests

Conducted per AET Procedure 01-LAB-030, which is performed in general accordance with ASTM: D4318 and AASHTO: T89, T90.

A.5.3 Sieve Analysis of Soils (thru #200 Sieve)

Conducted per AET Procedure 01-LAB-040, which is performed in general conformance with ASTM: D6913, Method A.

A.5.4 Particle Size Analysis of Soils (with hydrometer)

Conducted per AET Procedure 01-LAB-050, which is performed in general accordance with ASTM: D422 and AASHTO: T88.

A.5.5 Unconfined Compressive Strength of Cohesive Soil

Conducted per AET Procedure 01-LAB-080, which is performed in general accordance with ASTM: D2166 and AASHTO: T208.

A.5.6 Laboratory Soil Resistivity using the Wenner Four-Electrode Method

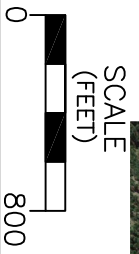
Conducted per AET Procedure 01-LAB-090, which is performed using Soil Box apparatus in the laboratory in general accordance with ASTM: G57

A.6 TEST STANDARD LIMITATIONS

Field and laboratory testing is done in general conformance with the described procedures. Compliance with any other standards referenced within the specified standard is neither inferred nor implied.

A.7 SAMPLE STORAGE

Unless notified to do otherwise, we routinely retain representative samples of the soils recovered from the borings for a period of 30 days.



| | |
|--|--------------------------|
| PROJECT: PROPOSED MAINTENANCE BUILDING ADDITION BLACK HILLS NATIONAL CEMETERY, SOUTH DAKOTA | PROJECT NO. P-0007904 |
| SUBJECT: FIGURE 1: SITE LOCATION MAP | DATE: FEBRUARY 3, 2022 |
| SCALE: 1 INCH = 800 FEET | DRAWN BY: JR |
| | REVIEWED BY: RT |



PROJECT: PROPOSED MAINTENANCE BUILDING ADDITION
 BLACK HILLS NATIONAL CEMETERY, SOUTH DAKOTA
SUBJECT: FIGURE 2: BORING LOCATION MAP
SCALE: 1 INCH = 60 FEET
DRAWN BY: JR

PROJECT NO. P-0007904
DATE: FEBRUARY 3, 2022
REVIEWED BY: RT



SUBSURFACE BORING LOG

AET No: **P-0007904** Log of Boring No. **B-1 (p. 1 of 1)**
 Project: **Proposed Maintenance Building Addition; Black Hills National Cemetery, SD**

| DEPTH IN FEET | Surface Elevation <u>92.7</u> MATERIAL DESCRIPTION | GEOLOGY | N | MC | SAMPLE TYPE | REC IN. | FIELD & LABORATORY TESTS | | | | |
|------------------|--|---------------------------------|----|----|-------------|---------|--------------------------|-----|----|----|--------|
| | | | | | | | WC | DEN | LL | PL | %-#200 |
| 1 | TOPSOIL , Lean Clay with organics, brown SILTY CLAY with a little gravel, black-dark brown, stiff (CL-ML) | TOPSOIL TERRACE DEPOSITS | 9 | M | SS | 18 | 16 | 90 | 26 | 20 | |
| 3 | SANDY LEAN CLAY with gravel, dark brown, firm to very stiff (CL) | | 6 | M | SS | 18 | | | | | |
| 4 | | | | M | MC | 12 | 15 | 101 | | | |
| 6 | | | 19 | M | SS | 18 | 17 | | | | |
| 7 | CLAYEY GRAVEL with sand, tan, red, medium dense to dense (GC) | | | | | | | | | | |
| 8 | | | 33 | M | SS | 18 | 3 | | | | 17 |
| 11 | | | 21 | M | SS | 18 | 4 | | | | |
| 13 | | | 23 | M | SS | 18 | | | | | |
| 15 | | | | | | | | | | | |
| 16 | | | 29 | M | SS | 18 | | | | | |
| Bottom of Boring | | | | | | | | | | | |

AET_CORP_P-0007904.GPJ AET-CPT+WELL.GDT 2/3/22

| | | | | | | | | | | | |
|--|--|-----------------------------------|--------------|--------------------------|--------------|---------------|----------------------|-------------|--|--|--|
| DEPTH: 15.0 | | DRILLING METHOD: 3.25" HSA | | WATER LEVEL MEASUREMENTS | | | | | NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG | | |
| | | DATE | TIME | SAMPLED DEPTH | CASING DEPTH | CAVE-IN DEPTH | DRILLING FLUID LEVEL | WATER LEVEL | | | |
| | | 1/11/22 | 10:06 | 16.5 | 15.0 | NA | NA | None | | | |
| BORING COMPLETED: 1/11/22 | | | | | | | | | | | |
| DR: ES LG: JS Rig: 15 | | | | | | | | | | | |



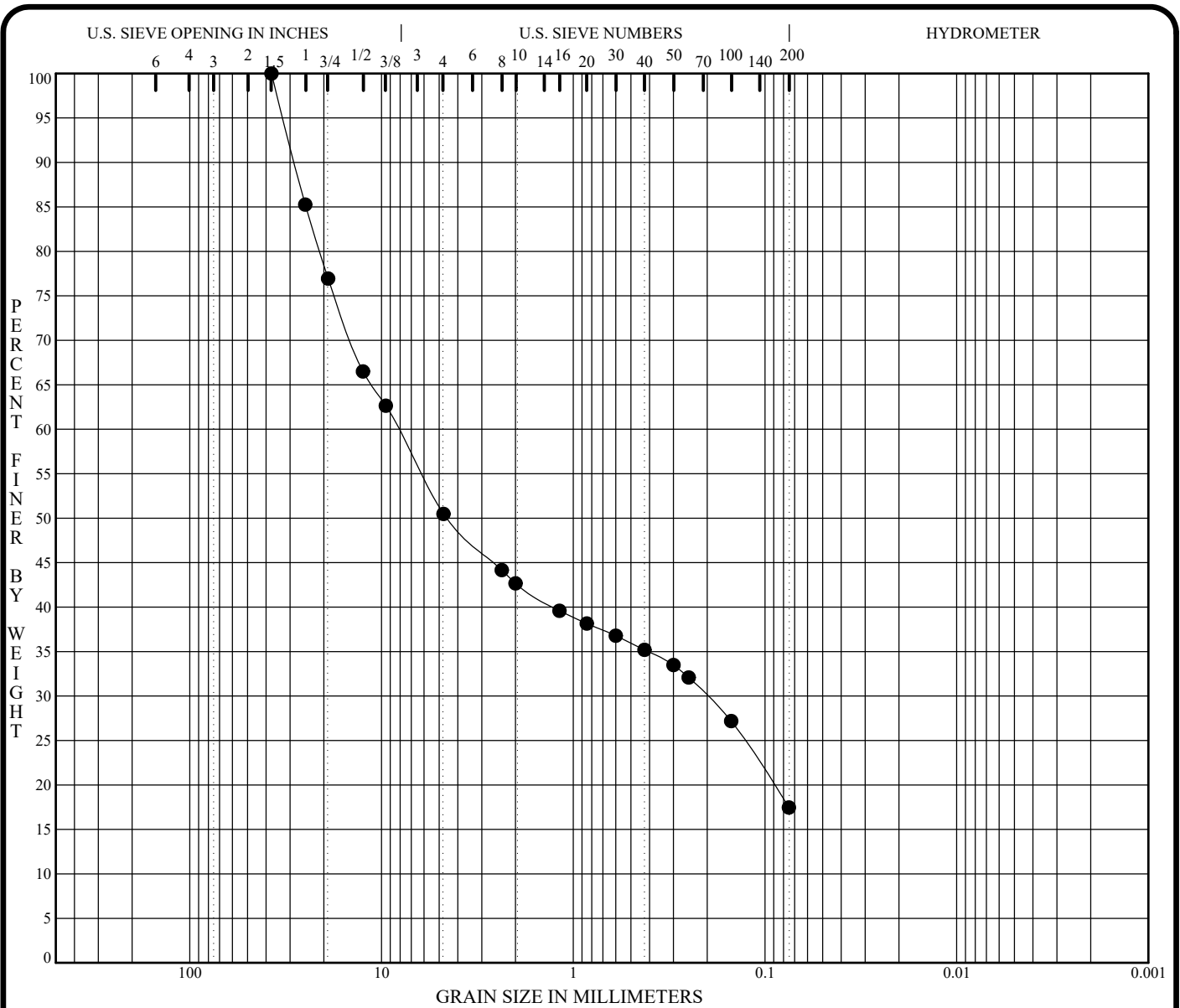
SUBSURFACE BORING LOG

AET No: **P-0007904** Log of Boring No. **B-2 (p. 1 of 1)**
 Project: **Proposed Maintenance Building Addition; Black Hills National Cemetery, SD**

| DEPTH IN FEET | Surface Elevation <u>92.4</u> MATERIAL DESCRIPTION | GEOLOGY | N | MC | SAMPLE TYPE | REC IN. | FIELD & LABORATORY TESTS | | | | |
|------------------|--|---------------------------------|----|----|-------------|---------|--------------------------|-----|----|----|--------|
| | | | | | | | WC | DEN | LL | PL | %-#200 |
| 1 | TOPSOIL , Lean Clay with organics, brown SILTY CLAY with gravel, brown-red, very stiff to stiff (CL-ML) | TOPSOIL TERRACE DEPOSITS | 16 | M | SS | 18 | 18 | | | | |
| 2 | | | | | | | | | | | |
| 3 | | | 9 | M | SS | 18 | | | | | |
| 4 | | | | M | MC | 12 | 20 | 101 | | | |
| 5 | CLAYEY GRAVEL with sand, tan-brown, loose (GC) | | | | | | | | | | |
| 6 | LEAN CLAY , dark brown, stiff (CL) | | 6 | M | SS | 18 | 5 | | | | |
| 7 | | | | | | | | | | | |
| 8 | | | 15 | M | SS | 18 | | | | | |
| 9 | CLAYEY GRAVEL with sand, red-brown, tan, yellow, medium dense to dense (GC) | | | | | | | | | | |
| 10 | | | | | | | | | | | |
| 11 | | | 13 | M | SS | 18 | 16 | | | | |
| 12 | | | | | | | | | | | |
| 13 | | | 29 | M | SS | 18 | | | | | |
| 14 | | | | | | | | | | | |
| 15 | | | | | | | | | | | |
| 16 | | | 35 | M | SS | 18 | | | | | |
| Bottom of Boring | | | | | | | | | | | |

AET_CORP_P-0007904.GPJ AET-CPT+WELL.GDT 2/3/22

| | | | | | | | | | |
|--|-----------------------------------|--------------------------|--------------|---------------|--------------|---------------|----------------------|-------------|--|
| DEPTH: 15.0 | DRILLING METHOD: 3.25" HSA | WATER LEVEL MEASUREMENTS | | | | | | | NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG |
| | | DATE | TIME | SAMPLED DEPTH | CASING DEPTH | CAVE-IN DEPTH | DRILLING FLUID LEVEL | WATER LEVEL | |
| | | 1/11/22 | 11:04 | 16.5 | 15.0 | NA | NA | None | |
| BORING COMPLETED: 1/11/22 | | | | | | | | | |
| DR: ES LG: JS Rig: 15 | | | | | | | | | |



| | | | | | | |
|---------|--------|------|--------|--------|------|--------------|
| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
| | coarse | fine | coarse | medium | fine | |

| Specimen Identification | Classification | MC% | LL | PL | PI | Cc | Cu |
|-------------------------|------------------------------|-----|----|----|----|----|----|
| ● B-1 5.0-11.5' | Clayey Gravel with sand (GC) | 17 | | | | | |

| Specimen Identification | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|-------------------------|-------|------|-------|-----|---------|-------|-------|-------|
| ● B-1 5.0-11.5' | 37.50 | 8.17 | 0.201 | | 49.5 | 33.0 | 17.5 | |

PROJECT **Proposed Maintenance Building Addition; Black Hills National Cemetery, SD** AET JOB NO. **P-0007904**
 DATE **1/11/22**

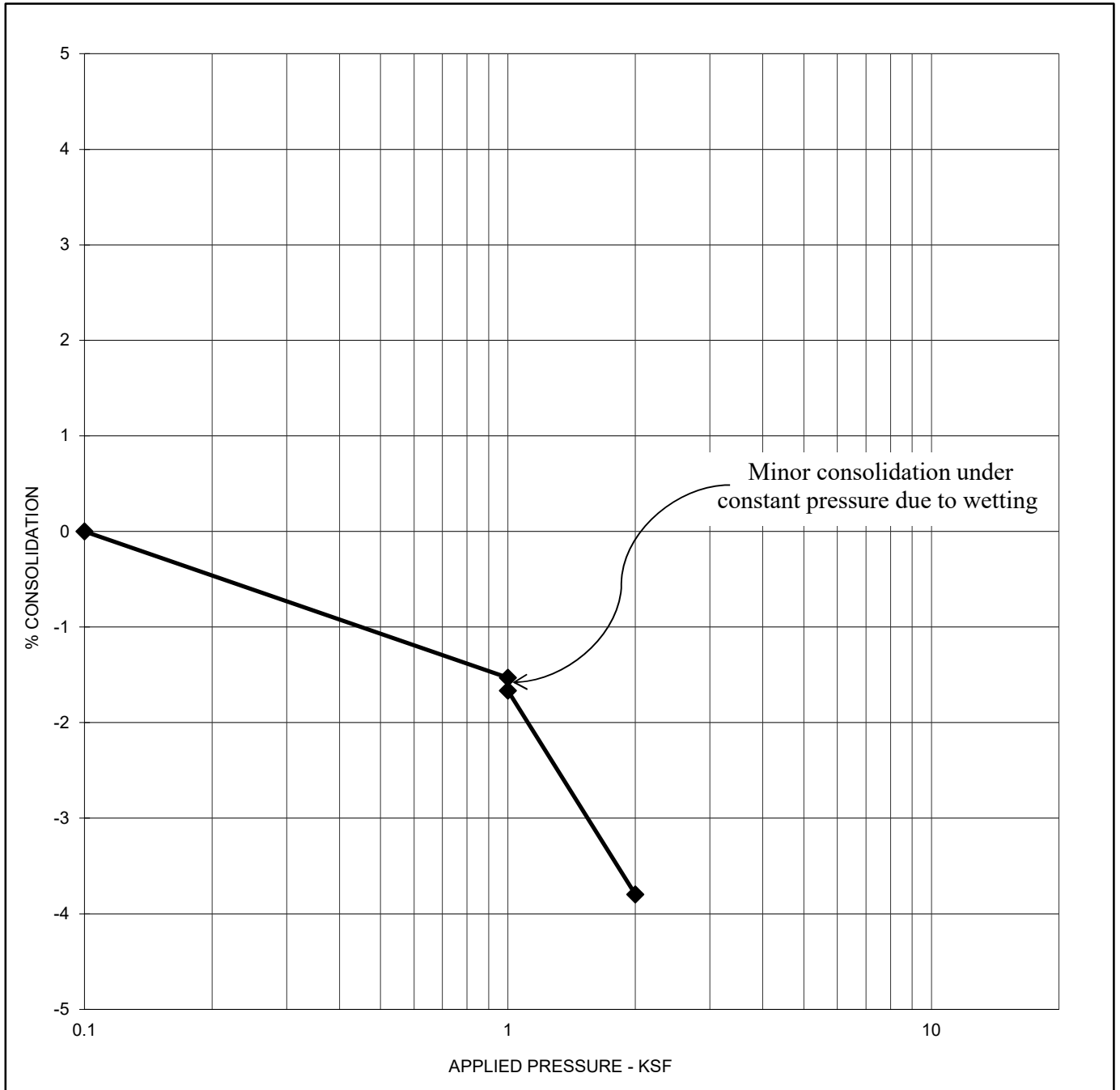


GRADATION CURVES



AMERICAN ENGINEERING TESTING, INC.

MOISTURE CONTENT: 15.2 percent
DRY UNIT WEIGHT: 100.9 pcf
BORING/DEPTH: B-1, 4-5'
SOIL DESCRIPTION: Sandy Lean Clay (CL)
% Consolidation: 0.1



Report of Geotechnical Exploration
Proposed Maintenance Building Addition – Black Hills National Cemetery, South Dakota
February 8, 2022
AET Project No. P-0007904



Appendix B

Geotechnical Report Limitations and Guidelines for Use

Appendix B

Geotechnical Report Limitations and Guidelines for Use

AET Project No. P-0007904

B.1 REFERENCE

This appendix provides information to help you manage your risks relating to subsurface problems which are caused by construction delays, cost overruns, claims, and disputes. This information was developed and provided by GBA¹, of which, we are a member firm.

B.2 RISK MANAGEMENT INFORMATION

B.2.1 Understand the Geotechnical Engineering Services Provided for this Report

Geotechnical engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical engineering services is typically a geotechnical engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

B.2.2 Geotechnical Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared solely for the client.

Likewise, geotechnical engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will not be adequate to develop geotechnical design recommendations for the project.

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project or purpose;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. If you are the least bit uncertain about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

¹ Geoprofessional Business Association, 1300 Piccard Drive, LL14, Rockville, MD 20850
Telephone: 301/565-2733: www.geoprofessional.org, 2019

B.2.3 Read the Full Report

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do not rely on an executive summary. Do not read selective elements only. Read and refer to the report in full.

B.2.4 You Need to Inform Your Geotechnical Engineer About Change

Appendix B

Geotechnical Report Limitations and Guidelines for Use

AET Project No. P-0007904

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

As a general rule, always inform your geotechnical engineer of project or site changes – even minor ones – and request an assessment of their impact. The geotechnical engineer who prepared this report cannot accept responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.

B.2.5 Most of the “Findings” Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface using various sampling and testing procedures. Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing is performed. The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgement to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team through project completion to obtain informed guidance quickly, whenever needed.

B.2.6 This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, they are not final, because the geotechnical engineer who developed them relied heavily on judgement and opinion to do so. Your geotechnical engineer can finalize the recommendations only after observing actual subsurface conditions exposed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.

B.2.7 This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a continuing member of the design team, to:

- confer with other design-team members;
- help develop specifications;
- review pertinent elements of other design professionals' plans and specifications; and
- be available whenever geotechnical engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction-phase observations.

B.2.8 Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical engineering report, along with any attachments or appendices, with your contract documents, but be certain to note conspicuously that you've included the material for information purposes only. To avoid misunderstanding, you may also want to note that “informational purposes” means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, only from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and be sure to allow enough time to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

B.2.9 Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials

Appendix B

Geotechnical Report Limitations and Guidelines for Use

AET Project No. P-0007904

with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. Read these provisions closely. Ask questions. Your geotechnical engineer should respond fully and frankly.

B.2.10 Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical engineering study. For that reason, a geotechnical engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. Unanticipated subsurface environmental problems have led to project failures. If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

B.2.11 Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer's services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration. Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. Geotechnical engineers are not building-envelope or mold specialists.